EMPOWERMENT AT THEIR FINGERTIPS: A CASE STUDY OF THE IMPLEMENTATION OF A MOBILE APP PROJECT FOR FARMERS IN SENEGAL

by

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DISSERTATION ABSTRACT

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The advent of the information age brought with it a strong belief in the potential of information and communication technologies (ICTs) for allowing Third World countries to leapfrog many stages of the development process. If in the early years of development initiatives, radio and television were perceived as powerful instruments that could lead people in developing countries to cut their ties with their traditions and embrace progress, in recent years new ICTs such as the Internet, computers, and mobile phones have been praised for their capacity to empower the poor and disadvantaged groups. International organizations entertain a wave of ICT fetichism, promoting various projects in Third World countries.

This research analyzes the project called "Agricultural Services and Digital Inclusion in Africa" launched by the Food and Agriculture Organization (FAO) in 2017,

which consists of a mobile app with four components designed for farmers in Senegal and Rwanda. Beyond these two countries, the FAO intends to replicate the project in the whole African continent. This dissertation studies the implementation of the project in Senegal within the pilot region of Tambacounda. Using a critical approach to the Modernization Theory, the Capability framework, and a gender perspective, the research, which is based on a survey, in-depth interviews, focus groups, and document analysis, explains why the project did not yield the expected results.

The findings show that illiteracy, a lack of access to telecommunications and network, as well as a lack of financial means which mostly affect women, would prevent farmers to fully benefit from the FAO project. The study also reveals that the potential beneficiaries face structural problems such as access to land, inputs, and equipment which cannot be solved with a click on a mobile app. The findings also suggest that the UN Agency used a top-down approach to implement this project which was planned in its headquarters in Rome before farmers, including women, were contacted through various activities for feedback.

The study indicates that gender and other identity biases were evident in the initial design of the mobile app project, which fell into disuse at the end of the pilot phase.

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Diop, L (in press, 2021) The Senegalese Council for Broadcast Regulation: A giant with feet of clay. In *Media Ownership in Africa: Challenges, continuity, and change*, edited by Loubna El Mkaouar and Winston Mano, Westminster School of Media, Arts and Design.

Kreutler, M. et al. (including myself, in press, 2021) Migration coverage in Europe, Russia, and the United States, *Journalism Practice*.

Diop, L. (2019) Money and the media in Senegal: Watchdogs or sounding boards? *Journal of Mass Communication & Journalism,* 9(*3*), pp. 1-9.

Diop, L. (2019). State, society, and spectrum in Africa: A study of television content control in Senegal. Beau Bassin: Lambert Academic Publishing.

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To my wife and children

To my dear parents

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CHAPTER I

INTRODUCTION

I begin this dissertation on a personal note to help the reader understand my interest in this specific subject of study. I am a son of farmers. My parents originated in Walo, in the Northern part of Senegal where an abundance of arable land and proximity to the 1,086-kilometer Senegal River have turned subsistence agriculture into the population's main activity. With the harsh years of drought that struck the country in the late 1960s and early 1970s, my father and mother who were from different villages migrated to the capital-city for a better livelihood. On both sides of my family, my relatives have remained primarily farmers despite the harsh conditions of existence that it requires. However, a large part of the family has also migrated to Europe and other African countries to seek better employment. Yet only a few members of the extended family, especially those who were born in the 1970s and 1980s managed to get university degrees and hold jobs in the Senegalese administration.

For my family members who remain in the remote areas of the Walo zone, as well as for the others who dwell mainly in the capital-city, Dakar, the holy city of Touba, and the rest who are scattered in various countries across Africa and Europe, new information and communication technologies such as WhatsApp have offered a vital way to reconnect and reconstruct the old traditional palaver tree where members of the community used to gather to discuss issues of general interest. With the creation of WhatsApp, family groups of men, women, and youth participate to various debates and discussions by sending audio messages in local languages about social life, economic activities, health, history, traditions, and the like. My curiosity about this phenomenon

increased when I realized that the different WhatsApp family groups would often lead to virtual debates with men and women contributing in a more equitable way that might be the case in person. That observation prompted me to study the ways in which information and communication technologies could contribute to the betterment of living and working conditions of farmers in rural communities.

Background of the Study

Since the inception of development programs, technology, along with capital transfer, has been central to the modernization paradigm. If in the early years of development interventions, the focus was on newspapers, radio, and television stations, around the 1980s, the concept of ICT4D was introduced (Thapa & Saebo, 2015) to refer, not only to legacy media such as radio and television but also computer hardware and software, and electronic media such as the Internet, electronic mail, electronic commerce, and computer games (Marcelle, 2000). Currently, the discourse about ICT4D is still articulated around the modernization paradigm with the perception that ICTs are tools that allow developing countries to leapfrog many stages of development (Alzouma, 2005; Melkote & Steeves, 2015). Support to ICTs for development currently comes from state governments but also international organizations which encourage developing countries to implement ICT strategies with the purpose of building knowledge societies and fostering development (Azouma, 2005).

My dissertation examines the use of information and communication technologies in agriculture in Senegal. In fact, there is a strong belief that ICTs and especially the Internet constitutes a tool that can allow farmers to access global markets, carry out financial transactions, as well as gather information relevant to local needs and realities.

The Internet can also be used to develop applications and services that cater for the needs of local people (Richardson, 1998).

Despite a general optimism about ICT4D, critical, postcolonial, and post-development scholars advocate for an assessment of the real contribution of ICTs to development since technologies and access to them are not neutral. These scholars agree that, through its choice and use of language, through its informational content, and undeclared presumptions, a technology may carry certain values or convey ideological messages (Granqvist, 2005; Melkote & Steeves, 2015).

Flowing from these considerations, in my dissertation, I intended to explore the project called "Agricultural Services and Digital Inclusion in Africa" which was launched by the Food and Agriculture Organization in 2017 and which consists of a mobile application with four components for farmers in Senegal and Rwanda. The first component is called "Cure and feed your livestock" whose objective is to provide information for animal disease control and feeding; the second section is called "Weather and crop calendar" which combines weather forecasting with crop calendars; the third one, "AgriMarketplace" provides information about markets and crop prices; and the fourth component, "E-Nutrifood" gives information related to the production, conservation, and consumption of nutritious food. Even if Senegal and Rwanda were chosen as pilot countries, the app has been designed to be adapted in the other African countries. That being said, my dissertation is focused mainly on the implementation of the project in Senegal where the project did not yield the expected results.

Defining ICTs, ICT4D, and e-Agriculture

ICTs mean different things to different people. In the sector of development studies, they have traditionally referred to the instruments and tools used to disseminate information and knowledge. Under that perspective, ICTs represented a central pillar in the conceptualization of the modernization paradigm and were often assimilated with the mass media. However, with the development of digital technologies and especially with the appearance of more individualized media such as desktop and laptop computers and mobile phones, a differentiation has often been made between old and new ICTs. Marcelles (2000) offers a compelling definition of ICTs that encompasses both new and traditional media:

> Information and communication technologies (ICTs) comprise a complex and heterogenous set of goods, applications, and services used to produce, distribute, process, and transform information. They include the outputs of industries as diverse as telecommunications, television, and electronic media (e.g., the Internet, electronic mail, electronic commerce, and computer games) (Marcelles, 2000, p. 5).

The definition offered by Marcelles points to the comprehensive nature of ICTs which do not exclude each other but rather "overlap, evolve rapidly, and co-exist" (Steeves & Kwami, 2017, p. 176). In this light, the concept of ICTs encompasses not only electronic hardware such as radio, television, satellites, and mobile phones but also a variety of network software, applications, and services. ICTs therefore include any instrument that allows one to communicate, receive, transform, and store information and data in the form of text, sound, or image.

As stated earlier, the contemporary discourse about ICTs dovetails with the modernization paradigm through the view of ICTs as tools that could allow developing countries to speed up their progress towards modernity (Alzouma, 2005; Melkote &

Steeves, 2015). This view is in line with the position of Modernization Theory pioneers like Daniel Lerner and Wilbur Schramm who considered information technologies such as radio and television as strategic to economic and social change.

The adherents to the Modernization Theory assumed that a deficiency in knowledge is an underlying cause of underdevelopment. By contrast, they often consider ICTs as neutral and transparent tools that operate as vehicles of information and knowledge, access necessary for development. This conception of a linear relationship between technology transfer and economic development continued to underpin development programs in the Third World, particularly in the 1960s through the 1980s (Kwami, 2010) and it is in this context that the concept of ICT4D came into existence in the 1980s (Thapa & Saebo, 2014; Melkote and Steeves, 2015).

If for Heeks (2006), ICT4D refers just to an interaction between information (I), communication (C), technology, and development (D), for others, the meaning of the concept varies depending on the definition given to ICTs and development (Melkote & Steeves, 2015). Torero and Braun (2006) argue that ICT4D refers to newer technologies such as the Internet, computers, and mobile phones which are credited with the possibility of enhancing development processes and projects.

Like the hopes that were attached to mass media in the early years of development programs, international organizations and development agencies associate ICTs with high potential for developing countries. In its 1998 World Development Report, the World Bank stressed the importance of information, knowledge, and ICTs in the development process. According to the World Bank, the dissemination of knowledge through ICTs will lead to an improvement of people's standards of living, create new opportunities for

the poor, and enhance good governance through the sharing of knowledge among institutions, governments, and think tanks (World Bank, 1998; Schech, 2002).

Alongside the concept of ICT4D, the idea of e-agriculture also known as ICT4Ag has been spearheaded by the Food and Agriculture Organization (FAO). According to the UN agency, the concept refers to the design, development, and application of innovative use of ICTs in rural areas with a particular focus on agriculture (FAO, 2007). It also encompasses the provision of norms, methodologies, and tools as well as the development of the individual and institutional capacity, and policy support (FAO, 2007). The mission of e-agriculture includes fostering discussions on the adoption and use of ICTs and digital applications in sectors such as agriculture, forestry, fisheries, natural resource management, and rural development (FAO, 2020). ICTs that can be harnessed for e-agriculture include various kinds of devices, services, and applications ranging from new technologies such as the Internet and sensor technologies to devices that have been in usage for a much longer period like radio, television, satellites, telephone, mobile phones (FAO, 2017)

According to the FAO, the concept of e-agriculture was born out of Action Line C7 ICT Applications decided by the World Summit on the Information Society (WSIS). Assigned as the facilitator for this line of action, in 2007 the UN organization initiated an e-agriculture community of practice that operates as a platform for sharing information, ideas, and resources about the use of ICTs for sustainable agriculture. The e-agriculture community of practice numbers over 14,000 members in 170 countries (FAO, 2018). Sharing a common interest in the promotion of ICTs in agriculture, the members of the

community of practice include information and communication specialists, researchers, farmers, students, government authorities, development specialists, entrepreneurs.

In 2017, the Food and Agriculture Organization launched a project called "Agricultural Services and Digital Inclusion in Africa" which is the object of study of this dissertation.

Problem Statement and Rationale

In this dissertation, I intend to contribute to the discussions on ICTs for development by offering a close look at an ambitious project initiative launched by the Food and Agriculture Organization for farmers in Africa. This project which consists of an app with four components is in its initial phase and has not yet been subjected to any scholarly assessment. The study that I carried in Senegal gives a clear idea of the modernist ideology and motivations that undergird the FAO project. I argue for a critical approach to the debates related to ICT4D projects in developing countries in order to shed light on the biases embedded in the various initiatives. Further, I hope to provide insight into the lack of neutrality associated with all technologies. As Granqvist (2005) put it, even through its design, a technology may convey an ideology or call for a particular behavior. For these reasons, there is need for an assessment of all ICT efforts towards marginalized groups and this assessment should focus on the usage they allow, the behavior they prompt and the social values they convey (Granqvist, 2005).

Another goal of the study is to contribute to the debates related to technological bias associated with many ICT4D projects. For scholars such as Granqvist (2005) a way to avoid technological bias is to involve the beneficiaries at the design phase. However,

in many development projects, participation is just cosmetic (Granqvist, 2005). In this dissertation, I intend to provide information about the level of participation and involvement of the beneficiaries in the FAO project called "Digital inclusion and agricultural services in Africa". Another reason to study the FAO is to critically explore the gender digital divide in the Global South. My dissertation offers an analysis of the access of women to mobile phones and explores the extent to which women farmers in the region of Tambacounda were involved in the introduction of a mobile app in rural areas.

Ultimately, the study examines the extent to which the national and local contexts of developing countries may or may not be favorable for a success of ICT4D projects. It provides insights about the social, political, cultural, and structural constraints that can thwart the implementation of ICTs projects in rural areas.

Significance of the Study

My dissertation has implications for the implementation of ICTs in rural areas. The lessons learned from the rolling out of the mobile app in Senegal will serve, not only the promoters of ICT projects but also policy makers. Analyzing the implementation of the project in Senegal provides evidence of the best practices and procedures that allow the poor to benefit from all the potential of ICTs. Beyond policymakers, UN agencies and also bilateral organizations which intervene at grassroots level can benefit from the insights provided by the study. In view of the rise of the use of the Internet in Africa, understanding the policy adopted in Senegal sheds light on the current debate on the digital divide. In fact, scholars like as Alzouma (2005) point to the need for policy makers to think about the digital divide within African societies. Alzouma (2005) argues

that in Africa, a small elite holds power, economic resources, and knowledge and has access to technologies. At the same time, poor people who lack technological skills are at risk of marginalization. So, instead of being tool for liberation, ICTs can, in fact, further marginalize the poor and the illiterate (Alzouma, 2005). My dissertation offers new insights in the debates related to the promotion of ICTs for the poor.

Moreover, since each technological invention carries with it the biases that are related to the environment where it emerged (Granqvist, 2005; Melkote & Steeves, 2015), my dissertation adds to the body of knowledge related to the ideological messages of ICTs, the usage they allow, the behavior they prompt, and the social values they convey. Additionally, an analysis of the content of the mobile apps and the constraints that explain the lethargy or failure of the FAO project contributes to the current debate on the digital gender divide (United Nations, 2005; Hafkin, 2012; Alozie & Akpan-Obong, 2017).

Overview of the Dissertation

This dissertation comprises ten chapters. The first chapter sets the general background of the study, provides the definition of ICTs, ICT4D, and e-agriculture. In it, I also describe the problem that the dissertation intends to explore and the rationale for using a critical approach to the study of ICT4D projects in developing countries. The last part of the chapter stresses the significance of the study for national policymakers, as well as for bilateral, multilateral, and international organizations.

I dedicate chapter two to providing the context of my research by introducing the political and social history of the country. In the chapter, I stress on the emergence of the

first ICTs that were introduced as a result of the occupation of the country by French settlers. Then, I describe the efforts deployed by the authorities for the promotion of old and new ICTs since the country became independent in 1960. Great efforts were achieved in 2000 with the first political regime change. With the election of President Macky Sall in 2012, the country has conceived a strategic plan for social and economic development named the Senegal Emerging Plan that ascribes particular importance to the promotion and use of ICTs.

In chapter three, I present the main theories upon which the study is grounded. I first offer a review of communication for development through a description of the tenets of the Modernization Theory. I then introduce the critiques of Modernization Theory which take the forms of Dependency Theory, the participatory model and the Capability Approach promoted by Amartya Sen. In the last part of the chapter, I focus on gender and feminist critiques of development.

Chapter four provides a review of studies related to ICT4D. It begins with a description of the contribution of telecommunications and mobile technologies to economic growth, individual and collective livelihoods. I offer an analysis of the impact of mobile apps on agriculture in terms of access to information, markets, financial services but also in terms of agricultural extension and e-commerce followed by a review of the literature related to gender and ICTs. I conclude the chapter by introducing the following research questions around which the dissertation revolves.

1) To what extent is the national context of Senegal favorable to the FAO project: "Agricultural Services and Digital Inclusion in Africa??

2) To what extent is the local context of Tambacounda favorable to the implementation of the FAO project?
3) To what extent has the FAO used a top-down approach versus a bottom-up approach in the rolling out of the mobile app?

   3a) To what extent have local farmers including women been involved in the project planning?
4) To what extent does the project address farmers' local needs?

   4a) Are gender or other identity biases evident?
5) What social, cultural, political constraints explain the transfer of the project to the National Agency of Rural and Agricultural Advisory Services (ANCAR)?

In chapter five, I introduce the methods used for this research. The dissertation consists of a case study about a project that the Food and Agriculture launched in Senegal. After defining the meaning of a case study, I present the site of the study and describes the FAO project. I also explain the different methods employed for the dissertation which include: a survey, in-depth interviews, focus groups but also an analysis of the documents that detail the origin of the project, its objectives, and the expected results.

Chapter six presents the national context and explains to what extent the national context is favorable to the FAO project. Through an analysis of policy documents and in-depth interviews with state officials, ICT specialists, and start-ups promoters, I show that great efforts have been achieved by the Senegalese authorities for the promotion of ICT infrastructure. At the state level, different ministries have launched initiatives for the promotion of ICTs in sectors such as agriculture and livestock even if the results have not

been as great as expected. In another register, I also show that different start-ups are already offering the same services that the FAO wants to offer through its project "Agricultural Services and Digital Inclusion in Africa".

In chapter seven, I offer insights into the local context of Tambacounda, explore the difficulties facing farmers and describe their interactions with mobile technologies. The analyses of the survey data combined with the in-depth interviews and focus group discussions reveal that the local context is not quite ready for the project that the FAO intended to launch. Issues such as illiteracy, lack of electricity, and financial means hamper the development of mobile phone use. I also show that farmers in this part of country face structural challenges such as access to land, equipment, and inputs to name but a few. These problems which are more pronounced for women cannot be overcome by just clicking on a mobile app.

Chapter eight traces the origin of the project called "Agricultural Services and Digital Inclusion in Africa" and explores the strategy used by the FAO for its implementation. It appears that the project was conceived by the FAO authorities, but the UN agency strove to ensure involvement of the beneficiaries through focus groups and workshops. Even if the project presents promising prospects for meeting farmers' needs, certain biases related to gender, literacy, and languages continue to hamper its efficacy.

Chapter nine describes the social, cultural, political constraints that explain the failure of the project and the transfer of the content to the National Agency for Rural and Agricultural Advisory Services. In addition to management and administrative issues, poor choices related to the implementation of the project underpin the delay in the execution and the lethargy that followed the end of the pilot phase.

Finally, in chapter ten, I offer summaries of the different chapters and highlight the major findings. I also present the implications of the study for theory and policy making. The last part of the chapter describes the limitations of the study and formulates suggestions for future research.

CHAPTER II

THE RESEARCH CONTEXT

As it is the case in any country, a study of the use of information and communication technologies cannot overlook the political, economic, and social context in which these technologies have emerged. For Senegal, if the appearance of legacy media such as radio is closely associated with the colonial past, the spread of digital technologies is the result of innovative actions taken by the authorities, especially during the last two decades. In this chapter, I offer an overview of the political history of Senegal followed by a presentation of its economic development. In particular, I focus on the share of agricultural activities in the development strategies. In the last part of the chapter, I review the history of ICT development in Senegal and emphasize gender disparities in ICT access and use.

Colonial and Political History of Senegal

Senegal occupies the westernmost tip of Africa and is often referred to as the gateway to the black continent (Hargreaves, Camara, & Clark, 2019). Bordered by Mauritania in the North, Mali to the East, Guinee to the Southeast and Guinea Bissau to the Southwest, the country surrounds the Gambia which represents an enclave between the southern part of Senegal and the sea (See Figure 1). The large opening of the country into the Atlantic Ocean to the west with 700 km (435 miles) of coastline explains the place and role that the country has played during the tragic historical events that have marked the odyssey of the African continent (Gellar, 2005). With Goree island, Senegal harbored one of the most important commercial posts during the trans-Atlantic slave

trade (Samb, 1997; Austen, 2001). This period was followed by a long stage of colonization when the country was contested by several European powers including England, France, Portugal, and the Netherlands (Hargreaves, Camara, & Clark, 2019; Gellar, 2005).

Figure 1: Map of Senegal (Source: Encyclopedia Britannica)

The Portuguese were the first Europeans to arrive on the shore of Senegal in 1445 and entertained flourishing trading relationships with the Arabs, already established at Arguin, a place located in the Northern part of the Senegal river (Gellar, 2005; Hessling, 1985). The Portuguese traders used to ship yearly 700 to 800 slaves back to their country, then the largest maritime power in the world. They also traded gold, rubber, and ivory with the local kingdoms of Walo and Cayor (Hesseling, 1985). Between 1600-1800, with the rise of the mercantilist doctrine, which focused on a growth of national wealth

through trade, other European countries would follow in the wake of the Portuguese in West Africa. The French started to visit the West African coast regularly from 1520. The Dutch took over the Portuguese in the second half of the seventeenth century. They conquered Arguin, the Portuguese stronghold and started building forts on Goree island (named after Goree island located in the Netherlands) and also in the mainland, in Rufisque (to the East of the current capital city, Dakar). The Dutch's success in Senegal and their control over the trans-Atlantic trade triggered cravings for power by the English and the French. As noted by Hesseling (1985), in 1659, a French trader named Louis Caulier established at the mouthpiece of the Senegal river a trading post which would develop into the city of Saint-Louis, the first place where the French established themselves and came into contact with local people. It was in Saint-Louis that French companies traded slaves, rubber, ivory, and leather. Later, in 1677, the French conquered Rufisque and Goree but they abandoned those places to the English in 1662 (Hesseling, 1985). On the West African coast, the seventeenth and the eighteenth century were marked by ongoing fights between Dutch, English, and French. However, Senegal was recognized as a French territory after the signature in 1783 of the Treaty of Paris by France and Great Britain. Despite armed resistance from part of the local kingdoms of Walo, Cayor, Djolof, Baol, Sine, Saloum, Rip, Boundou, Gabou and resistance led by Islamic figures such as Cheikh Ahmadou Bamba and El Hadji Malick Sy, Senegal fell under the total domination of France in the late 19th century (Hargreaves, Camara, & Clark, 2019).

The country, which gained independent from France in 1960, today, covers an area of 196,722 square kilometers (76,000 square miles) (CIA, 2019). According to the

National Agency for Statistics and Demography, the population of Senegal is estimated to 15, 726, 037, with 7,896,040 women (50.2) and 7,829,997 men (49.8%)(ANSD, 2019). As far as the geographical distribution is concerned, more than half of the Senegalese population (53.3%) lives in rural areas compared to 46.7% of city dwellers (ANSD, 2019). The National Agency for Statistics and Demography (2019) also reveals wide disparities in the distribution of the population between the different administrative entities. Roughly 23% of the population lives in the capital city, Dakar, which covers 0.3% of the country's total area with a population density estimated at 6,637 inhabitants per square kilometer. By contrast, Kedougou which is the least populated region with 1.1% of the population has a density of 11 persons per square kilometer. The vast majority of the population is made of young people. According to the Fourth Census of the Population, Housing, Agriculture and Livestock carried out in 2013, children under 15 represent 42.1% of inhabitants, with boys (43.6%) outnumbering girls (40.5%) (ANSD, 2014).

When it comes to education, the illiteracy rate is estimated at 65%. In addition to regional disparities, the phenomenon affects more women than men. It is estimated that 53.8% of men can read and write compared to 37.7% of women (ANSD, 2014). French, which is a legacy of colonization is the official language of Senegal. It coexists with six other codified national languages - Wolof, Pular, Serer, Jola, Mandingue and Soninke - which represent the six major ethnic groups that make up to 95% of the population (Gellar, 2005). In Senegal, Wolof stands out as a lingua franca and is spoken by 80% of the population (McLaughlin, 2008).

Arabic is another language that is used widely in Senegal, a country where Islam is the dominant religion and Muslims account for 94% of the population. The Christians, who represent 5% of the citizens, are mainly Roman Catholics and 1% of the population practices animism. A common belief amongst the Senegalese is that the form of Sufi Islam practiced by the majority of the population has set the country as a beacon of peaceful co-existence and social stability and provides the citizens with a strong cultural identity (World Bank, 2018). In fact, the peaceful co-existence of Muslims and Catholics has always been praised and offered as example. The country's first President Leopold Sedar Senghor, a member of the Catholic minority who reigned over the country for twenty years (1960-1981) contributed to the emergence of Senegal as a democracy. Apart from the activities of a separatist movement in the Southern part of the country, Senegal has been exempted from the ethnic conflicts and military coups that have ravaged much of the African continent. It is a republic with a multi-party system where the President is elected for a five-year term and can be re-elected once. Alongside the executive branch, legislative power is exercised by the National Assembly whereas the judicial power is vested in the courts and tribunals. The country is often depicted as a showcase of democracy in Africa as it is manifested through freedom of expression, a free press, and fair elections (Sow, 2014). After a long period of one-party system, the government started recognizing opposition parties in 1974. As of 2018, there were 299 political parties registered in the country (Savana, 2018)

Economic Foundations of Senegal

When it gained independence in 1960, Senegal had a great advantage compared to the other West African countries. Since Dakar was the capital of French West Africa, the

country benefitted from various forms of infrastructure, including transportation, administration, education, and health as well as a higher level of industrialization. However, these conditions, on their own, did not lead to a steady development within the country. From the early 1960s to the mid-1990s, the Gross Domestic Product fluctuated constantly, moving from 2.2% per year between 1960 and 1969 to 3% between 1970 and 1979. In the period 1980-1984, the GDP growth fell to 1.8% before reaching 2.2% in the period 1985-1993. (Diagne & Daffe, 2002). Gaye and Daffe (2002) explain that, until the mid-1970s, the economy depended on groundnut crops and a relatively significant industrial structure. Groundnut production has always been the heart of economy and triggered the dynamism of the secondary and tertiary sectors.

A key point in Senegal's economic history is the succession of Leopold Sedar Senghor by Abdou Diouf as second Head of State in 1981. President Abdou Diouf inaugurated his reign with the Structural Adjustment Programs imposed by the Bretton Woods institutions. In fact, in the late 1970s, the government led by then Prime Minister Abdou Diouf was facing difficulties for finding funds to pay the civil servants' salaries (Dieng, 1996). The main priority was therefore to pay the salaries on time in order to avoid protests and socio-political turmoil. To help the government face this issue, the World Bank offered a structural adjustment loan of $60 million in 1980 which came with a stabilization program decided by the International Monetary Fund. The different interventions of the Bretton Woods institutions through the SAPs led to a reduction of the budget deficit, a decrease of the inflation rate, a reduction of public expenses and the privatization of different companies. Diouf (1994) mentioned that in Senegal, the SAPs resulted in massive job losses through enterprise closures or restructuration, an erosion of

purchasing power linked to the increase of the prices of goods and services, a deterioration of the education and health systems.

In 1994, the devaluation of the CFA franc was accompanied by soaring prices and a high inflation rate which rose up to 32%. This economic policy imposed on the African countries that used the CFA franc currency pegged to the former French franc, came with strong economic reforms with the objective of strengthening those economies. These measures spurred higher growth rates.

The regime change in 2000, with the election President Abdoulaye Wade, increased economic options. In fact, in the four decades between independence in 1960 and the year 2000, the country was under the rule of the Socialist party, first with Leopold Sedar Senghor (1960-1980) later replaced by Abdou Diouf (1981-2000). It was only in 2000, with the election of Abdoulaye Wade, leader of the Senegalese Democratic Party, that the citizens experienced a regime change. Wade, who believed in liberalism, initiated vast infrastructure projects in various sectors. During his two tenures (2000-2007, 2007-2012), the country achieved outstanding economic performance (Thiam, 2015). President Wade's reign was also marked by the construction of several infrastructural improvements, including the development of the road network, a program for highway construction, a new airport, interchanges, crossroads, and the modernization of the Port of Dakar. Wade also initiated strategies for agricultural diversification and launched programs such as REVA (Return to Agriculture) and GOANA (Great Agricultural Offensive for Food and Abundance).

In 2012, the election of Macky Sall as President brought with it the adoption of a new development model called "Emerging Senegal Plan" whose objective was to

accelerate the country's progress towards economic emergence. The main objectives of this program, which is ongoing, are the acceleration of the GDP growth rate and the provision of better living conditions by 2035. This vision is based on three pillars:

- A structural transformation of the economy through the consolidation of current engines of growth and the development of new sectors to create wealth, jobs, and social inclusion, with a strong capacity to export and attract investment. This pillar is based on a more balanced approach to development, with the promotion of regions and economic poles in order to stimulate the potential for development across the entire country;
- A significant improvement in the population's living standards, a more sustained struggle against social inequality, combined with a preservation of the resource base and a support of the emergence of viable regions;
- The reinforcement of security, stability, governance, the protection of rights, and liberties, and the consolidation of the rule of law in order to create better conditions for social peace and the fulfilment of people's potential (Emerging Senegal Plan, xii).

Agriculture in Senegal's Economy

Along with mining, construction, tourism, fishing, agriculture represents one of the key sectors of the Senegalese economy (CIA, 2019) and is, essentially, dependent on the rainy season which lasts about four months (from June to September). As noted by Dieng (1996), the development of agriculture in Senegal was conceived to serve the French market and over a long period of time, was centered on the production of one export crop: groundnut.

As early as 1850, when the country was still under French rule, August-Leopold Protet, Governor of Senegal believed that groundnut represented a resource that could save the country (Monteil, 1962). This position echoed the sentiment taken by French settlers at the abolition of slavery who asked newly freed workers to grow groundnut. While in 1900 groundnut production was estimated at around 100,000 tons, in 1960, the year when the country became independent, it rose eightfold to 826,000 tons.

Among the factors that contributed to the expansion of the production of groundnut, Bonnefond and Couty (1988) mention the construction of the Dakar-Saint-Louis (finished in 1885) and Thies-Kayes (finished in 1923) railroads. In fact, the extension of the cultivated lands required reliable transportation infrastructure. Other factors included the establishment of peasant cooperatives and the implementation of a system for administrative supervision with the creation of the OCA (the Office for Agricultural Trading) which held the groundnut production monopoly. The OCA would, in turn, sell the production to companies operating in Senegal or corporate interests for export to France. The OCA, which later became the OCAS (The Office of Trading in Senegal), was dissolved in 1967 and its missions were taken over by the ONCAD (The National Office for Cooperation and Support to Development), created in 1966 with the objective of agricultural commercialization as well as the promotion of cooperatives and rural development.

Between 1945 and 1967, Senegal's groundnut production grew at an annual rate of 4.7% and was the driving force of the economy (Durufle, 1995). However, since the late 1960s, the yields have been unstable while the cultivated lands have decreased at an average of -1.6% every year. The factors that explain the low performances in groundnut

production include seed and soil degradation, low use of fertilizers, high dependency on rainfall, abandonment of fallowing practices, and the lack of farm equipment (Emerging Senegal Plan, 2014). Contrary to the groundnut sector, millet and sorghum production (which are both cultivated in rotation with groundnut) has been increasing by 4% since the 1990s. (Durufle, 1995). In addition to groundnut, millet, and sorghum, other major crops grown in Senegal include rice, cotton, and corn.

From the independence of the country in 1960 to the 1990s, agriculture in Senegal was characterized by stagnation and a consequent decrease of cultivated lands, low increase in yields, and a deficiency in cereal production (Durufle, 1995). Among the causes of the agricultural crisis, Durufle (1995) mentions the successive rain failures as well as soil saturation and degradation. To face these cyclical issues, in 1984 the government initiated a New Agricultural Policy (NPA) to achieve food self-sufficiency. The authorities hoped to achieve five goals: 1) an increase of the prices for groundnut producers; 2) a protection of local cereals by working on the commercialization price of imported rice; 3) the emergence of producer organizations; 4) a reduction of the role of the State in agricultural sectors, and 5) the development of crop irrigation systems along the river valley. In 1994, under the recommendation of the donors, the NPA was reinforced by the Adjustment Program for the Agricultural Sector (PASA) which was accompanied by an Investment Plan for the Agricultural Sector (PISA). With the PASA, the focus was on a pricing policy and institutional reforms in the rice, cotton, groundnut, and livestock sectors, as well as a decrease of taxes on farm inputs, and a reduction of the interest rates for farm credits (Oya & Ba, 2013).

These various policies appeared inefficient for facing the structural constraints in the agricultural sector in Senegal, which was marked by high food dependency, low productivity, and rural poverty. With the regime change in 2000, President Abdoulaye Wade initiated a liberal policy characterized by a will to stop the overwhelming importance given to groundnut production in agricultural programs. The measures he took included the dissolution of SONAGRAINES, a state company charged with collecting and transporting peanut production. The government introduced a system called "*carreau-usine*" which allowed farmers to deliver their production to the oil processing company, SONACOS. The main goal of the measure was to make it possible for farmers to sell their product at the official price and not the prices set by intermediaries. President Wade also decided to privatize SONACOS, the oil processing company, which led to a control of the sector by private individuals. Under President Wade's tenure major programs for the agricultural sector included the Return to Agriculture Plan (Plan REVA) and the Great Agricultural Offensive for Food and Abundance (GOANA).

Two years after his election in 2012, President Macky Sall launched the Emerging Senegal Plan accompanied with a program called PRACAS (Program for an Acceleration of the Pace of Agriculture in Senegal) which includes important goals for the agricultural sector. The authorities hope to intensify irrigated agriculture and to give a new impetus to groundnut production through a renewal of the industrial equipment, but also a promotion of the consumption of local oil and edible groundnut (Emerging Senegal Plan, 2014). In addition to agriculture, the Emerging Senegal Plan also places major emphasis on the promotion of ICTs. In the following section, I offer an overview of the development of

ICTs in Senegal before exploring the objectives set by the authorities through the Emerging Senegal

ICTs in Senegal

In 1859, French settlers introduced ICTs to Senegal with the construction of the first telegraphic line between Saint-Louis, the then-capital of the country and Gandiole which was an important trading place 15 kilometers to the South (Sy, 1996; Sagna, 2001). The opening of the telegraphic line at Saint-Louis-Goree, in 1862, connected Senegal to France via a submarine cable which extended from Saint-Louis to Spain. The year 1900 witnessed the completion of the network with the construction of the line Sedhiou-Ziguinchor, which coincided with the elimination of local military resistance to colonization and a total conquest of the country by France (Sy, 1996; Sagna, 2001). To expand their influence over other countries, in 1911, French settlers established a radio-telegraphy network for French West Africa which took the form of a wireless telegraphy system for administrative and military purposes. The main mission of this line was to convey public correspondence between ships and the coast, on the one hand, and the telegraphic stations established along the West African coast on the other (Sagna, 2001).

This first phase of ICT development which started in the second half of the 19th century and lasted until the late 1920s aimed at colonial domination, the integration of administrative and military posts for control of the territory, protection of places critical to wealth production, as well as the facilitation of the economic exploitation of the country. Similarly, the French colonizers introduced mass media with the creation of Radio-Dakar station in 1939. From its inception, radio primarily played a military role and was used as a special listening center by the army, and it was only in 1946 that

settlers decided to broadcast five news bulletins from France to a number of destinations in the West African colonies. The first locally produced shows were aired from Saint-Louis in 1952. They were largely influenced by French media production style in their conception, content, and form of broadcasting. The large majority of the audience were European but also a few groups of literate Senegalese (Sagna, 2001). Radio was, therefore, an urban phenomenon. However, after the country gained independence, these broadcasts started to penetrate the masses. The new authorities used radio for the promotion of development projects. According to Fougeyrollas (1967), radio served as a tool to face "the many challenges of independence (increased literacy, modernization of the rural population, increased productivity, and national integration) and seeking historic shortcuts for overcoming the lack of development" (Fougeyrollas, 1967, p. 964 as cited by Diamanka, 2013). Between 1960 and 1964, the number of radio sets rose from 125,000 to 180,000. This increase stemmed from a removal of the radio tax in 1962 (Dia, 1987). The local authorities also initiated a policy of radio-set placement across a number of regions. Starting from 1962, the government established more than 145 sets for collective listening in seven discrete regions of the country. These sets were the responsibility of volunteer teams which all included a teacher, a nurse, a rural development facilitator or a veteran.

In collaboration with UNESCO, in 1963 the government launched a radio and television station dedicated entirely to educational programs in Wolof, the predominant national language. The new community television had the ambition to adapt to Senegalese cultural specificities and to involve the population in the design of programming (Africultures, 2011). For Henry Cassirer, a former UNESCO executive,

community television was a resounding success across the working-class in the poor areas of the capital-city. Around the capital-city, tele-clubs were set up for watching programs on hygiene, music, dance, history, legendary figures, and news. However, they failed to attract wealthy viewers who were more Westernized, sought to emulate French culture, and showed contempt towards programming presented in Wolof (Africultures, 2011). Cassirer explains that the UNESCO community television failed because of the hostility of the French expatriates and the Senegalese elite who preferred to have programs aired in French (Africultures, 2011).

Contrary to community television, the Rural Educational Radio launched in 1968 thanks to the support of UNESCO was more successful. The Rural Educational Radio started with a program called *Disso* (Dialogue in Wolof) created to educate rural people about the government's development plans (Diamanka, 2013; Informant 6, 2019). Across the country, listening clubs were created in villages and rural people were asked to send letters to the radio station to express their opinions about the government's action. The Senegalese President Leopold Sedar, who was a staunch supporter of the program, ordered that the opinions of the rural people should not be censored as long as they were respectful to moral standards. The radio program then operated as the mouthpiece for rural communities across the country. Any letter that bore the address of the Rural Educational Radio was conveyed by the Post Office, free of charge. As Cassirer mentions (1973), the results went far beyond expectations:

> It was like opening the flood gates. More than 300 letters came in during January and February 1969. Letters of misery and complaints, or rage against being cheated and of inquiry about the rights of peasants. (Cassirer, 1973 as cited by Moulton, 1977, p. 96).

As Informant 6 of this study revealed, even if most of the letters were written in Wolofal (a derivation of the Arabic script for writing the Wolof language), they were also translated in the news bulletin into French. Originally aired on Mondays, Tuesdays, and Fridays, the program later became a daily show broadcast from Monday to Saturday (See Figure 2: Host of Disso and one guest in the studio of RTS). Each show lasted 30 minutes except on Saturdays.

> The Saturday show was longer; it used to last 45 minutes because during that show we had to give the answers to the questions sent by the rural population (Informant 6).

Figure 2: The host of the program Disso and a guest in the studio of RTS.

Source: Layire Diop

In addition to the letters from people in rural areas, *Disso* included news reports on agriculture, livestock, and fisheries sent by different correspondents. Also, the program was often broadcast remotely from the different regions where reporters, directors, and technicians used to stay for days with the local population. In addition to

information related to economic activities in rural areas, these decentralized events were opportunities for organizing cultural performances that featured the talents of local singers, poets, and dancers, some of whom became national stars.

In these early days of Senegal's independence, the national radio operated two channels: an international channel which transmitted on mediumwave at 1305 kHz and the national channel which aired on mediumwave at 765 kHz and on shortwave at 4890 kHz. Until the 1960s, local private radio stations were still absent from the media landscape. However, foreign radio networks such as Radio France Internationale, The Voice of America, Radio Moscow, and the BBC were already airing in Senegal on shortwave (Dia, 1987; Sagna, 2001). Broadcasting from the Gambia, a private commercial radio station called Radio Syd was also accessible to the Senegalese citizens.

It was only in 1990, with the Dakar International Fair, that a Senegalese station started to air on the FM band for the first time (Sagna, 2001). The experimental channel (called Dakar FM, broadcast on the frequencies 94.8 and 96.9) offered a musical programming interspersed with news flashes and commercials. The success of this provisional channel led the authorities to turn it into a new radio channel. In 1991, Radio France Internationale signed a contract with the Senegalese National Radio and Television System (RTS) for the creation of a bi-cultural channel. Under this agreement, Radio France Internationale would broadcast over FM 92 for 18 hours while RTS aired its programming for 6 hours. By December 1992, Africa No.1 started to broadcast in Senegal at the frequency of 102 FM (Sagna, 2001).

After independence in 1960 and up to the 1990s, the Senegalese government denied nationals ownership of radio stations, claiming a scarcity of the frequencies.

Thanks to local pressure, the first private radio station, named Sud FM was launched on July 1st, 1994 by the media group Sud Communication which also owns the newspaper *Sud Quotidien*. The success of Sud FM led other operators to ask for radio frequencies. On December 24, 1994, Radio Dunya started its programming and six months after that, on July 15, 1995, Nostalgie-*Dakar*, a subsidiary of a French station of the same name, began to air on 90.3 FM. In December 1997, the media group, Wal Fadjri, which publishes a newspaper of the same name, began broadcasting Wal Fadjri Radio at 99 FM. Many other private broadcast companies followed suit, including 7FM which was launched in December 1998 and Diamono FM which started its activities in October 1999.

However, the inception of private radio broadcasting did not occur without constraints (Sagna, 2001). While it was the role of the Senegalese Radio and Television System (RTS) to collect the annual broadcast fee from other radio stations, it also competed with these same stations for audience share. The National Telecommunication Company (SONATEL) was in charge of the technical management of the frequencies. As far as community radios were concerned, Radio Penc Mi was the first to come into existence in November 1996 (Sow, 2014). It is worth mentioning that in Senegal, the increase of community radio has been exponential. Between 2004 and 2014, the number of community radio rose from 36 to 70 (Sow, 2014).

When it comes to television, in 1963, UNESCO initiated television broadcasting with a pilot project which focused on educational programs and came to an end in 1972. However, the broadcasting of the 1972 Munich Olympic Games opened the era of popular television broadcasting. In fact, the broadcasting of the sports event in lieu of

hygiene and health programming was so popular that the authorities decided to create a television station. The national radio system then became the Office of Radio and Television Broadcasting (ORTS) with the adoption of Law 73-51 on December 3, 1973 (Sylla, 2006). ORTS operated two radio stations and one television channel. Until the 1990s, this national television remained the only television operating in the country. Canal Horizon, a subsidiary of the French channel *Canal+* was the first international network to access the Senegalese territory through satellite broadcasting and started its activities in 1991 after signing an agreement with ORTS for the creation of Canal Horizon Senegal.

In 1998, EXCAF (Expo Carrefour), a company founded in 1972 by a local entrepreneur, introduced a Multipoint Multichannel Distribution System, or MMDS. EXCAF first started by offering free access to dozens of television channels. However, starting from July 1999, it began to encrypt its channels, subjecting access to the purchase of a receiver and the payment of a monthly fee (Sagna, 2001).

At the institutional level, the authorities dissolved ORTS and turned it into a national company called Senegalese Radio and Television Broadcasting System (RTS) with the adoption of Law 92-02 on December 16, 1991 (Sylla, 2006). For a long period of time, RTS could not broadcast to the entire nation and a significant portion of the Senegalese people felt excluded from its programming and coverage. However, thanks to the Communication Satellite (COMSAT) Project which provided an investment of 13 billion CFA Francs (US $22 million), RTS managed to cover the entire country.

For several decades, television operation was a government stronghold, and it was only after the regime change in 2000 that the first private television channels started to

broadcast in Senegal. On October 21, 2003, the Senegalese Radio and Television System signed an agreement with Origines SA, a company owned by a local businessman for the creation of a cultural television channel — RTS2S. Due to a failure to comply with its commitments, the joint venture came to an end in February 2006 and RTS2S became 2STV, the first private television owned and operated by a local entrepreneur (Dioh, 2009). 2STV paved the way for the emergence of new television channels. On December 15, 2006 Wal Fadjri TV, owned by Groupe Wal Fadjri, started its programming for Europe and the United States via the satellites Hotbird and Nss7 and on September 28, 2007 began its over-the-air broadcasting in Dakar. Later, Radio Dunya Visions (RDV), owned by Groupe EXCAF started its programming (Dioh, 2009). As of 2017, 147 broadcast channels were allocated, which corresponds to 31 television channels. As far as radio is concerned, 457 frequencies were distributed to 276 radio stations which include 222 community radio stations, 48 commercial radio channels, and 6 international radio channels (Seneweb, 2017)

Sagna (2001) reveals that the introduction of new ICTs in Senegal began as early as the 1960s with the development of the first computer applications at the Ministry of Economy and Finance. Later, in 1972, the government created the National Committee for Informatics. This entity, which was attached to the President's office, was entitled to coordinate the national policy related to informatics and computer science. Until 1983, only 100 computers were listed in Senegal according to estimates (Sagna, 2001). However, between 1984 and 1998, the number of computers rose steadily, particularly in 1989 when 900 computers were purchased. A study carried out in 1996 revealed that there were 1,000 minicomputers and large systems, as well as 50,000 microcomputers in

Senegal. It also found that 2,500 new units came into the market every year. For its part, in 1997, the World Bank estimated that there were 11.4 computers per 1,000 inhabitants in Senegal (Sagna, 2001). Since 1998, SONATEL has implemented a system of X 25 data packet transmission called SENPAC. This system allows access to databases and connections with foreign networks at a speed of approximately 19,200 bps. Designed for broad businesses, higher education, and research applications, and despite the fact that SENPAC's speed has increased to 64, 000 bps, the number of subscribers has remained quite low.

The development of ICTs in Senegal coincided with the exponential growth in Internet content in the country. The origins of this growth reach back to the 1980s with the establishment of a node of the RIO network. RIO which stands for *Reseau Intertropical d'Ordinateurs* (the Intertropical Network of Computers) was a network for electronic communication developed by ORSTOM, a French scientific research agency operating in Africa. The RIO network linked 25 UNIX hosts in 10 countries and provided roughly 80 access points (The Internet Society, 2019). This experience of the Internet with RIO network was followed by the establishment of a Fidonet/Greennet node by the NGO ENDA Tiers Monde. In these early years, the Internet was only used by a small group of NGOs, administrative services, and higher education and research institutions. In general, the main services offered included email and file transfer. Only in March 1996 did Senegal become officially connected to the Internet with the signature of an agreement between the national telecommunications company SONATEL and the American company, MCI. The country was connected via a 64 Kbps and, subsequently,

Telecom Plus, a subsidiary of SONATEL, began marketing Internet access in April 1996 (Sagna, 2001).

In recent years, the sector of telecommunications and Internet services has risen as one of the drivers of the Senegalese economy. In terms of mobile services, there exist three nationwide mobile operators: The first is SONATEL which offers service under the Orange brand. The second operator to explore the sector of mobile services is Tigo, a subsidiary of the Luxemburg-based MILLICOM which has been active in the market since 1999. On October 1, 2019, Tigo changed its name to Free. This change resulted from an acquisition of the company by French billionaire Xavier Niel (Monnet,2019). The third operator is EXPRESSO, a subsidiary of the Sudanese group SUDATEL which started its operations in 2009. According to the International Telecommunications report of 2017, Senegal has one of the highest levels of mobile access in sub-Saharan Africa. In 2015, 93 per cent of households had a portable telephone, with only minor differences between urban (97%) and rural (89%) areas (ITU, 2017). The country's first wireless broadband network based on CDMA was launched by EXPRESSO in 2009. In 2010, the same company launched a 3G+ network, followed by SONATEL in 2011 and TIGO in 2013. In terms of coverage, 2G and 3G mobile infrastructures allow a coverage of 64% of the country and 92% of the population (Ministry of Posts and Telecommunications, 2016). SONATEL was the first to launch 4G LTE when its license was renewed in 2016. The license renewal includes an obligation of SONATEL to provide LTE coverage to 70% of the population by 2020 and 90% by 2025 (ITU, 2017). According to government statistics, mobile telephony has reached a penetration estimated at 116.71% and the

Internet penetration is also on the rise, at about 60.28% (Ministry of Posts and Telecommunications, 2016)

When it comes to fixed telecom services, the incumbent SONATEL was privatized in 1997 when shares were bought by France-Telecom (now Orange). Parts of the company's shares were listed on the regional stock exchange and some given to the employees. This has led to mixed ownership between France-Telecom (42% of the shares), the Government of Senegal (27%), private investors (25%) and employees (8%). SONATEL is the leader of the fixed telecommunications market. In Senegal, most fixed broadband connections are using ADSL. Fiber-optic connections exist in the country, but they are mainly targeted at large businesses and government (ITU, 2017). Thanks to its geographical position, Senegal was one of the first countries in West Africa to connect to an undersea fiber-optic network through the Atlantic-2 cable in 2000. Two other cables have also landed in Dakar with SAT-3/WASC in 2002 and ACE in 2012. The main fiber-optic infrastructure is owned by five major actors: SONATEL, TIGO, EXPRESSO, the State IT Agency (ADIE), and the electricity company SENELEC (Ministry of Posts and Telecommunications, 2016). Currently 9000 kms of fiber optic are deployed around the country.

The important role of the telecommunications sector in the Senegalese economy is expected to gain momentum with the Emerging Senegal Plan which calls for an acceleration of ICT diffusion as well as a transformation of the ICT sector into a digital economy that would have a ripple-effect on the other sectors of the economy. For this purpose, the plan urges the availability of high-speed Internet all around the country. The government also commits itself to work for an improvement of the quality of the

infrastructure and services and for cost reduction. In addition to the construction of a large technology park near Diamniadio, located at around 100 kms from the capital-city Dakar, the government hopes to create a framework that allows the implementation of big ICT projects such as e-health and e-education (Emerging Senegal Plan, 2014) .

The Ministry of Posts and Telecommunications plays a central role in the execution of ICT policy and strategy in Senegal. It has produced a key policy document entitled *Senegal Digital Strategy* 2016-2025 which lists a series of actions and indicates six ambitious goals that the country intends to reach by 2025: 1) a minimum threshold for high-speed Internet of 2 Mbps (the average speed for 3G) and 30 Mbps (average speed for 4G); 2) a reduction by half of the cost of fixed- and high-speed Internet within three years; 3) access for 100% of urban and rural communities to online services (commerce, high resolution videos, teleservices) from various devices (computers, tablets, smartphones) at competitive prices and with safety; 4) 4G coverage for 70% of the country within five years and 90% coverage by 2025; 5) access to Internet at home for five out of 10 households; and 6) connection of 50% of Small and Medium-sized Enterprises to high-speed Internet (Ministry of Posts and Telecommunications, 2016) Despite these efforts, agriculture, which provides the highest number of jobs in the country, has not fully adopted ICTs except some experimental initiatives. By contrast, finance stands out as a sector in which ICTs are well used with the development of money transfer services such as Wari, Joni Joni, Kalpe, Poste Cash, Orange Money, Tigo Cash, Nafa Express, etc.

Gender and ICTs in Senegal

The Global Gender Gap report released by the World Economic Forum in 2017 ranks Senegal 91st out 144 countries. The country appears in the lower-middle quarter of each of the major indices of gender inequalities which include economic participation and opportunity, educational attainment, health and survival, and political empowerment. However, since 2009, the country has improved its score in the Global Gender Gap reports thanks to an improvement in women's political empowerment and access to education.

In Senegal, social and cultural values and traditions determine women's position in society and set up a hierarchy dominated by men (USAID, 2017). Even if there are variations in the relationships between men and women based on urban/rural residence, ethnicity, and religion, in Senegalese culture, women, as wives and mothers, are expected to exercise household duties which include housework, upbringing of children, and contribution to subsistence agriculture work (USAID, 2017). By contrast, the Senegalese society expects men to take the leading roles in decision-making, income generation, and public life. Diop (1985) explains that the Wolofs, who have a powerful influence in the cultural practices in Senegal, have a specific social organization that requires the distribution of power between men and women within the families and in the community (Diop, 1985 as cited by Sow, 2014). The traditional family is referred to as *ker* or a household, which represents the social unit at the village level. Hierarchy and communitarianism constitute the main principles that guide the social and economic organization of the Wolof family (Diop, 1985 as cited by Sow, 2014). These two principles allow for the preservation of male authority and female subordination.

Consequently, in Wolof society, women appear as dependents who do not have the right to access land and cannot own means of wealth production.

Critics such as Madeleine Deves-Senghor (1972) argue that the penetration of Islam contributed to a lower place for women in Senegalese society. Deves-Senghor contends that, with the spread of Islam, women's roles become reduced to that of wives and mothers, expected simply to submit to their husbands and bear children (Deves-Senghor, 1927 as cited by Diamanka, 2013). In the same vein, Creevey (1996) contends that religion, and particularly the prevalence of Sunni Islam, can be seen as one of the factors that led to the subordinate position of women. In her analysis, Islam promotes an ideology that justifies male dominance. For Creevey (1996), French colonial occupation also reinforced women's dependence on men. She argues that when the French introduced the peanut as a staple crop, they assumed that its production was a male responsibility. Therefore, men were the main receivers of selected seeds, fertilizers, and credit but also the beneficiaries of training in production techniques and tools. Long after independence, the situation continued to prevail (Forget, 1966).

This position is contested by authors such as Diop (1987), and Callaway and Creevey (1994) who contend that colonialism did more harm to African women than did Islam. These authors also note a long co-existence between Islam and African values, a convergence of the two which resulted in the inception of societies that attributed leadership roles to women (Diop, 1987; Callaway & Creevey, 1994 as cited by Diamanka, 2013).

In recent years, Senegal has taken important measures for improved involvement of women in development strategies. A case in point was the adoption in 2010 of the Parity Law, which aimed at gender parity in elective offices in the country. In fact, it became obvious in the eyes of the authorities that the country would not achieve economic and social progress if half of the population is left behind. The 2013 *Recensement Général sur la Population, l'Habitat, l'Agriculture, et l'Elevage* revealed that there was an almost equal number of men and women -- 49.8% men and 50.2% women (ANDS, 2014).

In addition to their role in the household, women occupy an important place in economic activities. When it comes to agriculture, it is worth mentioning that 60% of Senegalese women live in rural areas (Daffe, 2011), where they are in charge of the most important part of agricultural activities (Ndiaye, 2013). Women participate in all agricultural activities and their work generally consists of manual tasks that require a large portion of the workday. It is estimated that in Sub-Saharan Africa, 60 to 70% of the agricultural food is produced by women who carry on three-quarters of agricultural activities which include planting, weeding, harvesting, crop treatment, harvest storing, and agricultural products' processing (Ndiaye, 2013). When it comes to livestock, women also contribute to animal health. They also play an active role in the sale of fishery products.

Scholars concur that the primary sector as well as the other pillars of the Senegalese economy -- could greatly benefit from the development of ICTs. However, in a study entitled "ICT, growth, and household poverty", Daffe (2011) revealed great disparity between men and women in the access and use of ICTs. As in many African

countries, financial, technical, and socio-cultural obstacles continue to widen the gap between men and women. More specific causes -- such as illiteracy, lack of master of the dominant languages of the Internet, lack of IT training, and the belief that information obtained from ICTs is not useful to them -- stop many women from taking advantage of the benefits of ICTs (Minister of Communication, Telecommunications, Post, and Digital Economy, 2017). Furthermore, the localization of ICT infrastructure in urban areas where women are less numerous represents another hindrance. Also, most public spaces where ICT services are provided are generally conceived as male spaces such as telecenters, which does not induce women to enter those places. In the same way, sexist attitudes towards women who study or use ICTs constitute another cultural aspect of gender inequality. In Senegal, more than in any other African country, young girls are often seen as less suited for studies in science and technology (Ministry of Communication, Telecommunications, Post, and Digital Economy (2017).

The study done by Daffe (2011) shows close to equal access to television and computer in households headed by men and those headed by women. However, the research also indicates that the existence of a TV set, a computer, or a fixed telephone line in a household does not mean that all the members can access it in an equal way. The study reveals that male household heads are the main users of Internet connection whereas female household heads play a minor role in the acquisition and use of ICTs.

Daffe (2011) also mentions that, for households headed by men and those headed by women, communications via fixed phone and the Internet can only be achieved in Dakar, the capital-city, and other urban areas. Since most households headed by women are located in rural areas, access to ICTs in these households is limited. Daffe (2011)

explains that women who represent the majority of the population in rural areas are less likely than men to access ICTs. Another key finding of the study is that none of the rural households headed by a woman has a computer, a fixed phone, or Internet connection. By contrast, 27% of the rural households headed by men have a TV set and 10.3% are equipped with a computer.

In addition to a description of the ownership of ICTs by households, the study also offers an analysis of the disparities in access to ICTs between occupants in an individual household. The analysis which focuses on the possession and use of ICTs, shows that men have twice the access to computers as women (8.7% against 3.5%) and are also more often equipped with mobile phones. However, the study shows that women own more email accounts than men. In terms of accessibility and usage of ICTs, the study reveals that even if women's access to television is equal to that of men, they are half as numerous as the number of men who access a computer. The number of women who have access to the Internet is 60% less than the number of men.

Summary

In this chapter, I have attempted to provide an introduction to the political and social history of the country and to show that the appearance of ICTs in Senegal first resulted from the occupation of the country by French settlers. However, after the independence of Senegal in 1960, the new authorities sought to develop legacy media which have long been a stronghold of the government. Today ICTs make a substantial contribution to the country's GDP to the detriment of the primary sector and in particular agriculture which used to be the driver of Senegal's economy. Even if the Emerging

Senegal Plan launched in 2014 ascribes particular importance to the development of ICTs, the government must implement strategic measures to reduce the gender digital divide in Senegal.

CHAPTER III

THEORETICAL FRAMEWORK

The study of the use of ICTs in social development processes can be carried out through various theoretical frameworks, because of the multiple disciplines that intersect with the concept of development. In this chapter, I present the main theories on which the study is grounded, first, by offering a review of Communication for Development through a description of the Modernization Theory which has long served as the major model that guided development interventions in Third World countries. I then introduce the critiques of the Modernization Theory that arose from the failure of different development projects because of their top-down, ethnocentric, and Western approaches. These critiques include the Dependency Theory, the Participatory Approach, and the Capability Model promoted by Amartya Sen. The last part of this chapter is focused on ICTs, gender, and empowerment.

Communication for Development

Many controversies have surrounded the concept of development over the years because development represents different things to different people. While some scholars see it as an aspect of a Western belief system (Rist, 1996), others consider it a part of economic theory or a component of ideology (Latouche, 1990). At the micro or individual level, Rodney (1972) observes that development entails "increased skill and capacity, greater freedom, creativity, self-discipline, responsibility, and material well-being" (p. 1). Slim (1995) states that change is the bedrock of any development process. However, development is not just about any change. It is rather a change for the better. In

this sense, Slim argues that all scientific and technological progress that the world has undergone should be analyzed as factors of change and, thus, understood as indicators of development.

However, traditionally, development was equated with economic growth, with the general view that policies that led to growth would also have the propinquity to foster development and are therefore deemed to be good policies. Conversely, programs that had little impact on growth were seen as inadequate (Sant'Ana, 2008). It is noteworthy that this conception of development does not take account of other factors such as inequality, poverty, or social well-being. This "growth-based" conceptualization of development, also known as the income approach, was premised on the idea that economic growth would produce resources and revenue that would benefit the whole society (Sant'Ana, 2008). The general belief or inference was that the higher the GDP, the more possibilities and opportunities would exist for individuals.

Although the concept of development is not new, the idea of underdevelopment for itself dates back to the post-World War II period. In this respect, the election of Harry Truman as President of the United States was a milestone event. In his inaugural speech on January 20, 1949, President Truman launched the concept of "underdeveloped areas," appealing to the United States and the rest of the developed world to find solutions to the problems facing the poor areas of the globe. With the Truman doctrine, sometimes referred to as Point Four (the fourth point of his inaugural speech), the objective was to foster the replication of the features of Western countries in underdeveloped areas. It was assumed that there was only one form of development as showcased in developed countries, and underdeveloped countries just needed to replicate the Western model. In

President Truman's eyes, foreign aid would boost production in underdeveloped areas, and that increase in production would lead to peace and prosperity (Melkote & Steeves, 2015).

Despite the philanthropic appearance of President Truman's program, this "Fair Deal" should be understood as a part of the strategic battle that the US had engaged to prevent the newly independent states in Africa and Asia to join the Soviet communist bloc (Sachs, 1992). The Marshall Plan, launched the preceding year, had been a successful model for America to provide financial aid to war-torn Europe. Hence, the belief was that giving aid to the former colonies would lead to political and economic allegiances to the United States (Sachs, 1992). It was also believed that information delivery would play a great role in the development process. This assumption gave birth to the concept of Communication for Development which appears to favor the use of communication resources to promote economic development and social change (Melkote & Steeves, 2015). Various terms have been used during the last 70 years to describe the process that included communication tools in development programs. These terms include communication and national development, development support communication, project support communication, communication and development, communication for development, development communication, and strategic communication (Cambridge, 2019). However, Nora Quebral is acknowledged as the first scholar to use the term Development Communication in 1971, defining it as :

> the art and science of human communication applied to the speedy transformation of a country and the mass of its people from poverty to a dynamic state of economic growth that makes possible greater social equality and the larger fulfillment of the human potential (Quebral, 2006, p. 69).

In Quebral's definition, the purpose of Communication for Development is not just the transmission of knowledge and information to alleviate poverty, it also stresses the necessary inclusion of the different segments of society in the process of development communication. For their part, Colin Fraser and Sonia Restrepo-Estrada (1998, p. 63) offer a multifaced definition of Communication for Development which they see as:

> the use of communication processes, techniques, and media to help people toward full awareness of their situation and their options for change, to resolve conflicts, to work toward consensus, to help people plan actions for change and sustainable development, to help people acquire the knowledge and skills they need to improve their condition and that society, and to improve the effectiveness of institutions (Fraser & Restrepo-Estrada, 1998, p. 63).

In suggesting a holistic approach to development communication, these definitions contrast with earlier conceptions of Communication for Development that mainly insisted on the powerful capacity of the media to change the minds and habits of people living in underdeveloped areas. Those conceptions were essentially articulated around the Modernization Theory which treated Communication for Development simply as the delivery of persuasive messages and the implementation of marketing techniques.

The Modernization Theory

President Truman's Point Four program provided the foundation for what would become the Modernization Theory. According to Daniel Lerner (1972, p. 386) modernization can be defined as "the process of social change whereby less-developed societies acquire characteristics common to more developed societies." The Modernization Theory was most influenced by the work of Walt Whitman Rostow (1960), who identified five stages of economic growth through which underdeveloped countries had to go in order to reach the level of development of wealthier states.

In his book *The Stages of Economic Growth*, Rostow (1960) argues that the first phase is the "traditional stage" in which production is largely agricultural and human societies take the forms of tribes or clans. This stage which is characterized by a lack of financial capital and technology is followed by the "pre-condition for take-off stage" in which the traditional society receives financial capital and technology through foreign aid schemes and investment deals secured from Western states.

This phase is followed by the "take-off stage" during which people abandon their old practices for more beneficial modern activities, whereas the fourth phase is called the "drive to maturity stage" which is signaled by the exportation of raw materials and manufactured goods. The last phase is "the age of high mass consumption" in which the society is completely urbanized with a high level of social welfare. For Rostow, modernization is achieved after a process that includes the introduction of capital and investment from Western countries, an adherence to Western ways of life including the nuclear family as the primary form of social organization, the implementation of democratic institutions, and the export of manufactured goods to the West (Rostow, 1960).

Based on Rostow's theoretical framework, the Modernization Theory contends that underdevelopment is the result of endogenous factors such as traditions, agrarian structure, levels of literacy and infrastructure (Melkote & Steeves, 2015; Kutor, 2014). Thus, progress requires breaking the chains of traditional society and a move towards an era of modernity where science and technology allow individuals to take control of their social and physical environment. The adherents to Modernization Theory also consider that the process of development could be observed and measured scientifically since the

historical model of the West would serve as the prototype for poor countries to emulate. In this sense, the Modernization Theory has built upon the works of Daniel Lerner who argues that Western modernization is the basis for others to follow . In the preface of his book , *The Passing of Traditional Society* (1964, p. viii), Lerner writes:

> Modernity is primarily a state of mind -- expectation of progress, propensity to growth, readiness to adapt to change. The nations of the North Atlantic area first developed the social processes -- secularization, urbanization, industrialization, popular participation – by which this state of mind came to prevail. The "Western Model" is only historically Western; sociologically it is global.

For Lerner, Western societies provide the most developed model of societal attributes in terms of power, wealth, skills, and rationality. Lerner also insists on the importance of mass media in the development process, assuming that exposure to media messages from the West would help people in the former colonies replace their traditions with modern values and ways of life (Lerner, 1964). Like Lerner, Wilbur Schramm, in his book, *Mass Media and National Development* (1964*),* argues that the media foster development through a transfer of ideas from the first countries to the developing states. For Schramm, this function of the media is even relevant in the Third World where they contribute to a communication of information and knowledge from urban areas to rural zones.

The Modernization Theory conceives social development as a Westernization process based on a top-down, one-way approach to communication. The paradigm prioritizes economic growth through the building of infrastructure and an adoption of Western science and technology. The adherents to this approach considered that the media can foster economic development by connecting audiences with new ideas and realities from the North (Melkote & Steeves, 2015).

This position was reinforced with the introduction of the diffusion of innovation theory by Everett Rogers (2003) who posits that change cannot occur in closed settings such as a peasant village without the introduction of new ideas by external forces. Rogers considered diffusion as the process by which an idea is disseminated to the members of a society over time. He defined the main elements in any analysis of the diffusion of an innovation: 1) the innovation itself, which is any idea considered new by the recipient; 2) its diffusion through channels; 3) among the members of a social system; 4) and over time.

The diffusion of innovation theory defines five stages of the adoption process:1) awareness, 2) interest, 3) evaluation, 4) trial, and 5) adoption. For Rogers (2003), the mass media plays a great role in raising awareness about innovation. However, at the evaluation and adoption stages, interpersonal communication and local sources of information are stronger determinants. The diffusion of innovation theory conceives that the adoption rate takes an S-shaped curve which starts slowly as the innovation is introduced in the social system; it accelerates as more people are convinced by the innovators to use the idea and slackens when no more people are adopting the innovation. The adopters are divided into five categories: 1) the innovators, 2) the early adopters, 3) the early majority, 4) the late majority and 5) the laggards. The diffusion of innovation theory argues that there are differences between adopters based on their social categories, their behavior towards the media, and their economic status. Early adopters were found to be young, used more media, and occupy a high social and economic status compared to late adopters.

In the 1960s, the diffusion of innovation theory was widely used to guide communication campaigns in Third World countries. However, it appeared that the theory was imprecise and lacked consideration of the feedback of the recipients. Critics of the approach called for a reference to commercial marketing techniques for the promotion of prosocial ideas, which led to the introduction of the social marketing approach in 1971 (Kotler & Zaltman, 1971). Proponents of social marketing developed new concepts such as market research, audience segmentation, facilitation, incentives, product development to maximize the responses of the recipients. Social marketing puts the emphasis on four Ps: Product, Pricing, Placement, and Promotion. In many development projects, social marketing is associated with Entertainment-Education which consists of embedding educational content in programs in media such as radio, television, folk theater, etc. (Melkote & Steeves, 2015).

Despite the vast sums of money invested in aid and assistantship for the South, the Modernization Theory did not succeed in lifting the standards of living in underdeveloped countries. Critics saw Modernization as synonymous with Westernization, and also objected to its ethnocentrism as well as for its ignorance of the history and culture of people in underdeveloped areas (Wright, 2005; Melkote & Steeves, 2015).

Critiques of the Modernization Theory

The most powerful critique of the Modernization Theory came from proponents of the Dependency Theory who, starting in the 1960s, offered new explanations for the

concepts of development and underdevelopment. Dependency is defined by Ghosh (2012, p. 44) as :

> a form of unequal international relationship between two sets of countries. One set of countries is called the center or metropolitan center, and another set of countries is called the periphery or satellite. The center represents developed capitalism, and the periphery represents underdeveloped regions.

The Dependency Theory which stood out as a challenge to the Euro-centric perception of development started with Latin American social scientists. According to Ghosh, the theory is originally Marxian in character because it is based on the concept of exploitation of the weaker, less developed countries by the capitalist, developed countries. The adherents of the Dependency Theory contend that underdevelopment is not the result of internal factors in Third World countries, it is rather related to exogenous factors.

Andre Gunder Frank saw underdevelopment as the result of the way in which the Third World is incorporated into the international economic and political system. He believes that capitalism has invaded every corner of the satellite (periphery) world and put the metropoles and satellites in dominant/dependent relationships (Frank, 1967). Frank contends that there is a systematic and continual transfer of economic surpluses from the periphery to the metropolitan centers of the advanced countries, a process that has contributed to the development of the metropoles while harming the satellites which have become underdeveloped.

For Frank, underdevelopment in African, Asian, and Latin American countries is a result of their contact with developed countries. Colonization shaped the course of their

economic history by turning the colonies into exporters of primary products and importers of finished goods. Therefore, the colonial system was a retarding force because it prevented merchant capital from developing into industrial capital. For Frank, this system distorted the growth process of the economies and he contends that, for the underdeveloped countries, salvation would come with a separation from the capitalist system and the adoption of a socialist one.

Like Frank, Franco-Egyptian scholar, Samir Amin finds that underdevelopment is the result of the introduction of Western capitalism in peripheral countries. This introduction has created different kinds of distortions. First, capitalism gives more consideration to export activities and leads to an extraversion of the economy. Amin believes that export activities dislocate the internal production structure. Second, the entry of capitalism from the metropoles encourages technology transfers and therefore leads to technological dependency in the periphery. Third, capitalism from the metropoles also leads to a distortion of the tertiary sector, which grows larger than other sectors. Consequently, many people are absorbed in the tertiary sector with a low level of productivity and income (Amin, 1976). For Amin, no development is possible in the less developed countries without a complete break from the world capitalist system. Like Andre Gunder Frank, Amin believes that socialism is necessary for underdeveloped countries because it is the only way for achieving auto-centric accumulation, which is to say, accumulation of wealth that prioritizes local production (Ghosh, 2001).

In the same vein as Frank and Amin, Immanuel Wallerstein explains underdevelopment as the result of capitalist penetration into less developed countries. In his book *The Modern-World System* (1974), Wallerstein describes the world economy as

divided into three parts: the core, the semi-periphery, and the periphery. Capital generated by the periphery is expropriated by the core whereas the semi-periphery works as a buffer; it is at the same time an exploiter and an exploited one.

Dependency and critical theorists see communication as a field for organizing resistance. They denounce the vast flow of media products from the North to the South and suggest strategies that protect local cultures. From this perspective, as mentioned by Steeves (2003), Dependency theorists prefer policies of cultural dissociation. They also call for the promotion of bottom-up forms of communication, the creation of alternative media, and the implementation of policies that are in line with each country's values.

Like the modernization paradigm, the Dependency Theory has not escaped criticisms. It is often accused of presenting the world as "a zero-sum or negative-sum whereby the gains of the core came at the expense of the periphery" (Hoogvelt, 1997, cited by Nhema and Zinyama, 2016, p. 155). Dependency Theory is also more pessimistic than Modernization Theory about the possibilities of peaceful development. For many critics of the Dependency Theory, emerging economies (South Korea, Taiwan, Singapore, Hong Kong) illustrate that core capitalism especially in the USA does not always produce peripheral underdevelopment (Nhema & Zinyama, 2016). Dependency Theory is also criticized for seeing imperialism as the cause of all evils. It seems to deny any agency to the periphery which is described as a passive respondent to outside forces.

A major shift from Modernization and Dependency Theories came with the introduction of participatory communication (Chitnis, 2005). This model is closely associated with Paulo Freire (2000) who argued that peace and stability around the world

would derive from the elimination of oppression. He saw poverty as a form of oppression and organizations that work to make a profit as a part of the system of oppression that includes multilateral, bilateral, and international aid organizations that implement the modernization paradigm. Freire also criticizes what he calls the banking system of education which contributes to maintain the system of oppression. Rather he suggests an alternative known as the problem-solving approach to education. For Freire, the teachers and development agents who implement the modernization paradigm are also victims. In his analysis, oppression is dehumanizing for the oppressed but also the oppressor. Therefore, he calls for a dialogic process that constitutes a pathway to liberation and empowerment. For Freire, this emancipatory dialogue is a process that includes, not only the marginalized people but also all members of the system. Consequently, Freire's ideas stand in contrast with the top-down, one-way flow of information. He calls for the development of contra-flows of communication, which lead to what he calls *conscientizacao*, an awakening that allows people and communities to determine their lives.

Over the years, many scholars have built on Freire's ideas and offered various approaches to participatory communication. Melkote and Steeves (2015) argue that participation has been operationalized in two ways: the participation-as-a-means approach which reflects the dominant paradigm and the participation-as-an end approach which refers to a context-based paradigm. Adherents to the participation-as-an-end perspective consider participation as a human right that is as essential as food and water. This human right should be recognized and guaranteed, and not used just as a means for achieving other goals.

Tufte and Mefalopulos (2009) argue that the definition of participation varies depending on the perspective from which it is applied. Some scholars see it as the mobilization of people for an eradication of the inequalities in access to knowledge, power, and income whereas others define it as the inclusion of inputs by local people in development projects and programs. Tufte and Mefalopulos (2009) contend that the first approach is the social movement perspective and the second is the project-based or institutional perspective of participatory communication.

For Melkote and Steeves (2015), media and communication represent key aspects to participatory initiatives. Development cannot be achieved without the involvement of poor, rural, and marginalized groups. Instead, their needs and problems should be taken into consideration in the different strategies and processes. Servaes and Malikao (2005) concur that participatory communication implies a change in the role of the communicator since it requires careful listening to the audience, which shortens the distance between communicators and receivers, and ensures a higher level of trust. Participatory communication, therefore, puts a particular emphasis on the cultural specificities of local communities. It considers ordinary people as the main pillar of the development process. In support of this idea, Bessette (2006) argues that participation constitutes a move from the transmission of information to citizens to change their behaviors and fosters knowledge-sharing among different agents. In participatory development communication, researchers and development planners work as facilitators rather than central agents for solving problems (Freire, 1970; Bessette, 2006). Scholars argue that the idea of power and control is one of the principles that underpin participatory communication (Ayee, 1993; White, 1994). Participation contributes to the

empowerment of marginalized groups and a fair allocation of political and economic power. Like Freire, Thomas (1994) sees participation as an emancipatory process and an experience for liberation. Through the possibility offered to people to determine their own lives, they gain the confidence and self-reliance that are necessary for their freedom.

Tufte and Mefalopulos (2009) argue that participation is essential at all the four key stages of a development project: 1) the research stage, 2) the design stage, 3) the implementation stage and 4) the evaluation stage. At the research stage, which is where the development issue is defined, all the significant stakeholders can be involved. Participation allows the target society or community to learn from previous experiences, gather information regarding local knowledge, existing values, and practices as well as culture, gender roles, and socio-economic conditions.

At the design stage which refers to the definition of the activities, participation ensures beneficiaries' ownership and commitment. It also contributes to enhancing the quality and relevance of the development activities. At the implementation stage, participation helps increase the commitment of the communities involved and the relevance and sustainability of the development interventions. At the final stage - the evaluation stage - participation can be used as a tool to ensure that the significant changes are taken into consideration and assessed. For Tufte and Mefalopulos (2009), for the evaluation to be meaningful, all the relevant stakeholders must be involved in the definition of the indicators and measurements in a participatory process from the beginning. Tufte and Mefalopulos distinguish four types of participation: passive participation, participation by consultation, participation by collaboration, and empowerment participation. With passive participation, the stakeholders to a project get

information about what the project is about and the actions that are going to be implemented. In this form of participation, the local people's opinions and feedback are less critical and participation is evaluated by counting the number of persons present and the contributions that are made.

Participation by consultation occurs when stakeholders have to answer questions asked by outside researchers and experts. In this type of participation, external professionals who have the power to make decisions are not obliged to take into consideration the input provided by the primary stakeholders. Participation by collaboration is a process whereby groups of stakeholders take part in discussions related to the preconceived objectives of the project. Tufte and Mefalopulos (2009) contend that with participation by collaboration, the level of participation of the beneficiaries does not lead to great changes in the objectives of the project. The collaboration requires high levels of stakeholder-involvement around how the objectives can be achieved. Participation by collaboration implies horizontal communication and capacity-building for the different stakeholders.

The fourth type of participation, empowerment participation, occurs when the stakeholders have the capability and willingness to initiate the process and participate in the analysis. For Tufte and Mefalopulos (2009), empowerment participation leads to the involvement of all the stakeholders in the decision-making about the objectives and the methods used to attain them. In this form of participation, the primary beneficiaries are equal partners whose opinions and views are very important in the decision-making process. Dialogue and exchange represent key strategies in empowerment participation. Dialogue allows the stakeholders to identify and analyze critical problems, and exchange

of knowledge and experience open pathways to solutions. This form of participation leads to ownership and control of the process by the primary stakeholders.

Despite its promises, the participatory approach is subject to criticisms. Scholars contend that many projects that pretend to use a participatory approach constitute, in reality, up-down initiatives that often fail to empower the beneficiaries (White, 1996; Cooke & Kothari, 2001). In many cases, participation is imposed on the beneficiaries to support the goals of the development organization (Cooke & Kothari, 2001). White (1996) sees participation as political because the practice always raises tensions about who should participate, in what way, and under which terms. For White (1996), even if it has the potential to challenge social and economic dominance, participation can be used to reinforce and reproduce power relations. The form and function of participation represent a focus of struggle.

> If participation means that the voiceless gain a voice, we should expect this to bring some conflict. It will challenge power relations, both within any individual project and in wider society. The absence of conflict in many supposedly `participatory' programmes is something that should raise our suspicions. Change hurts. (White, 1996. p. 155).

In the same vein, Servaes (1996) argues that participation is not always synonymous with total adhesion or unanimity. It is likely to be a conflictual process that challenges the existing structures. Despite its limitations, the participatory approach seems relevant to this study. It allows us to explore the ways farmers in Senegal have been involved in the design, implementation, and rollout of the mobile app by the FAO .

The Capability Approach

The Capability Approach (CA) to development, formulated by Amartya Sen in his book *Development as Freedom* (1999), stands out as an approach that assesses societal changes and the ways they affect individual well-being. For Sen, development should not just be equated with growth in gross national product, individual revenues, technological development, or modernization. All these aspects contribute to expanding people's freedoms in society, but freedoms also depend on other social and economic factors such as access to education and healthcare as well as political and civil rights.

Considering development as the expansion of freedom places the focus on the ends of development (freedom) rather than on the means that can play an important role in the process. In Sen's analysis, without freedom, people cannot make the choices that allow them to help themselves and others. He argues that development cannot happen without an elimination of the sources of unfreedom which include poverty, tyranny, economic and social deprivation, lack of public facilities as well as intolerance or repression from part of the state. For Sen (1999), the primary ends and the primary means of development should be the expansion of freedoms. As he puts it "development has to be more concerned with enhancing the lives we lead and the freedoms we enjoy" (p. 14). The expansion of freedoms makes people's lives richer and more fulfilling, allowing individuals to exercise their wills and interact with the world.

Sen defines five categories of instrumental freedoms that complement each other and contribute to individual freedoms: 1) *political freedoms*, 2) *economic facilities*, 3) *social opportunities*, 4) *transparency guarantees* and 5) *protective security*. *Political*

freedoms, which include civil rights, refer to the possibility for people to select their authorities and determine the principles of governance, to express their political views, and to have access to a free press. *Economic facilities* refer to the possibility of people to access economic resources. Sen argues that the ownership of resources, their availability, the conditions of exchange, which include prices and the conditions in the markets, determine the economic possibilities that a person may have. For Sen, an increase in income and wealth resulting from economic development should lead to an enhancement of the economic entitlement of the population.

Social opportunities represent the facilities set up for education, healthcare and so on, and which are designed to allow people to improve their living conditions. In Sen's analysis, these facilities contribute to an improvement of private lives but also operative participation in social and economic activities. *Transparency guarantees* represent the fourth category of freedom and refer to the necessity to ensure trust among members of the collectivity. For Sen, people's interactions in society are based on what is offered to them and what they expect to receive. Such presumption of trust and openness in transactions are fundamental for social operations. For Sen, *transparency guarantees* which lead to trust, prevent bribery and other financial wrongdoings. The fifth category of freedom is *protective security* and consists of providing citizens with a system of safety to protect them against misery, starvation, and death. *Protective security* includes institutional measures such as unemployment benefits, but also arrangements such as famine and emergency relief systems that provide general safety nets to vulnerable people.

Sen's ideas lead to the formulation of the Capability Approach which emphasizes the concepts of *functionings* and *capabilities* (Sen, 1999). For Sen, *functionings* refer to things people value and can have, things which provide them with an acceptable level of wellbeing. In Sen's analysis, the idea of wealth or economic wellbeing should not be seen as unique indicator of development. For him, development involves different variables that wealth cannot measure, and people may value things that wealth cannot provide. So, the focus of development should be on fostering the *functionings* which refer to a variety of *doings* and *beings*.

> The concept of "functioning", which has distinctly Aristotelian roots, reflects the various things a person may value doing or being. The valued functionings may vary from elementary ones, such as being adequately nourished and being free from avoidable disease, to very complex activities or personal states, such as being able to take part in the life of the community and having self-respect. (Sen, 1999, p. 75).

Sen combines the concept of *functionings* with the idea of *capabilities*, which refer to the opportunities and freedom to achieve *functionings*. For Sen, development implies the existence of choices and the possibility for people to make choices. To illustrate his ideas, Sen gives the example of a rich person who decides to fast. This rich person has the same functioning achievement in terms of food as a poor person who is compelled to starve, but the first person has different *capabilities* in the sense that he or she can decide to eat well or be well nourished, which the poor person is not able to do.

Sen argues that individual substantive freedom (*capabilities*) constitutes the primary objective and the main means for development (Sen, 2000). The objective of development should be to increase people's capability set or their fundamental freedoms that lead to a life of their choosing. Sen's conceptualization was adapted by the United

Nations Development Program (UNDP) to formulate statistical measures of human development such as the Human Development Index (HDI), the gender development index (GDI), the gender equity measure (GEM), and the human poverty index (HPI). As far as ICT4D research is concerned, the Capability Approach emphasizes the potential of technologies to increase the capabilities of human beings to function in their societies. The goal is not just to provide ICT services, but to build an environment that allows the destitute to access and evaluate information, create knowledge, and make their own decisions (Thapa & Saebo, 2014).

Even if the Capability Approach has been criticized for focusing on the individual and overlooking social structures and groups (Corbridge, 2002; Devereux, 2001; Navarro, 2000), scholars such as Thomas L. Jacobson (2016) praise its contribution to development research. Jacobson (2016) contends that compared to the Modernization Theory, Sen's Capability Approach is more conscious about market disruptions, more focused on people, and more centered on cultural values. Jacobson considers the Capability Approach as an appropriate framework for research in communication for development and social change. He affirms Sen's definition of development which offers a perspective that has been missing in communication studies. Different critics of the Modernization Theory have argued that development should not be equated with Westernization, while others have advocated for another development or post-development. However, for Jacobson, these critics under-conceptualized what development should be, which is not the case with the Capability Approach.

For Jacobson (2016), a second reason for viewing the Capability Approach as promising is that it represents a general framework for an analysis that integrates

different disciplines. Jacobson contends that communication for social change has been theorized from different perspectives: neo-Marxist dependency theory, post-colonialism, environmentalism, and a participatory perspective. Sen's Capability Approach offers a framework that allows governments, bilateral and multilateral institutions to overcome the tensions linked to the differences between the competing theoretical perspectives on communication for development and social change.

Gender and Development

Development as conceived by the United States was seen solely as modernization. This approach which was mainly based on Rostow's five stages of economic growth tied development with industrialization and urbanization of economies and societies. Development was also based on the adoption of Western science which emerged in patriarchal contexts through which the public sphere of science and technology was associated with men while the home and childcare were associated with women. In most Western societies, women were thought to be more susceptible to subjective feelings, and therefore, less rational, whereas men were thought to be better equipped to use objective reason (Melkote & Steeves, 2015).

Consequently, in the first years of development interventions in Third World countries, a welfare approach to women in development theory prevailed and policies aimed at women only addressed their roles as wives and mothers. The general assumption was that the benefits of macroeconomic strategies for growth would trickle down to the poor, and that poor women would benefit as the economic situation of their husbands improved (Momsen, 2010). The welfare approach which found its roots in the notion of

social welfare embedded in the nineteenth century European Poor Laws, treated women as recipients rather than contributors, clients rather than agents, and reproductive rather than productive (Kabeer, 1994). Boserup's groundbreaking book *Women's Role in Economic Development* and published in 1970 shed light on the bias of development interventions, namely the failure to account for the productive roles that women performed, especially in the agricultural sector. Boserup pointed out that colonial and post-colonial governments systematically ignored women in the dissemination of new technologies, extension services, and other productive inputs.

These governments had certain misperceptions about what women did, and development planners actions were based on stereotyped assumptions about women's domesticity (Kabeer, 1994). Boserup also demonstrated that colonial and post-colonial aid in the new cash economies increased women's workload growing food crops and caring for children, as men were diverted to wage labor in cities, mines, and cash crops. To make it worse, men often failed to share cash with their families back home. Therefore, the benefits of modernization increased for men, but women's situation worsened (Melkote & Steeves, 2015). Boserup also indicated that, contrary to men, women were denied access to technical training, education, rights to land, and modernizing technologies. Boserup's book appeared as a call to policy makers and planners for an inclusion of women in development as producers and contributors to the economy. Boserup's contribution and the work of other scholars gave way to the Women in Development (WID) approach whose main objective was to demonstrate that women were important economic actors.

Women in Development (WID)

WID activists argued that women should not only be seen as houseworkers and caregivers at home and that housekeeping and caregiving, considered as "nonproductive" by mainstream economists, allowed and subsidized men's participation in economic growth. The adherents to the WID approach called for the improvement of women's access to resources and their participation in development. The WID approach fostered more visibility of women in development projects. For example, in the United States, the lobbying of women involved in development projects led to the adoption by the United States Agency for International Development of the Percy Amendment in 1973. This amendment required gender-sensitive social impact studies for all development projects.

The WID approach asked governments to create national institutions such as ministries for women, to promote and oversee national efforts that advance women and WID units. The aim of WID was to integrate women in economic development by providing them with resources for income-generating activities, but also by developing appropriate technologies that lighten women's workloads. The approach succeeded in raising more concern about women and its lobbying culminated with the UN Decade for Women (1975-1985) which ended with the Nairobi Conference on Women, Development, and Peace that led to the creation of WID units, women's bureaus, and ministries in developing countries (Melkote & Steeves, 2015).

A major limitation of the WID movement was that it tended to view women in isolation and ignored their position relative to men. Actions were developed for the promotion of women without engaging men in understanding their needs. Moreover, this

movement treated women as a homogenous group without regard to class, ethnicity, and intra-household gender differences. Another limitation of the WID approach was that it focused on the integration of women in development projects without questioning the existing development paradigms and the power relations that put women at a disadvantage. It also appeared that, even if many governments created WID offices, these entities were just co-opted and did not contribute to transform the subordination of women (Parpart, Connelly, & Barriteau, 2000).

Another limitation of the WID approach was that it was closely related to the dominant Modernization Theory. The WID approach assumed that modernization would lead to industrialization and the adoption of Western strategies would lead to solutions to women's problems. The focus of WID was on access to economic resources and the approach overlooked the importance of social and political structures (Rai, 2011). Boserup and the other WID scholars ignored the processes of capital accumulation and seemed to offer prescriptions that would allow women to compete with men (Rai, 2011). As is the case with Modernization Theory, the WID approach considered that Western institutions had solutions to women's problems and consequently, it did not recognize the contribution of indigenous knowledge (Parpart et al. 2000), which would eventually pave the way for the emergence of a new approach mainly led by women from the Global South.

Women and Development (WAD)

The movement known as Women and Development claimed that the WID perspective failed to consider important issues such as colonialism and unequal global relationships. The approach was closely related to the critique of the Modernization

Theory which took the form of the Dependency Theory formulated by Gunder Frank and other scholars such as Samir Amin. WAD feminists argued that women in the Global South have always been part of development processes, but their work was exploited to benefit others in the Global North. For the WAD paradigm, the distinctive roles, responsibility, work, and knowledge of women should be acknowledged and valued. More precisely, the WAD approach called for a recognition of the contribution of women in agriculture as well as their reproductive roles within the household. This concern was translated through the slogan "Give credit where credit is due." (Parpart et al., 2000).

For WAD feminists, it was important to identify the role of capitalist production in gender hierarchies in order to identify the structures of inequality that reproduced women's invisibility and determined women's inferior status in relation to men (Harcourt, 2016). The WAD advocated for increasing women's share in resources, land, employment, and income. Additionally, in comparison with the WID approach, WAD was more concerned about the relationship between women and development rather than the integration of women into development. WAD focused on the sexual division of labor and the hierarchical interactions between productive and reproductive spheres of labor (Harcourt, 2016). Again, the WAD approach offered a critique of development projects whereas the WID approach did not question whether development was good or bad.

The main contribution of WAD was that it fostered the launch of campaigns designed to change policies and placed women's issues on national and international agendas (Parpart et al., 2000). It also offered an important shift from the WID's assumption that male-dominated states can be used to alter gender inequalities (Parpart et al., 2000). However, the WAD approach had its limitations in the sense that it downplayed class,

racial, and ethnic differences among women. Closely related to the Dependency Theory, WAD focused on international relations of power and neglected relations between gender and classes. The approach equally failed to consider the role of patriarchy and did not adequately explain gender power relations and their impact on development (Parpart et al., 2000). Additionally, WAD adherents advocated for separate projects for women as well as women's organizations, and in many cases these projects and organizations did not have the desired transformational impact.

Gender and Development (GAD)

In the 1980s, it appeared that WID and WAD failed to address the inequalities that women faced, which led to the emergence of the Gender and Development approach (GAD). GAD represents a crucial contribution to feminist thinking and practice within development studies (Harcourt, 2016). With GAD, the main focus was no longer on women, but the approach brought gender into the analysis of development. GAD, instead, focuses on identifying how power operates and not simply on how to incorporate women in development. The adherents to this approach see gender relations as a key determinant of women's position in society. GAD mainly recognizes women as a diverse group with interests that vary by class, age, and ethnicity. This approach asserts that women experience oppression differently based on their race, class, culture, colonial history, and position in the global economic system (Parpart et al., 2000).

For GAD activists, women should not be viewed as passive recipients of development but should rather be seen as active agents. However, the approach does not assume that women have perfect knowledge or understanding of their situation . It focuses on women's material conditions and class position but also on the patriarchal

structures and ideas that maintain women's subordination. GAD tries to look at the totality of social organization, economic, and political life in order to understand the shaping of particular aspects of society. Melkote and Steeves (2015) argue that the GAD framework includes not only a feminist approach but also a Marxian social analysis . For GAD, it is both the ideology of male superiority as well as the control of valuable resources by men that cause women's disadvantages.

Contrary to WID and WAD, the GAD perspective recognizes men as partners in development and advocates for equal access for men and women to resources as well as to the benefits which accrue from development. Another particularity of the GAD approach is its focus on strategic gender needs contrary to the WID approach which insisted on practical gender needs. Strategic gender needs are a result of women's subordination; therefore, they call for changes in the social structures and institutions that define women's position in society. For instance, equal access to land, capital, and participation in decision-making in the public sphere are strategic needs for women and the satisfaction of these needs allows women to meet practical needs such as food, water, clothing, education, and health care.

This focus on the strategic needs can be seen as a major contribution of GAD in the sense that it raises concerns about the necessity to challenge gender relations and social structures to improve the situation of women. It also emphasizes the need for women to mobilize in order to achieve greater political impact. GAD also contributes to shifting responsibility onto the state to provide social services to support women's social reproduction role.

Furthermore, the GAD approach also contributes to the conception of gender mainstreaming which includes the process of assessing the implications of men and women in any planned action, including legislation, policies, and programs, and which has now become a globally-accepted strategy for the promotion of gender equality. Additionally, the organizing of GAD activists led to the introduction of the Gender-Related Development Index in 1995 by UNDP, which aggregates measures of access to health, education, and income and reveals large gaps between countries. The UNDP added to it the Gender Empowerment Measure to account for women's participation and leadership in economic and political decision-making. However, both of these measures have received severe criticisms for failing to account for the differences between women and men within countries, such as rural/urban location, ethnicity, age, as well as macro and micro-level structural constraints (Melkote & Steeves, 2015).

Postcolonial Feminism

In addition to WID, WAD, and GAD, postcolonial feminism ranks among the approaches that stand out in the history of feminist thought. It developed as a response to feminism focusing only on the experiences of women in the First World. The main focus of postcolonial feminism is to account for how racism and colonialism affect non-White, non-Western women in the postcolonial world. For postcolonial feminists, the legacies of colonization and the impact of capitalism make it difficult for women in the Global South to have their concerns taken into consideration by Western feminists. In a seminal essay entitled *The Master's Tools Will Never Dismantle the Master's House (1984)*, Audre Lorde criticizes white women within the feminist movement for focusing on their oppression as women and ignoring the differences of race, sexual preference, class, and

age. In it, she denounces the tendency of white feminists to homogenize the experiences of women of color under the umbrella of sisterhood which, according to her, does not exist. The homogenization of the description of Third World women by Western feminists is also at the core of Chandra Mohanty's essay *Under Western Eyes* (1991), in which she stresses the codification of Western feminist scholarship that uses a discourse which colonizes and ghettoizes the Third World woman as the "Other". For Mohanty, white Western feminists have come to the constitution of the colonial Other because of three presuppositions. First, they assume that Third World women represent a coherent group with identical interests, experiences, and goals before their entry in the socio-political and historical field. In the discourse of Western feminists, Third World women appear as subjects situated outside social relations, and there is no interest in the way these women are constituted within these social structures. Western feminists criticize the economic, religious, and familial structures in Third World countries and see the typical woman in these areas as religious, family-oriented, legal minors, illiterate, and domestic. With this production of the Third World Other, Western feminists discursively represent themselves as sexually liberated, educated, free-minded, modern, in control of their own lives.

Secondly, Mohanty criticizes the system of power that such writings imply, a system of power that describes the classical notion of men as oppressors and women as oppressed. According to Mohanty, this system of power is not adequate because it suggests a universal notion of patriarchy, and only puts the emphasis on the binary men versus women. Because Western feminists fail to take into account the social and political contexts, they deny Third World women of their historical and political agency.

For Mohanty, cultural aspects such as female genital cutting, marriage, dependency, the sexual division of labor, religious practices should be interpreted within specific contexts in order to understand the practices but also to effectively work toward social change. Thirdly, Mohanty criticizes Western feminists for using methodological practices that are over-simplified with the objective of finding proofs of powerless women in order to support the idea of Third World women as powerless victims. Mohanty also takes down the notion of sisterhood because it implies a false sense of common experiences and goals, as if women represent a monolithic group that suffer from the same type of oppression.

Mohanty and the other adherents to post-colonial feminism stress on the tendency of mainstream feminism to overlook differences between women. They brought a shift in the discourse of sameness and human rights which characterized the first and the second wave of feminism. In fact, the focus has long been on universalist aspirations for women represented as a group sharing patterns of oppressions that stem from global patriarchy. Nair (2018) contends that a major contribution of postcolonial feminism is the insight that marginality is embedded in histories of imperialism and colonialization that are not similarly experienced but constitute a common oppression. Postcolonial feminism focuses on gendered and racialized oppression and exploitation but also constitutes a resistance to neo-liberalism and capitalism (Nair, 2018). In her essay entitled “Can the subaltern speak?”, Spivak (1988) insists that, in the context of colonial production and the international division of labor, the subaltern women cannot speak. It is not because the people who belong to this social group do not have the ability to voice their concerns, but the problem is that Western discourse does not care about the members of the

subaltern class. In order to transcend the boundaries of differences once drawn by colonialism and re-actualized today by the international division of labor, it is important for those who are at the privileged side to learn to speak to (rather listen or speak for) the subaltern women and try to communicate on an equal level (Spivak, 1988).

Postcolonial feminism calls for particular attention to the damages that Western imperialism and global capitalism inflected on people in the developing world. Most postcolonial feminists believe that it is not up to Western feminists to present themselves as saviors for women in the Global South. Feminism must rather emerge at the local level from regional knowledge instead of being imposed from outside. For her part, Mohanty (2003) suggests a reconfiguration of the boundaries of feminist epistemologies to include an understanding of racial, political, and economic boundaries and to transcend them through feminist solidarity. For her, the borders among feminists should not be ignored or erased. They should rather be acknowledged and transcended to form a union against the exploitation of global capitalism. In this sense, Mohanty calls for a decolonization of feminism through critical pedagogy, anti-capitalist solidarity, and transnational feminist practices. By stressing on the differences between women, postcolonial feminism highlights that oppressions on women vary depending on societies and contexts. In this sense, postcolonial feminism is considered as a branch of intersectionality which rose in the 1990s as a major framework for the study of women's contribution to development.

Intersectionality

Intersectionality appears as a framework designed to study the dynamic between identities (for example woman and black) and systems of oppression (for example patriarchy, white supremacy). Kimberle Crenshaw (1991) who studied gender and race in the US pioneered interest on the notion of intersectionality which challenges the assumption of the feminist movement that women are a homogenous group, equally positioned by structures of power. Crenshaw argued that women's situation must be analyzed as a complex web of identities in a specific local and global context. She discussed black feminism which argues that the experience of a black woman cannot be understood in terms of being black and being a woman considered independently, but the analysis must include interactions between the two identities which reinforce each other. Crenshaw explores two types of male violence against women, namely domestic violence, and rape, to show that women of color have an experience different from white women due to their race and color. Through a study of domestic violence and rape, she demonstrates that the experiences of women of color is a combination of both racism and sexism. For Crenshaw, because women of color are present within discourses that address either race or sex, and not both at the same time, they are marginalized within both of these systems of oppression.

Crenshaw uses the example of a traffic intersection to describe the various dimensions of intersectionality. For her, black women's situation is similar to a traffic at an intersection, coming and going in all four directions. She posits that discrimination, like traffic through an intersection may flow in one direction or another. An accident at

the intersection may be caused by cars travelling from any number of directions and sometimes, it can be caused by all of them. Similarly, if a black woman is harmed because she is at an intersection, that injury may be the result of sexual discrimination or racial discrimination.

Crenshaw's work will be extended by other black feminists such as Patricia Hill Collins (1990) who claims that oppressions of race, class, gender, sexuality, and nations are intersecting, mutually constructing systems of power. Collins believes that, for black women, there is a matrix of domination that works in four different domains: the structural domain, the disciplinary domain, the hegemonic domain, and the interpersonal domain. The structural domain functions to organize power and oppression. The disciplinary domain manages oppression in attempts to sustain it. The hegemonic domain works to legitimize oppression. As for the interpersonal domain, it controls the interactions and consciousness of individuals. Collins asserts that all black women are within this matrix of domination; however, the differences in the intersections of oppression make the experiences and the perspectives of black women differ.

Intersectionality offers a framework that postulates that there is not a fixed reality to be lived by all who share the same identity (such as being a woman) but there are rather multiple realities that are experimented by different identities. For example, because of race, a white woman and a black woman will experience differently their womanhood. In the field of international development, intersectionality has allowed to have a good understanding of the social, political, economic, and legal contexts for each individual case of discrimination or violence. As bell hooks (1984) puts it, this approach challenges

the notion that gender is the primary factor for determining a woman's fate. An intersectional analysis of gender and development helps to conduct power analysis to see how individuals experience oppression and privilege at the same time.

Gender and Empowerment

Even though most feminist critiques of development aimed at ensuring a better place of women in society, the concept of empowerment is closely associated with the GAD discourse which considers that women are affected by patriarchy and power relations in society. For GAD feminists, empowerment appeared as a strategy that would allow to change social power dynamics. However, the definition of empowerment in the development discourse is not very precise and the concept has often been defined as a process through which women gain power over men or a process that allow women to access to decision-making processes and instances of power (Oxaal & Baden, 1997). Rowlands (1997) states that , in the development discourse, the word 'empowerment" is used in a way that presupposes that the reader or listener understands the meaning but the question of how empowerment comes about can either be assumed or ignored. She sees empowerment as a way of bringing people who are outside the decision-making process into it. For Rowlands, empowerment implies participation in political structures and formal decision-making as well as participation in the economic sphere with the ability to have an income that allows a participation in economic decision-making. For Rowlands, people are empowered when they are able to maximize the opportunities available to them without constraints. However, she also argues that empowerment goes beyond economic and political participation and is concerned with the processes that

allow people to become aware of their own interests and how those interests relate to the interests of others, in order both to participate from a position of greater strength in decision-making and to influence such decisions. Being empowered includes understanding the dynamics of oppression. Rowlands insists that empowerment is more than participation in decision-making and includes the processes that lead people to perceive themselves as able and entitled to make decisions.

For Kabeer (1999), the concept refers to the processes by which those who were denied the ability to make choices acquire this ability. Kabeer argues that changes in the ability to make choices should be understood as changes at three levels: resources, agency, and achievements. Resources refer to the conditions under which the choices are made. Agency for itself is at the heart of the processes by which the choices are made. As for the achievements, they are related to the outcomes of the choices. For Kabeer, these three dimensions (resources, agency, and achievements) are inter-dependent in the sense that changes in each dimension contributes to, and benefits from changes in the others. The achievements made at a particular moment are translated into enhanced resources or agency, and into a capacity of making choices at a later moment in time.

In Kabeer's analysis, resources can take different forms. They can be material, social or human. They include economic resources such as land, equipment, finance, working capital as well as human and social resources that allow to enhance the ability to make choices. For Kabeer, human resources are internalized by the individual, and they encompass his or her knowledge, skills, creativity, imagination, and so on. As for social resources, they are represented by the claims, obligations, and expectations that are

related to the relationships, networks, and connections that exist in different social spheres and which enable people to improve their situation and life beyond what would be possible through their individual efforts alone. For Kabeer, empowerment entails a change in the terms the resources are acquired but also an increase in access to resources.

In Kabeer's analysis, the second dimension of empowerment is agency which refers to the ability to define one's goals and to act upon them. For Kabeer, agency goes beyond the observable action and includes the meaning, motivation, and purpose that people give to their activity, their sense of agency, and the power within. Contrary to the view of mainstream economic literature, agency should not just be operationalized as individual decision making. Instead, it encompasses a wide range of actions including bargaining, negotiation, deception, manipulation, subversion, resistance, and protest, but also the rational processes of reflection and analysis (Kabeer, 1999). Agency also includes collective but individual reflection and action.

When people have the resources and agency, they have the capabilities to achieve certain things, which constitute the third dimension of empowerment. For scholars, resources and agency are the main components of empowerment (Malhotra, 2003). However, resources only should not be seen as enough for empowerment. They should rather be considered as catalysts of empowerment, as enabling factors that can foster empowerment. The second component of empowerment, which is agency, derives its importance from the rejection of top-down approaches to development (Malhotra, 2003). At the institutional level, agency suggests popular participation and social inclusion. At

the micro level, it is embodied in the idea of self-efficacy, and women's own realization that they can be agents of change in their lives (Malhotra, 2003).

However, it can be objected that in many development projects, empowerment is not well understood and is often equated with income-generating activities for women. It is clear that income generation does not lead to women's empowerment if they do not have full autonomy to spend the income or control the resources. It is possible that women increase their income without being able to increase their power in decision making, social relations, or freedom of movement. Furthermore, as noted by Malhotra (2003), women can be empowered in some areas, and not in others.

Melkote and Steeves (2015) suggest that empowerment should be seen as a mechanism by which individuals, organizations, and communities have control over their social, political, and economic conditions, as well as democratic participation. It also includes the possibilities of individuals to have control over their stories. Melkote and Steeves (2015) argue that scholarly work on local people do not often give voice to local people themselves. Local people's stories consist of narratives about their own lives, histories, experiences, and values. However, the power to create and tell stories is often controlled by elites through their organizations, networks, agents, and genres. The elites also have control over the media and information channels and therefore minorities, women, the poor and local communities do not have control on the right to tell their own stories. For Melkote and Steeves, people's right to tell their stories should be central to participatory strategies that lead to empowerment.

It is clear that, on account of the ambition of the FAO project to ensure equal participation of men and women in the rolling of its app in rural areas, theories related to gender and development, especially post-colonial feminism and intersectionality offer appropriate lenses that allow to study this international initiative.

Summary

In this chapter, I have reviewed the theoretical frameworks that undergird this dissertation. The Modernization Theory has long stood out as the main reference for the implementation of development programs and plans. Even though, in the early years, traditional media such as radio and TV were instrumental in changing people's behaviors and fostering new values and ideas, in the last decades, more focus has been put on new technologies such as computers, mobile phones, and apps. In this chapter, I have also addressed the different critiques of the Modernization Theory which include the Dependency Theory, the participatory model, and the Capability Approach to development. The last part of the chapter has provided an account of gender and development and reviewed different feminist critiques of development. In the next chapter, I will offer a review of the relevant literature on ICT4D with a particular focus on the contribution of ICTs to agricultural development.

CHAPTER IV

RELATED STUDIES

Scholars agree that whatever is the definition given to development, ICTs have a significant impact on its processes (Heeks, 1999; Rao, 2005). In this chapter, I first offer a review of the literature related to the impact of ICTs on development, with an emphasis on telecommunications. The second part of the chapter deals with the contributions of mobile apps to agricultural and rural development. The positive effects of ICTs can be measured in terms of access to information and market prices, agricultural and rural advisory services, as well as the provision of financial opportunities. In the third part of the chapter, I review the issue of gender and ICTs with a particular focus on the African context.

ICTs and Development

The impact of ICT in development processes can be assessed in terms of economic growth (Donner, 2004; Abraham, 2007; Jensen, 2007), sustainable livelihood (Molla & Al-Jaghoub, 2007; Khan & Ghadially, 2010), or individual capabilities (Kivunike et al.; 2009; Olatokun, 2009). Thompson and Garbacz (2007) who studied panel data of 93 countries between 1995 and 2003 declared that the development of telecommunications networks had a positive impact on the world and the poorest nations. It increased economic growth through a rise in infrastructure investment, and improvement of the efficiency of how these resources are used. Thompson and Garbacz (2007) argued that an improvement in information and communication technologies

contributes to business efficiency and decision-making but it also helps improve the functionality of institutions.

Similarly, Gruber and Koutroumpis (2011) who used annual data from 193 countries from 1990 to 2007 found important effects of mobile telecommunications on economic growth. However, the authors revealed that the impact is not great for countries with low mobile penetration, which are usually low-income countries. They contended that in low-income countries, the contribution of ICTs to annual GDP growth is 0.11% whereas, for high-income countries, it is estimated at 0.20%.

Fernandez-Portillo et al. (2019) who studied the impact of ICTs on the growth in GDP per capita of European countries from 2014 to 2017, identified five constructs that have a relationship with economic development: 1) connectivity, 2) human capital, 3) use of the Internet, 4) technological integration, and 5) digital public services. The authors revealed that connectivity contributed to 10.92% to the increase of GDP per capita whereas the contribution of human capital was estimated at 8.22%. Fernandez-Portillo et al. (2019) declared that sustainable economic development requires investments for improvement of connectivity in remote areas and training of the population in ICT use and development. A major finding of this study was that public digital services was the construct that provided the highest contribution to the variance of GDP and it was estimated at 14.26%. Fernandez-Portillo et al. (2019) concluded that the deployment of ICT contributes to sustainable economic development, at least within the European Union. The authors called governments to put more emphasis on digital administration, investment on connectivity, and training in the field of ICTs.

Beyond the broad concept of telecommunications, scholars have produced a large swath of literature on the specific impact of ICT devices. Examining the association between ICT penetration and growth during the period 1996 – 2005, Vu (2011) found that the penetration of personal computers, mobile phones, and the Internet had a tremendous impact on growth. The study also revealed that the effect of the penetration of Internet use is more important than the impact of mobile phones, which is, in turn, more important than the effect of personal computers (Vu, 2011)

In addition to economic progress, ICTs play a great role in the improvement of individual and collective livelihoods. Molla and Al-Jaghoub (2007) who used the livelihood framework to examine the impact ICTs in Jordan called for an alignment of ICT projects with the development paradigm, a combination of digital technologies with social life, integration of digital projects with the structures and resources existing in the community. They also considered that good management of ICT projects would allow an improvement of individual and collective livelihood.

In their study of the use of ICTs by people living in rural communities in Uganda, Kivunike et al. (2009) stressed the quality of life resulting from ICT use. They revealed that people appreciate the various social aspects they derive from ICTs which are mostly used for social interaction and pleasure. Khan & Ghandially (2010) who did a study on the use of computers by 155 young Muslim men and women in India found that ICT education, access, and use contribute to empowering women and marginalized groups. However, the authors deplored the lack of awareness of people about the potential that ICTs offer in the process of development.

Jensen (2007) who did a specific study in the fisheries sector in India and surveyed 300 sardine units in Kerala, revealed that the introduction of mobile phones contributed to a reduction of price dispersion and waste. The addition of mobile devices led to an increase in profits for fishermen and fostered consumer welfare. The access to information through mobile phones makes markets work and the functioning of markets contributes to general social welfare. Jensen (2007) concluded that fishermen are willing to pay for mobile phones on account of the increased profit they derive from it. Like Jensen (2007), Abraham (2007) also asserted that the use of mobile phones at sea allows fishermen to react more quickly to market demand and to prevent the wastage of catch. When it comes to marketing, mobile phones facilitate the coordination of supply and demand and the free flow of price information help traders and transporters to better cater to demand in markets that are undersupplied.

Contrary to the optimistic view, different scholars deny the effect of ICTs on economic growth. Dewan and Kraemer (2000) carried out a study of the impact of Information Technology (IT) and non-IT inputs on GDP output and came up with interesting results. Analyzing panel data from 36 countries over 1985-1993, they revealed significant differences between developed and developing countries in terms of returns from capital investments. Returns for IT investments were positive for the developed countries but were not significant for developing states. Dewan and Kraemer (2000) argued that, in developed countries, IT investments were accompanied with supportive investments in factors such as infrastructure and human capital, as well as the informatization of business models. By contrast, in developing countries, where these

factors were lacking, Dewan and Kraemer (2000) suggested that priority should be given to long-term infrastructure projects rather than short-term IT applications.

In the same vein, Pohjola (2002) who examined ICT investment data for a sample of 43 countries over the period 1985 – 1999 revealed that there was no significant correlation between ICT investment and economic growth. For Pohjola, this productivity paradox can be explained by the fact that, during the time of the study, many countries did not yet make substantial investments in the ICT sector. Pohjola (2002) posited that, even if some countries have invested enough money in ICT development, they failed to put appropriate investments in complementary infrastructure such as education and skills.

Mobile Apps for Agriculture

The potential of mobile phones to transform the lives of rural people lies in the applications they contain. Denovan (2017) defines an app as:

> a piece of software on a portable device (such as a mobile phone handset, personal digital assistant, or tablet computer) that enables a user to carry out one or more specific tasks that are not directly related to the operation of the device itself (p. 51).

Although mobile apps were originally conceived to achieve basic tasks on computer programs such as email, web browsing, contacts, calendar, and weather forecast, in recent years, a variety of mobile apps have been developed to meet specific needs in sectors such as banking, health, tourism, commerce, and agriculture. Mobile apps for agriculture and rural development are often referred to as m-ARD apps and can be categorized in four types: 1) education and awareness, 2) commodity price and market information, 3) data collection, 4) pest and disease outbreak warning, and tracking (Qiang

et al., 2011; Hellstrom (2010). In a more detailed way, Costopoulou, Ntaliani, and Karetsos (2016) suggest that the services offered to farmers through mobile apps include:

> weather forecasting for farmers, agricultural business news, information for agricultural machinery and equipment, agricultural product market prices, management of agricultural product, dairy farming, management of irrigation systems, management of crop sensors, yield forecasting and monitoring, registration of soil types, and calculation (p. 44).

In a study carried out in 2016, Costopoulou, Ntaliani, and Karetsos (2016) found that 1,300 mobile apps for agriculture were displayed on the existing platforms (App Store, Google Play, and Windows Phone store) compared to the 259,000 mobile health apps. Most of the apps focused on farmers' needs and many of them (more than one third) were free for download. Most of the apps were produced in the United States and had English as a primary language. The geographic coverage for other countries was also very limited (Costopoulou, Ntaliani, & Karetsos, 2016). In a study done for the World Bank, Qiang, Kuek, Daymond, and Esselaar (2011) argued that mobile apps can contribute to rural development and improvement of agricultural activities through the provision of information and services, and the results generated can be assessed at different levels which include: 1) the ability of beneficiaries to access better information, 2) the ability of users to better access extension services, 3) an improvement of market links and distribution networks, and 4) access to information on credit, insurance, and payment methods which contributes to yield increases and a diversification of the production.

Mobile Apps, Market Information, and e-Commerce

In its 2017 report, the Food and Agriculture Organization expounds on the importance of information for smallholders in Third World countries. In their farming activities, smallholders make all their decisions based on the information they get. The

crop they plant, the seeds and fertilizers they use, and the way they use it, the time to plow, proceed to seeding, or harvest depends on the information that smallholder farmers have. Information also allows smallholders to decide the part of the harvest to sell and the quantity they can store. However, access to appropriate information is often a costly process. De Silva and Ratnadiwakara (2008) found that in Sri Lanka, the cost of information from planting the crops to selling the products into the markets, represents up to 11% of the production costs. The authors also argued that information asymmetry constitutes a significant factor in transaction costs. In most of cases, farmers evolve in an unfavorable economic context where little information is available. Consequently, the choices that they made are not always the best (FAO, 2017).

In addition to information related to agricultural production, ICTs such as mobile phones provide farmers with price information on markets. These prices signal profitable opportunities to farmers for selling their products. They also can reflect changes in consumption patterns and give information about what and how much to produce (FAO, 2018). Price information also contributes to market efficiency by allowing farmers to produce and invest based on a good understanding of supply and demand.

A vast literature has been produced on the impact of price information on farmers' performance (Nakasone, 2013; Mitra & Sarkar, 2003; Fafchamps & Hill, 2008). In a study carried out on potato markets in West Bengal, Mitra and Sarkar (2003) pointed out that traders who are more exposed to commercial information make more profit from their commercial activity than farmers who do not have that information advantage. Similarly, Fafchamps and Hill (2008) who investigated coffee markets in Uganda found that the rise of international coffee prices does not lead to much increase in the price paid

to farmers because of their lack of knowledge about the increase of international coffee prices. Fafchamps and Hill (2008) contended that only traders who have an information advantage get a larger profit compared to farmers. In a study on the role of price information in agricultural markets in rural Peru, Nakasone (2013) found that households with access to information can have better prices for their crops, and their sales prices increase by 13% to 14% compared to households that do not access market price information.

Even if traditionally, farmers and cattle breeders have long learned from their trial and errors and local sources such as colleagues, extension workers, and broadcast media such as radio, the development of mobile technology brought new possibilities for farmers to access information in terms of cost, coverage, and facility of use (Aker & Mbiti, 2010). Aker (2011) asserts that the preference of farmers for mobile technologies is caused by the constraints of traditional media. Even if many farmers still listen to the radio, the device does not provide a wide range of information and is essentially based on one-way communication. The main limitation for newspapers is that they are mostly destined to urban people, are costly, and require a certain level of literacy. In many rural areas, landline coverage remains limited and access to services such as emails and the Internet is negligible. As for traveling to different locations to get information, it implies transportation costs as well as the opportunity cost associated with the person's time (Aker, 2011).

Aker, Ghosh, and Burrell (2016) insisted on the capacity of mobile phones to foster information circulation among members of interpersonal networks and to allow farmers to get crucial information quickly and over large geographical areas. This

information which is less expensive than the transportation costs for getting it, contributes to better decision-making regarding crop selection, input adoption, and yields. However, Aker, Ghosh, and Burrell (2016) also posited that the effect of mobile technology depends on other factors such as how large the farmer's social network is, the capacity of the farmer to increase this network, the quality of the information provided and farmers' trust in the source of the information. Issahaku, Abu, and Nkegbe (2018) who carried out a study on the impact of mobile phones on the productivity of smallholder maize farmers in Ghana found that mobile phones improved the productivity of user-farmers by at least 261.20 kg per hectare for each production season. The authors also revealed that phone ownership and use have more impact on productivity than phone use only.

In many countries, the wide penetration of mobile phones has led to an application of e-commerce to agriculture. Minkoua, Nzie, Bidogeza, and Ngum (2018) who examined the effects of mobile phone use on transaction costs related to price information search, asserted that the use of mobile phones by farmers increases their transaction costs for carrots and tomatoes, unlike for cabbages. Similarly, Muto and Yamano (2009) who studied the impact of mobile phone coverage expansion on market participation in rural Uganda found increased sales of perishable crops such as banana but not of maize. The authors argued that commercial information obtained from mobile phones has a larger impact on perishable products. Timely information available through mobile phones allows producers to market their perishable products without delay and to avoid waste. Similarly, Aker and Fafchamps (2014) studied the impact of mobile phone coverage on producer price dispersion in Niger and revealed that mobile phone coverage

contributes to a reduction of spatial producer price dispersion by 6 percent for cowpea, which is a semi-perishable commodity but has no effect on producer price dispersion for millet and sorghum, which are two storable grains.

Despite these studies that applaud the role of mobile phones in the provision of market price information, Burell and Oreglia (2015) took a different stance. In a study done in China and Uganda, they argued that the impact of market information on market efficiency is a myth. They contended that the scarcity of price information depends on the location. In some of the villages where the study was conducted, people access market prices from different sources such as radio, television, extension workers, traders, neighbors, and could double-check the information through discussion. The authors concluded, when it comes to small trade, price information is dependent on social relationships. They argued that the improvement of market efficiency does not necessarily stem from the use of mobile phones but the capacity of coordination, and management work between trusted partners.

Mobile Apps and Agricultural Extension

The origin of public agricultural extension services goes back to Ireland and the United Kingdom in the middle of the 19th Century (Swanson & Rajalahti, 2010). In Ireland, agricultural advisors contributed to alleviate the effect of the 1845-1851 potato famine by helping farmers diversify their crop production. The lessons were replicated by many European and North American governments in the second half of the 19th Century. As for the term, *extension* itself, Swanson and Rajalahti (2010) explained, that it was first used to refer to education programs for adults designed by Oxford and Cambridge

universities in England in 1967 to expand the work of the two universities in the neighboring communities.

When it comes to agriculture, extension services were originally conceived as systems aimed at bridging the lack of information of rural farmers who do not have great access to sources of information such as landlines, newspapers, and radios (Aker, 2011). Anderson and Feder (2007) define the term *extension* both as a system and a set of functions. As a set of functions, extension involves technology transfer with the view of allowing farmers to ensure sustainable production, processing, and marketing. It also includes management transfer for better organization of farmers and farming activities. Another function consists in transferring knowledge and skills that contribute to educate and build local capability in terms of market intelligence, farm and pest management, financial negotiation, seeds, and fertilizers (Anderson & Feder, 2007). As a system, extension refers to both public and private organizations that work for knowledge transfer, mobilization, and education of rural people.

In 2005, the number of extension workers was estimated at 500,000 and a large majority (95%) worked in public organizations (Aker, 2011). Some scholars contend that there is little evidence of the impact of extension workers on agricultural knowledge, technology adoption, and yields since the inception of extension programs which are often criticized for the vast sums of money they cost, the constraints related to scale, and little accountability (Anderson & Feder, 2007; Aker, 2011).

Aker (2011) demonstrated that ICTs contribute to the optimization of the services offered by agricultural extension institutions. Comparing the marginal cost of an extension system for providing agricultural price information through extension worker's

visits, SMS, or a call-in hotline in Niger, Aker (2011) found that the marginal cost of delivering price information via SMS is cheaper than providing the same information via an additional visit of an extension agent and is similar to giving the same information via radio. Aker (2011) concluded that a reduction of the costs of information dissemination contributes to enlarge the geographic scope and scale of agricultural extension institutions and fosters better communication between extension workers and farmers.

ICT services for agricultural extension include voice-based information delivery services, radio dial-up and broadcasts, SMS-based information, and e-learning programs (Aker, 2011). However, the use of ICTs for agricultural extension can face several constraints (Aker, 2011). A major issue is that the appropriation of such services is dependent on the quality of the information delivered. For Aker (2011), even if the dissemination of information on market prices and weather via mobile technology can reach large constituencies and be more efficient than extension workers' visits, it needs to be accompanied with additional information on agricultural practices and inputs. Another constraint is related to the fact that SMS cannot hold large information and are only accessible to literate and technologically skilled farmers. Additionally, these services often work for the delivery of simple information but may appear limited when it comes to the exchange of complex information. Aker (2011) also indicated that voice-based services may not be easy to implement and can require machines that are capable of producing human speech.

Other constraints may also hinder a wide use of mobile apps and ICTs for agricultural extension. Etwire et al. (2017) who did a study to assess the use of mobile phone-based dissemination of weather and market information by 310 farmers in the

Upper West Region of Ghana revealed that bad network coverage and high cost of electricity for using mobile phones represent constraints to the development of mobile phone-based extension services (Etwire et al., 2017). Similarly, in a study on the use of ICTs in learning and disseminating livestock husbandry knowledge in Tanzania, Angello (2015) contended that the constraints to the utilization of mobile phone-based extension services include the high cost related to the use of mobile phone, lack of network, and poor network coverage.

Mobile Apps for Finance in Agriculture

Mobile phones are increasingly bridging the gap between urban and rural areas in terms of access to finance. Traditionally, people in rural areas often have difficulties accessing financial services that could increase their productivity. For Qiang et al. (2011), financial institutions do not often target farmers on account of the high cost of transactions and loans but also because of the difficulties related to claim management.

However, the past recent years have witnessed a surge of the concept of mobile money (m-money) which refers to the use of the mobile phone for carrying out financial transactions (IFC, 2011). Various mobile money initiatives have been developed in Third World countries and particularly in Africa, allowing people with mobile accounts to add credit to their accounts, keep it for later use or send it via SMS to other mobile subscribers who can turn it into cash (Must & Ludewig, 2010; Abunyang, 2007). Mobile money allows users to carry out financial transactions quickly and easily and to avoid physical travels and the high costs of traditional wire transfer services (Must & Ludewig, 2010). Scholars have found that mobile money facilitates money transfer between

partners, reduces transaction costs, and contributes to a promotion market exchange (Kikulwe, Fischer, & Qaim, 2014).

Using panel survey data and regression models, Kikulwe, Fischer, and Qaim (2014) who analyzed the impact of mobile money on the welfare of smallholder farmers in Kenya, revealed that mobile money has a positive impact on household income. This improvement in household welfare is achieved through remittances that smallholder farmers receive from friends and relatives. The authors argued that these remittances have a direct impact on income and at the same time, contribute to the promotion of agricultural marketing through a reduction of risk and liquidity issues. Kikulwe, Fischer, and Qaim (2014) also contended that, contrary to farmers who do not use this technology, smallholders who access mobile money are in a position to use more farm inputs, market their production at a large level, and gain better profit. The authors concluded that mobile money alleviates financial concerns, one of the major challenges to market access for smallholder farmers (Kikulwe, Fischer, & Qaim, 2014).

Mobile money also operates as a tool for the promotion of agricultural investment. Batista and Vicente (2019), who conducted a field experiment introducing a remunerated mobile money saving account to smallholder farmers in rural Mozambique, found that access to the mobile savings account increased the amount of money saved, at least if interest is paid on mobile money balances. Batista and Vicente (2019) explained that part of this increase stemmed from the rise in the transfers that the smallholders receive, particularly through mobile money. The authors concluded that these savings foster agricultural investment and particularly the purchase of fertilizers which increased by about 30 percentage points.

In Africa, the first mobile money application to be introduced is the Kenyan model M-Pesa launched in 2007 by Safaricom, the country's largest mobile network. The service allows subscribers to deposit money in an account that they store in their mobile phones, to send balances via SMS to other users, and to redeem the deposits for money. The company deducts charges from the users' accounts anytime they send money or withdraw cash (Jack & Suri, 2011). Adopted by a large majority of the adult population in Kenya, the M-Pesa model has been replicated in other Africa countries. In a study carried out in rural Uganda, Murendo and Wolni (2016) declared that the use of mobile money contributes to food security. The authors indicated that the use, frequency of use, and volumes of mobile money transfer are associated with rises in food expenditures. Similarly, Awunyo-Vitor (2016) who did a study in Ghana found that convenience, speed, reliability, and security represented the main factors for successful mobile money services. The author also revealed that the level of formal education and financial literacy ranked among the factors that drive mobile money services demand by farmers in Ghana.

In addition to information, market, agricultural extension, and financial services, Lohento (2020) found that there are other apps related to blockchain technology, a service that is quite new in Africa. Blockchain is a decentralized system of transaction records operated by a network of computers or databases. With this system, if a farmer who is in a supply chain or contract farming, brings his or her production to an aggregator, the latter can easily answer the producer's request and the producer receives payment without delay. For Lohento (2020) blockchain technology ensures more efficiency and more transparency through the use of devices that allow to spatially and

temporally trace the movement of agricultural products from the producers to the consumers.

Gender and ICTs

The issues of gender and power relations are often overlooked in the analysis of the potential of ICTs in development processes. Alzouma (2005), and Steeves and Kwami (2017) argue that ICTs are often praised as value-free implements, empowering tools that allow to address social inequality, without a critical study of the people who are empowered and those who become disempowered. A key issue is that the discourse around ICT4D does not deal with gender disparities that stem from the diffusion of ICTs. Alzouma (2005) points out that policymakers, and specially development agents rarely admit the gendered dimension of technology. The general public is often called to consider that technology is neutral and represents a sort of independent area which evolves in its own pathway without any connections with societies and social stakes. For Alzouma (2015), under this view, the prevailing opinion is that social divisions, categories, and identities have no impact in the introduction, reception, and appropriation of technology.

According to Steeves and Kwami (2017), the result of this position about value-neutral technologies is that ICT4D projects and discourses fail to address issues of power relations regarding access, adoption, use, and appropriation of technology. Steeves and Kwami (2017) contend that the failure to interrogate power and the way it plays out in the spheres of policy and practice hinders girls' and women's active engagement in ICT4D both at macro and micro levels. Because of the lack of gender analysis in most ICT4D

projects, such projects fail to take into consideration the needs of all the members of the communities.

Recent studies stress on the existence of a digital gender divide which relates to the ways men and women differ in their relationships with ICTs (Huyer & Sikoska, 2003; United Nations, 2005; Alozie & Akpan-Obong, 2017). One point is related to the fact that there is disparity in ICT access and use, and this is generally in favor of men. The second aspect is related to the sociology of ICTs and the fact that ICT leadership and decision-making, content and applications determination are issues controlled by men and organized to concur with men's worldview (Alozie & Akpan-Obong, 2017). As far as the Internet is concerned, Joiner, Stewart, and Beaney (2015) who report a series of studies carried out over 10 years, establish differences between what they call the primary gender digital divide and the secondary gender divide. The primary gender digital divide is related to the access to Internet and the secondary digital divide refers to Internet use by men and women. The scholars conclude that, even though the divide in terms of access to the Internet has disappeared over the last 20 years, the secondary gender digital divide in Internet use has persisted over time and across different technologies.

For their part Kennedy, Wellman, and Klement (2003) contend that even if the percentage of women online in North America is quite equal that of men, gender continues to have an impact on how the Internet is used, and the average woman has less experience online and is more concerned about safety. The authors contend that gender roles and domestic responsibilities (such as housework and care giving to children and spouse) in the home shape how much time women spend online.

These findings are confirmed by the 2018 report of the Organization for Economic Co-operation and Development (OECD). Among other findings, the report revealed that gender divide in Internet use is widening. Although the global digital gender divide in Internet usage remained unchanged between 2013 and 2017, at about 11%, there is an increase in the gap between developed and developing countries and this is driven by the gender Internet usage gap of 3 percentage points in least developed countries (LDC) and 4 percentage points in Africa. The report also revealed that in low- and middle-income countries, only 10% of women own a basic mobile phone with 9% in the Middle East and North Africa, -2% in Europe, and Central Asia, 2% in East Asia and Pacific, 2% in Latin America and Caribbean, 14% in Sub-Saharan Africa, and 26% in South-East Asia. When it comes to smartphone ownership around the world, the share of females is 26% with 21% in the Middle East and North Africa, 4% in Europe and Central Asia, 4% in East Asia and Pacific, 4% in Latin America and Caribbean, 34% in Sub-Saharan Africa, and 70% in South-East Asia (OECD, 2018).

In its 2017 report, the International Telecommunication Union (IUT) revealed that the proportion of women using the Internet is 12% lower than the proportion of men using the Internet worldwide. The report noted the gender gap has widened in Africa where the number of women using the Internet is 25% lower than that of men. In least developed countries, only one out of seven women is using the Internet compared with one out of five men (IUT, 2017).

In their study on the digital gender divide in Africa, Alozie and Akpan-Obong (2017) found strong evidence of the existence of disparities between men and women in access and use of technology. They argue that the variables that explain the digital gender gap

include differential returns for men and women in areas such as education, socio-economic status, domesticity, and traditionalism. Similar findings were made by Hilbert (2011) who did a study in 12 Latin American countries and 13 African states and revealed that women have less access to technologies compared to men, which stems from their unfavorable conditions related to employment, education, and income. When controlling these variables, women tend to show more activity in the use of digital tools than men. On account of women's affinity with ICTs, and the ability of digital technologies to improve people's living conditions, Hilbert (2011) found that ICTs represent opportunities for tackling challenges of the gender divide in developing countries, including access to employment, income, education, and health services.

Many studies consider that ICTs have direct impact on women's empowerment (Badran, 2015; Maier & Nair-Reichert, 2008; Jagun et al. , 2008; United Nations, 2005). Scholars see ICTs as remarkable tools for inclusive development strategies, which not only expand the power of knowledge but also have the potential of transforming women's rhetoric into reality (Huyer & Sikoska, 2003). Huyer and Sikoska citing Mijumbi (2002) explained how a Uganda CD-ROM project allowed women to be more confident, more knowledgeable, more prepared to experiment new approaches for reducing poverty. Similarly, Abubakar and Dasuki (2018) who studied the use of WhatsApp by women in Nigeria revealed that the use of mobile phones allows women to expand income generation, increase saving opportunities, as well as enlarge their businesses. The use of mobile phones also provides women with social opportunities to enhance their information capabilities. For Abubakar and Dasuki (2018), WhatsApp contributes to an improvement of women's media literacy and helps them gain

knowledge in the areas of health and education. Additionally, women's use of WhatsApp not only gives them a sense of belonging within the community, but it also provides them opportunities to generate economic capabilities via employment and business. The mobile app also operates as a tool that contributes to the freedom of women to participate in social, economic, and political activities.

However, the positive impact of ICT use on women's condition is often contested. Chew, Levy, and Llavarasan (2010) who carried out a survey of women micro-entrepreneurs in Mumbai, India contended that, despite the positive impact that ICTs have on small businesses headed by women, there exist specific dynamics that hinder productivity. They asserted that adding mobile phones, computers, and Internet access to a microenterprise might increase profits and the number of hired workers, but only minimally. The scholars also revealed that mobile phone access alone does not produce business growth. The study showed that fewer than 10% of women who owned microenterprises consistently used their mobile phones to conduct business. In order to allow ICTs such as mobile phones to have an impact on business growth, it is necessary for female microentrepreneurs to use ICTs much more frequently and intensively in their businesses. Similarly, Dasuki, Abott, and Azerikatoa (2014) who did a study of the prepaid electricity billing system in Nigeria rejected the technological determinism approach and contended that there is no relationship between ICTs and human empowerment. For Dazuki et al. (2014), there is a dynamic connection between ICTs and the social, economic, cultural, and political contexts in which they are deployed.

Likewise, Masika and Bailur (2015) who did a comparative study of the use of ICTs by women in Uganda and India found that there is no evidence that ICTs easily empower women or achieve greater equality and reduce patriarchy. Masika and Bailur (2015) argued that more attention should be paid to women's socio-cultural contexts and the bargains they make. A similar conclusion was made by Nyemba-Mudenda and Chigona (2017) who studied the use of the mobile technology for healthcare service delivery (mhealth) in Malawi. They revealed that factors such as age, literacy, lack of resources, poor infrastructure, religious beliefs, and position of women in society hinder the empowerment abilities of mobile phones.

These different perspectives confirm the necessity to reconsider the idea formulated by Walscham (2017) who calls for more gender-based studies with the perspective of allowing a better understanding of ICT4D.

Research questions:

Even though several studies have been carried on the use of mobile apps in agriculture in Africa, they mostly focused on English speaking countries. This study will be among the first to address this issue in Senegal. Moreover, the FAO project which is at its initial phase has not yet undergone an evaluation that would serve to provide insights to policymakers.

In this study, I intend to investigate the implementation of the project called "Agricultural Services and Digital Inclusion in Africa" and situate the problems that explain the delay in its implementation in Senegal, which led to a transfer of the initiative to the Agency for Agricultural and Rural Advisory Services (ANCAR). The objective is

to better understand the strategies implemented by the FAO in the conception, development, and implementation of the project to ensure its success. The study will therefore revolve around the following research questions:

1) To what extent is the national context of Senegal favorable to the FAO project: "Agricultural Services and Digital Inclusion in Africa??
2) To what extent is the local context of Tambacounda favorable to the implementation of the FAO project?
3) To what extent has the FAO used a top-down approach versus a bottom-up approach in the rolling out of the mobile app?

   3a) To what extent have local farmers including women been involved in the project planning?
4) To what extent does the project address farmers' local needs?

   4a) Are gender or other identity biases evident?
5) What social, cultural, political constraints explain the transfer of the project to ANCAR?

Summary

In this chapter, I have reviewed the literature related to the use of ICTs in development. It starts with a description of the various contributions of telecommunications and mobile technologies to economic growth, individual and collective livelihoods. The chapter also has offered an analysis of the impact of mobile apps on agriculture in terms of access to information, markets, agricultural extension, e-commerce, and financial services. The chapter has also discussed the major debates related to ICTs and gender before concluding with the research questions around which

this dissertation revolves. In the next chapter, I present the methods used to answer the five different research questions.

CHAPTER V

METHODS

A researcher's personal experience and training is a determinant factor in the choice of the methods of his or her study (Creswell & Creswell, 2018). I came to the Ph.D. program of the School of Journalism and Communication of the University of Oregon after over fifteen years of journalism practice at the Senegalese National Television (RTS). I started my career as a news reporter before moving forward to become news anchor and occupy different leadership positions. As it is known, the practice of journalism is essentially based on interviews with the purpose of obtaining information that serves the audience. My professional experience also includes the production of television shows that were mainly formatted around in-depth interviews. On account of this experience, I feel at ease carrying out interviews and leading focus group discussions. However, despite this preference for qualitative interviewing, I have also employed quantitative methods for the purpose of this study on account of the insights that this method provide. In this chapter, I will explain the reasons why I chose in-depth one-to-one interviews as a primary method for this case study focused on a FAO project. I will also provide insights about the addition of focus groups, a survey, and document analysis.

Case Study

A case study can be defined as a holistic investigation that explores a contemporary phenomenon in a particular context (Stake, 1995). Ylikosky and Zahle (2019) contend that a case study is always "a case of something" (p. 2). It presents the

study of something whether it is an organization, event, region, program, or a policy. The case may also be an event, a process, or a campaign. In a case study, whether it is a single or a multiple case studies, the goal of the researcher is to produce in-depth insights of the case. For Yin (2012) case studies are relevant study methods when the objective of the researcher is to find answers on "how" and "why", when the researcher does not or has little control over social behaviors, or when the study focuses on current issues as opposed to historical phenomena.

Yin (2012) explains that questions on "how" and "why" do not deal with the frequency or occurrence of a phenomenon. They rather relate to operational procedures that necessitate to be explored over time. Stake (1995) argues that in case studies, the objective is to collect detailed information and for that purpose, researchers employ a variety of data collection methods during a specific period. This use of various research tools allows investigators to focus on the case and to take a holistic perspective of the phenomenon under study.

Case study research has often been criticized for the great deal of rigor they require, the difficulty of generalization, and the long amount of time needed to carry out the research. Despite these pitfalls, Yin (2012) argues that case studies represent relevant methods for evaluation and there exist four areas where they can be applied. Firstly, case studies allow to explain the causal connections in real-world interventions whose complexity cannot be grasped through a survey or an experiment. Secondly, they provide a description of an intervention and the context in which it took place. Thirdly, by using a descriptive way, case studies offer an illustration of certain issues within an evaluation.

Fourthly, case studies contribute to highlight the situations in which the program or intervention under evaluation has not produced the expected results (Yin, 2012).

Case Selection

When designing case studies, one of the most important things is the selection of the case. Stake (2005) contends that the cases to study should be representative of the case. In my search for a dissertation topic, I had in mind to work on the field of agriculture and how new technologies could enhance agricultural productivity in Senegal. In addition to searching on the Internet, I started contacting the Ministry of Agriculture in Senegal, the Institute for Food Technology, and the Senegalese Institute for Agricultural Research via phone calls and emails to have an idea of the projects implemented in the country. At the same time, I decided to reach out to the FAO staff in Senegal with the same aim of learning about programs and projects deployed for the use of ICTs in agriculture. Not only the Senegalese institutions in charge of agriculture were very slow in providing responses to my requests, but the rare phone calls they answered made me be realized that little was done in the field of ICTs for agriculture. By contrast, the FAO staff in Senegal informed me about a project called "Agricultural Services and Digital Inclusion in Africa" that was being implemented and which could be very interesting to work on.

The first reason why I chose to study the FAO project lies in the technological innovation it entails and the new approach to development communication that it offers. In fact, traditional media such as radio and television have long been the catalysts of development in the Third World. By offering a mobile app to farmers, the UN agency outlines new prospects for development support communication. The second reason why

I decided to focus on this project is related to its objective which is to ensure digital inclusion for disadvantaged groups such as smallholder farmers. The project also pays particular attention to the youth and women who are often left out of development projects and programs. The third reason why I chose this case for a study lies in the huge ambition of the FAO which designed such a project to cover the whole continent. Even if Senegal and Rwanda were the pilot countries, the objective was to have the project replicated by other African states.

Therefore, the single case study of the FAO project is my focus for this dissertation with the main objective of exploring "how" it was implemented and "why" it did not provide the expected results. The study combines the use of in-depth one-to-one and group interviews with a quantitative survey and document analysis.

The Study Site

Tambacounda was created as a new region by Law 2008-14 of March 18, 2008 which modified Law 72-02 of February 1, 1972 related to the organization of local and territorial administration (ANSD, 2019). It covers 42,706 square kilometers and remains the largest region of Senegal. In 2016, the population of Tambacounda was estimated at 756,588 inhabitants, which represents a density of 17.7 inhabitants per square kilometer. The region has 50 local collectivities which include 46 communes and 4 departments (Tambacounda, Bakel, Goudiry, and Koumpentoum).

Located at 467 kilometers (290 miles) from the capital-city Dakar, Tambacounda is a natural crossroads bordered by the Islamic Republic of Mauritania, the regions of Louga and Matam to the North, the region of Kedougou to the South, the Republic of

Mali and the Islamic Republic of Mauritania to the East, and the Republic of the Gambia and the regions of Kolda and Kaffrine to the West (See Figure 3). For a long time, the Eastern region (in French "Senegal Oriental") was nicknamed "The forgotten Senegal" (in French *Senegal Oublié*) on account of its distance from the capital-city Dakar, its rural character, and a lack of infrastructure.

The name of the region comes from Tamba Waly, a Bamana hunter who founded the city around 1900 and first lived in the village of Tamba Soce, situated five kilometers from the actual location of the city (Pauleit, 2015). In the early 1920s, Tambacounda grew as a city with the construction of the railway Thies-Kayes by French settlers (Dupon, 1964). With the inauguration of the railway station on February 17, 1915 and the creation of a camp for railway workers, many segments of the population abandoned the Mandingo village of Tamba Soce to live near the railway station where economic activities started to thrive.

The settlement of the area culminated with the waves of migrations that followed the decline of the empires of Mali and Ghana (ANSD, 2019). Mandingo people who came from the North and the East established themselves in the Tambacounda region in the 18th Century. They arrived after other people including the Koniagui, Soninke, and Djalonke had already established roots. Most of the migrants were fleeing from Islamization wars and Kingdom conflicts that raged throughout the province. Even if Fulani and Mandingo ethnic groups were the first settlers, in the 20th Century, the region witnessed the arrival of Wolof people who mainly established themselves in the Boundou area, next to the railway line (ANSD, 2019).

For its largest part, Tambacounda is a flat zone with just some hills in the department of Bakel and small depressions made of the fossil valleys of Sandougou and Mayeldiby. The regional hydrographic network includes the Senegal, Faleme, and Gambia rivers, and several tributary streams and ponds that drain 30 billion cubic meters of water every year (ANDS, 2019). In terms of rainfalls, Tambacounda ranks among the wettest regions in Senegal where the rainy season lasts between four to five months and the South of the region receives most rains compared to the North. Known for extreme heat, Tambacounda goes through a period of low temperatures from July to February and a period of high temperatures that extends from March to June.

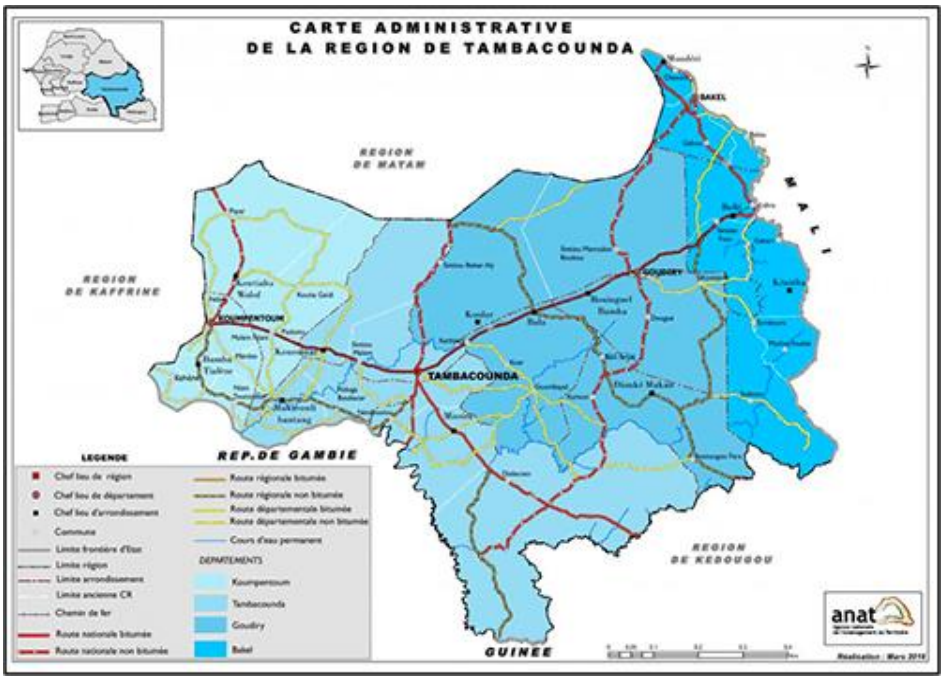

Figure 3: Map of the Tambacounda region

(Source: National Agency for Land Use Planning)

According to the National Agency for Statistics and Demography, the population of Tambacounda was estimated at 756,588 inhabitants in 2016, representing 5.1% of the total population of Senegal (ANSD, 2019). The large majority of the population (76.3%)

live in rural areas where women are outnumbered by men (ANSD, 2016). Tambacounda is an ethnically diverse region with a majority of Pular (46%) followed by Mandingo (17%), Sarakhole (11%), Wolof (9%), Serere (3%), Bambara (3%) who co-exist with other groups such as the Bassari and the Koniagui (Kpare, 2011).

On account of the high number of rainfalls in the region, agriculture has always been a sector that mobilizes large segments of the population in Tambacounda. However, because of the isolation of the region and the low number of its inhabitants, agriculture in Tambacounda has mainly been based on subsistence farming with a particular focus on millet, cassava, and corn. Contrary to other areas in the country, farmers in the region are not particularly interested in peanut production (Dupon, 1964). They rather invest in cotton and banana which remain the major specialties of the region. Even if cotton culture first started with sedentary Fulani shepherds (Dupon, 1964), it has attracted a large part of the population especially since the creation in 1974 of SODEFITEX (Societe Nationale de Developpement des Fibres Textiles), the Senegalese textile company which set up one of its major plants in Tambacounda (SODEFITEX, 2020). Additionally, clay and the loam texture of the soil combined with abundant rainfalls make Tambacounda favorable to banana growing and the region accounts for 80% of the national production (Badji, 2018; Fall, 2019).

Despite the region's potential, in recent years, a combination of different constraints led to continuous decrease in agricultural production in Tambacounda (Sidibe, 2015). The constraints that explain the downturn include the lack of motorized equipment, the difficulty to access markets because of the defective condition of the roads and the isolation of certain areas resulting from rainfalls. The impact of climate

change which causes a variation in rainfalls, lack of funding, quality seeds, fertilizers, and crop protection products represents other major constraints (ANSD, 2019).

As far as livestock is concerned, the agro-pastoral topography and the climate of Tambacounda make it an area favorable to the breeding of large and small ruminants such as sheep and goats. A key feature of the Tambacounda region is the abundance of natural resources with 11,855.59 square kilometers of forest reserve, representing 27.76% of the region. Additionally, Tambacounda is home to part of the Niokolo-Koba park, a world-heritage site known for its wildlife. The park covers an area of 913,000 ha which comprises gallery-forests, ponds, rocky slopes, and hills and counts a rich fauna which includes 350 bird species and 80 mammals, namely lions, leopards as well as elephants (au-Senegal.com, 2020). In terms of industrial production, mining activities are developing in the region with the prospection of basalt and marble deposits in the department of Bakel as well as the exploitation of phosphate and iron-ore respectively in Manael and the Faleme area (CSE, 2012).

The FAO Project Case Study

In 2017, Tambacounda was chosen as a pilot region in Senegal for the project called "Agricultural Services and Digital Inclusion in Africa" launched by the Food and Agriculture Organization. The project consisted of a mobile app with four components developed for farmers in Rwanda and Senegal. Even if Senegal and Rwanda were chosen as pilot countries, the app is designed to be adopted by other African countries. With an estimated cost of US$ 700,000, the project was scheduled to start in October 2016 and last 15 months. Of particular importance for the FAO was a participation of youth and women, with the purpose of overcoming the barriers to digital inclusion.

As explained in the proposal submitted to the donors, the criteria for the selection of the two countries (Senegal and Rwanda) included:

> existing demand for support in the development of ICTs by countries, FAO Regional initiative priorities, priorities of the UN Joint Program on rural women's economic empowerment, FAO Strategic Program 3 focus countries and close observation countries, Internet access in rural areas (FAO, 2016, p. 4).

In Senegal, the FAO project was in line with other projects already in progress in the country, which included the "Purchase from Africans for Africa" project which had the objective of developing value chains for products such as rice, maize, cowpea, and potato. Another similar initiative was the project called "Integration of climate resilience in agro-pastoral production for food security in vulnerable rural areas" carried out by the FAO through Farmers Fields Schools and Dimitra Clubs. Dimitra Clubs are FAO-established organizations that use a gender-sensitive and participatory approach to development by allowing information access and sharing as well as the use of technologies for the improvement of livelihoods within the communities. Additionally, Senegal counted many projects dealing with the marketing of agricultural products which included e-commerce initiatives for producers (FAO, 2016).

For the two countries, the FAO collaborated with local partners to develop four information services:

1) *Cure and feed your Livestock* is a content that provides real-time information and advice to livestock owners and allow them to enter information on disease symptoms on their animals and to receive information on diagnosis and cure. The sources of data included EMPRES-I and FAO database of pictures on the clinical conditions of animals. For the content, FAO referred to a software it had developed for

dairy producers and in Myanmar, Sri Lanka, and Thailand. However, the project would adapt to the needs of dairy producers in Rwanda and Senegal. In case local data were not available, the software would get information from the website Feedipedia.

2) *E-Nutritious food* is the section that offers information related to the production, conservation, and consumption of nutritious food. Through this service, the FAO intended to supplement the role of extension and community workers who are primary sources for the dissemination of best practices to farmers. In the first phase, the content would be sent as short text messages of 125 characters related to basic nutritious information that is specific to the country using data from the INFOODS databases and INPhO technical support framework (FAO, 2016). After this first phase which would be implemented in 30 days, the app would be upgraded to included other features. Initially, information for this app would come from the International Network of Food Data Systems 16, a network hosted by the FAO since 1984 and which gathers food composition experts.

3) *Weather and crop calendar* is the component designed to mitigate the effect of climate change on African farmers. It would allow access to weather forecasts, including rainfall probability, complemented later with information on crop production, water, soil, and vegetation. The FAO reckoned on its expertise, on real-time and relevant satellite information but also on its strategic partnership with Google Earth Outreach to provide information that is relevant to family farmers and contribute to women and youth empowerment. In addition to weather information, the app would include a crop calendar that gives information about more than 130 crops, from 283 areas of 44 countries,

including Senegal (FAO, 2016). The app would also give early warning about potential risks and build farmers' resilience. Data for this component would come from various sources including the World Agro-Meteorological Information Service, the World Meteorological Organization (WMO), the tropical weather forecast company Ignitia, and FAO resources such as FAO GIEWS (Global Information and Early Warning System).

4) *AgriMarketplace* is a service that was conceived to help farmers know best suppliers of products, their locations, and the prices in the market. According to the FAO, with this component, each farmer would be in a position to assess the services and quality of goods offered by suppliers and to offer products to traders and consumers. The beneficiaries of this service would include family farmers, suppliers, distributors, farmers associations as well as cooperatives, members of Farmer Field Schools and farmer promoters. In FAO's conception, data for this section would come from start-ups and businesses such as Manobi, Soreetul, Aywajjeune, Mlouma in Senegal, Esoko in Rwanda, FAO resources such as GIEWS, AMIS market outlook, Enhanced Fish Market Information Service (EMIS), but also financial services owned by local telecommunications operators such as Orange, Tigo, and Airtel as well as the UN Global Pulse (FAO, 2016).

Interviews

This study is primarily based on interviews. I have chosen to do interviews because of the quality of information that this method provides. Rubin and Rubin (1995) define interviewing as an approach to learning. It is based on the idea that understanding is achieved when people describe their worlds in their own words. In an interview every

step gives new information and opens windows in the experiences of the people that the researcher meets (Rubin & Rubin, 1995). It is a way of finding out what others feel and think about their worlds. The method allows to understand experiences and reconstruct events in which the researcher was not involved. For Rubin and Rubin (1995), through what the researcher hears and learns, he or she can extend his or her intellectual and emotional reach across time, class, race, sex, and geographical divisions.

I decided to use interviews in order to understand the origin of the project that the FAO decided to launch in Senegal. Choosing in-depth interviews represented an appropriate method that allowed me to step into the minds of the promoters of the mobile app, to experience and see the importance they give to the project and the impact it can have on users. I also considered that qualitative interviewing would facilitate an understanding of the impact that the mobile app can have on the lives of the farmers but also the constraints faced by the developers, the assumptions made by government officials, the viewpoints held by ICT specialists and start-up promoters.

For McCracken (1998), interviews allow a qualitative understanding of how culture mediates human action. It helps to know beyond what the numbers tell. Compared to surveys, qualitative interviewing helps situate the numbers in their fuller and cultural contexts. This study about a mobile app project provides an understanding of how mobile phones and apps are integrated into the farmers' lives, how they define these technologies, how they are using them and the assumptions they make about the technologies. Rubin and Rubin (1995) consider that qualitative interviewing allows researchers to share the world of others, to find out what is going on, why do people do what they do, and how they understand their worlds.

Sampling for the Interviews

The selection of participants is the step that follows the generation of a research question (Englander, 2012). At this level, Englander (2012) argues that the question that the researcher has to ask is "do these subjects have the experience that I am looking for?" The task is therefore to find and select participants who report having specific knowledge of the phenomenon.

Sampling strategies are guided by the principle of gaining rich, in-depth information. The persons selected, the places and the time depend on the judgments that the researcher makes, which are guided by the purpose of the study (Daymon & Holloway, 2002). The focus in qualitative study is not on how many people have been involved but the quality of the participants and the information they are susceptible to provide. For this study, it was clear that the FAO staff who conceived the project, the consultants who contributed to the design, the IT specialists who developed the app, government officials who collaborated with FAO in the project, and the farmers were the informants who could help answer my research questions.

I began the research process as early as October 2018. My starting point consisted in establishing contact with the stakeholders involved in the design of the project. As a matter of fact, my reference was FAO Senegal. Through referral, phone calls, and emails, I managed to reach out to the Senior Information Technology Officer of the FAO in Rome who was the main designer of the project. I personally targeted that resource person on account of his involvement in the project. For Rwanda and Senegal, that FAO officer who worked in Rome was the key resource person and played a central role in the development and rolling out of the mobile app. The first interview I did with him was

done through Skype on October 12, 2018. This initial contact interview turned around the origin of the project, the choice of Senegal and Rwanda as pilot countries, the role of local governments, the role of FAO, the choice of mobile technology instead of traditional media, the resource-persons and companies involved in the project, the participation of farmers to the project, the accessibility of the app, the cost for FAO, the cost for farmers, the period when the app will be available for use and the challenges faced in the rolling out of the app. In addition to the answers to the interview questions, the Senior Information Technology Officer provided me documents that describe the history of the project, the content of the app, the expected outputs, and the roadmap for the implementation. Additionally, I was given a link to access the content of the app online as well as the name of the consultants who worked on the project.

On the eve of my departure to Senegal in October 2019, I carried out a second interview with the FAO Senior Information Technology Officer to assess the rolling out of the mobile app. That second interview allowed me to understand that the project was facing difficulties in its implementation and was transferred to the National Agency for Agricultural and Rural Advisory Services.

On account of this new situation, I needed to address the reasons that explained the transfer of the project to ANCAR. From that perspective, it was clear that the study would use purposeful sampling, which, as mentioned by Lindoff and Taylor (2011) allows to have informed judgement about what to observe and whom to interview. Lindoff and Taylor (2011) contend that in qualitative research, people are recruited for interviewing because they have experience that are vital to our research questions, or they have specific knowledge, or they have particular stories to tell. Rubin and Rubin

(1995) explain that all the people that the researcher interviews should satisfy three requirements. First, they should be knowledgeable about the cultural arena or the situation or experience being studied. Second, they should be willing to talk; third, when people in the arena have different perspectives, the interviewees should represent the range of points of view. Purposefully, I decided to have interviews with different actors who are knowledgeable of the issue, and I developed different interview guides for them. The stakeholders I interviewed included the consultants of the project and the developers of the app, the FAO workers in Senegal, government officials, ICT specialists, ICT start-up promoters, extension workers, members of the CNCR (National Council for Rural Coordination and Cooperation) and of course, and the farmers.

The interviews with the FAO staff, the consultants and the app developers provided insights on the strategies used by the FAO for the development and implementation of the project. They also gave clear knowledge about the involvement of national stakeholders in the rolling out of the app. The interviewees explained the process employed for a participation of the farmers to the project as well as the main constraints they had to overcome.

The interviews with government officials informed about the national ICT policy, the Digital Senegal Strategy, the development of ICT infrastructure, the terms of reference for telecommunications operators, the access of Senegalese citizens to ICTs, and the promotion of ICTs for agriculture. They also shed light on major challenges facing the telecommunications sector and how the government intended to address them.

The interview with the DAPSA official gave information on the use of ICTs for the provision of statistical data regarding agricultural production. In addition to

explanations regarding the platform *Survey Solution*, the interviewee expounded on the implementation of the project "e-Subvention" (e-subsidy in English) conceived by the Ministry of Agriculture and its partners for tracking the provision of subsidized inputs to farmers. The interview also allowed me to understand the involvement of the Ministry of Agriculture in the FAO project and the structural factors that explained the delay in the rolling out of the mobile app.

The interviews with the Horticulture Director and the Livestock Director described the different projects initiated for the use of ICTs in the sectors of horticulture and livestock. At the department of Livestock, in addition to the Director, I also interviewed the ICT specialist. They both provided information about the involvement of the Department of Livestock in the FAO project.

The Head of the Weather Information Service at the National Agency for Civil Aviation and Meteorology (ANACIM) explained the use of ICTs for weather forecasts and gave insights about the strategies used by ANACIM for providing real-time weather information to farmers, cattle-breeders, and fishermen. As the focal point of ANACIM for the FAO project, the interviewee also talked about the participation of the national weather service to the project and the lessons learned from the initiative.

With ICT specialists and start-up promoters, I used snowball sampling also known as chain referral and which consists of finding a participant through another (Daymon & Holloway, 2012). ICT specialists provided insights about the state of affairs of ICTs in Senegal, the different stakeholders, the current ICT policy, the priority areas of ICT policy, regional and gender equality in ICT policy, and the challenges related to the development of ICTs (See Figure 4). As for the start-up promoters, in addition to

expressing their opinions about the FAO project, the interviewees shed light on their motivations for investing in the agricultural sector, their achievements, and the difficulties they face.

Figure 4: Interview with an ICT specialist

(Source: Layire Diop)

With the Director and the Partnership Manager of the National Agency for Agricultural and Rural Advisory Services (ANCAR), the interviews focused on the mission of the agency, the promises of digital technology use in advisory services, the inception of the project e-Conseil (e-Advice*)* as well as the transfer of the FAO project to ANCAR.

Moreover, I decided to have an interview with the Manager of Afrinnovations which is the company that collaborates with ANCAR in the new project. The interview provided information about the activities of the company related to the development of applications such *Aar Sa Toll* for protecting crops against disease, or *Naatal Sa Toll* for production management. The interviewee also provided information about the partnership between ANCAR and the FAO.

Sampling in Tambacounda, the Site of Study

As mentioned by Daymon and Holloway (2012), sampling decisions include *where to sample* (the level and site of the study), *what to sample* (the time period, activities, events, processes, and issues), and *whom* or *what to sample* (at the micro level, the group of people, or cluster of materials or artefacts). For Daymon and Holloway (2012), the most important sampling unit is people, and the sampling dimension related to them is the extent of their experience of the phenomenon under study (people with certain roles, people with experience). In my research, the people for whom the mobile app was designed represented important sources of information. Thus, I travelled to Tambacounda, the region chosen as the pilot area for the FAO project in order to meet the farmers and I used the technique of homogenous sampling which consists of recruiting individuals who belong to the same subculture or group and have similar characteristics. In homogenous sampling, the sample may be homogenous with respect to a certain variable only, for instance occupation, length of experience, age, or gender. In this study, the activity of farming and involvement in the FAO projects were the main criteria for sampling.

Thanks to a collaboration with FAO staff and the consultants, I was able to access the lists of farmers chosen as testers of the mobile application. These farmers participated in the different workshops organized by FAO for ensuring an ownership of the app by the potential beneficiaries. According to FAO sources, 50 farmers with an equal number of men and women were targeted as testers for the project. For the purpose of my study, I selected ten men and ten women among the testers for in-depth interviews, but I only managed to interview seven men farmers and five women.

The first part of the interviews with farmers turned around the place of agriculture in their lives. They explained what brought them in the agricultural sector, the number of years they have been practicing agriculture, as well as the difficulties they are facing. In the second part of the interviews, I asked question related to their communication patterns. The farmers expounded on their sources of information, the types of information they mostly look for, the benefits they get from each category of media (radio, television, Internet, computer, mobile phone). In the third part of the in-depth interviews, the farmers focused on the FAO project. They gave their opinions about the project, the extent to which the mobile app reflected their needs, the impact the project could have on their personal lives and on their communities. In the fourth part of the interviews, I asked the farmers questions related to their involvement in project and the extent to which their ideas and opinions were taken into consideration. In the last part of the interviews, the farmers explained the way the project could foster their empowerment, and they also stressed the challenges related to the use of mobile apps in agriculture.

In Tambacounda, in addition to the farmers, I also carried out interviews with other resource-persons who either were involved in the FAO project or occupied leadership positions in the region. The persons interviewed included the Governor of the region, the Regional Director for Rural Development, the Chairman and the Land focal point of the Regional Council for Rural Cooperation, as well as two extension workers. The governor of the region provided insights about the economic and social situation of Tambacounda (See figure 5). He also stressed on the programs implemented by the government to foster regional development.

Figure 5: Interview with the Governor of Tambacounda

(Source: Layire Diop)

With the Regional Director for Rural Development, the focus was on the state of affairs of agriculture in Tambacounda (See Figure 6). The interview shed light on the potential of the regions in terms of agriculture, access to land, equipment, and inputs for farmers but it also addressed the impediments to agricultural development. The interviewee also gave a snapshot of the different projects implemented in the agricultural sector. Tracing the start of the pilot phase of the FAO project, he provided information about the procedure used by the promoters, the choice of farmers as testers, the organization of training sessions for the farmers, and the impact the project could have on the agricultural sector.

Figure 6: Interview with Tambacounda Regional Director for Rural Development (Source: Layire Diop)

The interviews with members of the Regional Council for Rural Cooperation added information about the situation of agriculture in the region, farmers' access to land, equipment, and inputs. They also provided a grasp of the information needs of farmers, their sources of information, their use of mobile technologies. The interviews also uncovered the impact the FAO project could have in farmers' activities and the involvement of local population in the project. With the two extension workers, the interviews turned around their daily work, the challenges that had to overcome, their opinions about the FAO project, their involvement in the project, the potential that the app has for farmers but also for extension workers.

In addition to the resource persons who worked on the FAO project in Senegal, I found it useful to have an idea of the implementation of the same project in Rwanda. For that purpose, I carried out a phone interview with of one of the consultants of the project

in Rwanda. The interview on WhatsApp turned around the choice of Rwanda for the project, the role of local officials, app developers and telecommunication companies. The interviewee also described the differences between the design of the app for Rwanda and Senegal as well as the strategies employed by the FAO for the implementation of the project. The dialogue with the Rwandan participant also provided information about the satisfactory results that the project had achieved.

All these various in-depth interviews allowed me to address the five research questions of the study. A total of 58 persons were interviewed in three different languages. I used French to carry out interviews with FAO staff, the consultants, the app developers, government officials, ICT specialists, extension workers and start-up promoters. However, with the farmers, except for one who speaks French, all the interviews were done in local language Wolof while I used English to interview the FAO senior IT specialist and the Rwandan ICT consultant who received the digital copy of the consent form and agreed to participate. During the fieldwork, the participants with a good literacy level read the consent form in French before signing. As for the farmers who are illiterate, I fully explained the objective of the study and their consent was obtained as required by the IRB approval. The interviews were tape recorded, transcribed and translated into English.

Focus Groups

Morgan (1996) defines focus groups as a research technique that collects data through group interaction on a topic determined by the researcher. This definition highlights three essential elements. First, focus groups constitute a research method devoted to the collection of data. Second, it stresses the interaction in a group as a source

of data. Third, it recognizes the researcher's active role in creating the group discussion for collecting data.

I have decided to combine one-to-one interviews with focus groups on account of the benefit that can be derived from this approach. According to Morgan (1996), the reasons for combining individual and group interviews are related to the greater depth of the former and the greater breadth of the latter. Individual interview studies have used follow-up group interviews to check conclusions from their analyses and to expand the study population included in the research. This allows to get reactions from a wider range of participants in a relatively short time. Focus groups studies have used follow-up interviews with individual participants to explore specific opinions and experiences in more depth. This allows to first identify a range of experiences and perspectives, and then to draw from that pool to add more depth where it is needed.

For some scholars, individual interviews can be a more effective technique than focus groups for idea generation (Fern, 1982; Morgan, 1996). The presence of other people may inhibit individuals participating in group discussions (Fern, 1982). However, focus groups provide insights into the sources of complex behaviors and motivations. This advantage is an outcome of the interaction in focus groups, also known as the group effect. Agar and MacDonald (1995) postulate that the difference between interviews and focus groups is that the focus group members talk with each other in addition to the interviewer.

For Morgan (1996) and Fern (1982), what makes the discussion in focus groups more than the sum of separate individual interviews is the fact that the participants both query each other and explain themselves to each other. Such interaction offers valuable

data on the extent of consensus and diversity among the participants, and constitutes a strength of focus groups. Frey and Fontana (1993) consider focus groups as a source of validation of events observed and individual interview data. According to Morgan (1996) another strength is related to the researcher's ability to ask the participants themselves for comparisons among their experiences and views, rather than aggregating individual data in order to speculate whether or why the interviewees differ.

Among other advantages of focus groups, Frey and Fontana (1995) mention that this technique is not costly compared to face-to-face interviews because more persons are interviewed together. It represents an excellent mechanism for bringing the researcher to even more respondents; it is flexible and permits considerable probing. Focus groups can also provide insight for the researcher into the nature of relationships in the field (for example power differential or friendship patterns) that might otherwise not have been discernible through observation and interviews. Through the non-verbal actions of the respondents and the relations of the group members, the field researcher learns a lot about the social relations that exist beyond the group. Therefore, focus groups can provide the fieldworker with a greater depth of understanding about the field context and about the relations of the members of a particular setting.

For Frey and Fontana (1995), focus groups take advantage of group dynamics, provide insight into social relationships in the field, reduce distance between the researcher and the social context, and reduce total cost. They can also stimulate new ideas, identify language or symbols that were not previously acknowledged, serve as a testing ground for hypotheses or analytic suggestions, and expand the depth and variation in responses or descriptions of relevant social events (Frey & Fontana, (1995).

Comparing individual interviews to focus groups, Stewart, Shamdasani and Rook (2007) mention synergism, snowballing, stimulation, security, and spontaneity as the major advantages of the respondents' interaction. Synergism means that the combined effort of the group will produce a wider range of information, insights, and ideas that will the cumulation of individual interviews. Snowballing suggests that a bandwagon effect often operates in a group interview in that the comment made by one individual often triggers a chain of responses from the other participants. Stimulation refers to the fact that in general, after the introduction by the moderator, the respondents get 'turned on', in that they want to express their ideas and their feelings as the excitement over the topic increases. Security means that the participant is likely to be candid because the focus is on the group and not on the individual; what the participant says is not identified with him or her. Spontaneity refers to the fact that no individual is required to answer any given question in a group interview; so, individual responses can be more spontaneous and less conventional, and should provide a more accurate picture of the person's opinion about some issue (Stewart et al., 2007)

For all these reasons, I decided to combine focus groups with interviews in order to have more depth and breadth about the implementation of the FAO project. Another reason is that focus groups help me in testing the reliability of the individual statements made by the farmers in the in-depth interviews.

I opted for convenience sampling which is considered as the most common method for selecting participants in focus groups (Stewart et al. (2007). This kind of sampling allows the researcher to save time and money. The group must be representative of the whole population. In my study, I organized focus groups with the farmers who

participated as testers of the app and took part to the workshops organized by the FAO staff. This sampling of the focus groups is based on a process of segmentation which consists of creating groups that are as homogenous as possible by sex, age, marital status, and geographical location. In this study since gender difference is an issue of interest, I conducted discussions with separate groups of men and women (See figures 7, 8, 9, 10, 11, and 12). For Morgan (1996), segmentation offers two basic advantages. It builds a comparative dimension into the research project, including the data analysis. Moreover, segmentation facilitates discussions by making the participants more similar to each other.

The members of the focus groups were drawn from the testers and five men and five women accepted to take part to the discussions. They came from the municipalities of Sinthiou Malem, Koussanar, and Tambacounda. The discussions took place at the Senegalese Regional Radio Station, RTS Tamba. My status as former employee of RTS explained why the authorities of the station gave me the authorization to organize the focus groups in the studio of the regional radio in Tambacounda. RTS Tamba appeared as a convenient place to host the focus groups not only because it was a well-known site for the participants, but it also offered the facilities for recording the discussions. I conducted the focus groups in Wolof, one of the most spoken languages in the area. The focus groups discussion with the men farmers lasted 1 hour and 41 minutes whereas with the women, the duration was 1 hour and 11 minutes.

I started the discussion by introducing myself and explaining the purpose of the meeting. I then asked each participant to introduce themselves, tell their village of origin, and talk about their activities. The first two questions of the discussion focused on the

main challenges of the agricultural sector in the region of Tambacounda and the actions taken by the government to face the challenges. This paved the way for talking about the potential that new technologies offer to the agricultural sector. The third and the fourth questions dealt with the extent to which new technologies help farmers in their activities and I also asked to what extent technologies (radio, television, computer, mobile phone) are relevant to their work. The next part of the discussions (question 5 to 12) focused the FAO project, the different four content of the mobile app and the extent to which the app meets the farmers' needs.

After this section, the participants were asked questions about their involvement in the project. They talked about the way they were selected as testers, their participation to the training workshops, and the approach taken by the promoters of the project. The next questions dealt with the involvement of women in the project and the extent to which the project could lead to empowerment. The final questions were related to the weaknesses of the project, the challenges associated with the use of mobile apps in rural areas, the delay in the implementation of the FAO project, and the decision to transfer it to ANCAR which will roll out the app in another region instead of Tambacounda. After the focus group discussions, the participants were given an amount of money representing their transportation fee.

If for the one-to-one interviews some were done in French and others in local language Wolof, for the group groups, the discussions were only carried out in Wolof. As was the case for the interviews, all the focus group discussions were then transcribed manually and translated into English.

Figure 7: Women focus group at Tambacounda RTS station
(Source: Layire Diop)

Figure 8: Men focus group at Tambacounda RTS station

(Source: Layire Diop)

Figure 9: Principal investigator and women focus group participants

(Source: Layire Diop)

Figure 10: Women participating to the focus group discussion
(Source: Layire Diop)

Figure 11: Men participating to the focus group discussion

(Source: Layire Diop)

Figure 12: Principal investigator and men focus group participants
(Source: Layire Diop)

The two focus group discussions allowed me to address Research Question 2 (RQ2)"To what extent is the local context of Tambacounda favorable to the implementation of the FAO project?", Research Question 3 (RQ3) "To what extent has the FAO used a top-down approach versus a bottom-up approach in the rolling out of the mobile app?", Research Question 3a (RQ 3a) "To what extent were farmers, including women involved in the project planning", research question 4 (RQ4) "To what extent does the project address the farmers' local needs?", and Research Question 4a (RQ4a)"Are gender or other identity biases evident".

Survey

Surveys are quantitative methods used for collecting information with the objective of comparing people's opinions, attitudes, and behaviors. Fink (2003) considers that seven activities are included in a survey: a definition of the objective of the data collection, the design of the study, the creation of a survey instrument that is reliable and valid, the distribution of the survey, the analysis of the survey data, and the report of the findings.

In my study, the objective of the survey was to provide a snapshot of the use of mobile phones in rural areas. I considered that, before analyzing the relevance of the FAO project, it would be important to have an idea of the use of mobile phones in the target zone. In this sense, the survey would help address Research Question 2 (RQ2) "To what extent is the local context of Tambacounda favorable to the implementation of the FAO project?". From that perspective, I designed a study for the districts of Koussanar, Missirah, and Tambacounda where farmers had been selected by the FAO staff to be testers of the project.

On account of the interest given to gender by the FAO project, I decided to survey an equal number of men and women. My first aim was to administer 100 questionnaires in the three districts. However, I chose the number of questionnaires to distribute based on the population of each district. According to the figures released by the National Agency for Statistics and Demography in 2013, the district of Tambacounda has a number of population of 107, 293 that is twice higher than the number of inhabitants in Koussanar which is estimated at 26,362 and that of Missirah which is 41,659 inhabitants (ANSD/SRSD, 2013). Even if the figures might have evolved, I assumed that Tambacounda, which is the capital city of the region still has more population than the rural municipalities of Koussanar and Missirah. Therefore, I decided to distribute more questionnaires in Tambacounda where 50 farmers were then surveyed (25 men and 25 women). To make the number of questionnaires even in the two other districts, I chose to distribute 52 questionnaires in Koussanar and Missirah with 26 questionnaires for each district. In each of the two districts, 13 men and 13 women were chosen. The respondents who understood French gave a written consent before answering the questions. As for the respondents who were illiterate, the consent form was translate into Wolof before they agreed to participate. A total number of 102 questionnaires were administered face-to-face to 51 men and 51 women.

Table 1: Demographic Profile of the Survey Respondents

Gender	
Female	51(50%)
Male	51(50%)
Age	
Less than 25 years	4 (3.9%)
Between 25 and 35 years	38 (37.3%)
Between 36 and 45 years	31 (30.4%)
Between 46 and 55 years	20 (19.6%)
Between 56 and 65 years	9 (8.8%)
Marital Status	
Single	9 (8.8%)
Married	84 (82.4%)
Divorced	2 (2.0%)
Widow	7 (6.9%)
Education in French	
None	61 (59.8%)
Primary school	23 (22.5%)
Secondary school	15 (14.7%)
Post-secondary	2 (2.0%)
Other	1 (1.0%)

Table 2**: Literacy of Survey Respondents in native language**

Can read or write in native language	
No	72 (70.6%)
Yes	30 (29.4%)

The survey started with a question about the economic activity of the respondent. More precisely, the first question asked whether the respondent was a farmer or not. In case, the answer was no, the respondent stopped answering the questionnaire. Therefore, only respondents who defined themselves as farmers answered the questions. The

following questions asked about the number of years the person had been farming, if they own a crop land or not, and the size of the land. After these opening questions, the farmers provided information about their use of mobile phone, the type of phone they have, the functionalities in the mobile phones (voice call, SMS, camera, etc.) and the frequency of use of these functionalities.

In the next section of the questionnaire, the respondents gave information about their primary usage of mobile phones, their access or not to the Internet, their main sources of information, and what they considered as the major challenges to the use of mobile phones in rural areas. I then introduced questions related to the FAO project. The objective was to know whether the farmers were aware of the project and if they were ready to pay in order to access information on agriculture in their mobile phones. The last section of the survey asked questions about the respondents' level of education, literacy in national language, gender, marital status, age, and place of residence.

In Tambacounda, I hired three survey administrators and held one-day training sessions with them at RTS Tamba, the regional station of the National Radio. The objective was to clarify all the questions with them and avoid any ambiguity. At the end of the session, the survey was pre-tested with farmers who visited the central market of Tambacounda. The lessons learned from the test allowed me to bring some changes in the layout and the formulation of certain questions. After finalizing the questionnaire, the survey was administered orally, in Wolof language in the villages of the different districts. It took about 20 minutes to farmers to finish answering the questions. Each of the participants signed a sample of the consent sheet. The 102 questionnaires that were administered were later analyzed using the software SPSS.

Document Analysis

Yanow (2007) offers a thorough description of the insights that a researcher can get from the analysis of documents and states that:

> Document reading can also be part of an observational study or interview-based project. Documents can provide background information prior to designing the research project, for example prior to conducting interviews. They may corroborate observational and interview data, or they may refute them, in which case the research is 'armed' with evidence that can be used to clarify or perhaps, to challenge what is being told, a role the observational data may also play (p. 411).

For Wimmer and Dominick (2011), the documents that researchers can refer to can be public or private. Reports released by the police, stories in newspapers, archival data rank among public documents. Websites, blogs, newsletters published by companies, wall graffiti, and posters are also documents in the public domain. As for private documents, they include "personal letters, diaries, memos, faxes, emails, home movies and videos, telephone logs, appointment books, reports, and so on" (Wimmer & Dominick, 2011, p.131).

Scholars argue that document analysis is often used in qualitative research with the aim of triangulation, the use of different methods to study the same social fact (Bowne, 2009). Triangulation helps researchers to verify data and avoid being biased (Bowen, 2009). However, the researcher should always question the credibility and authenticity of the documents and for Macdonald and Tipton (1993), it is important to use documents with caution as would do a detective "in the sense that everything is potentially suspect, and anything may turn out to be the key piece of data" (p. 193).

For the purpose of this research, I decided to refer to a series of documents that allowed to capture the inception of the FAO project, its implementation and evolution. I

proceeded to a systematic review and evaluation of those documents for a purpose of gaining knowledge of the project. The documents I analyzed include the FAO website, documents on the project produced by the FAO, reports released by official partners, news stories on the project published on the Internet, and policy documents on ICTs in Senegal. With the delay in the rolling out of the mobile app, the analysis of documents produced by the FAO provided more visual knowledge about the design and content of the app than the in-depth interviews. As a methodological tool, the analysis of documents allowed me to address Research Question 1 (RQ1) "To what extent is the national context of Senegal favorable to the FAO project "Agricultural Services and Digital Inclusion in Africa?", Research Question 3 (RQ3)"To what extent has the FAO used a top-down approach versus a bottom-up approach in the rolling out of the mobile app?", and Research Question 5 (RQ5) "What social, cultural, and political constraints explain the transfer of the project to ANCAR?".

Data Analysis

For the purpose of this study, I used a mixed methodology that combined document analysis, survey, in-depth interviews, and focus groups. The use of multiple methods also known as triangulation was motivated by an attempt to better capture the phenomenon under study. Denzin and Lincoln (2005) assert that triangulation does not just help validate the data but it rather "adds rigor, breadth, complexity, richness, and depth to any inquiry" (p. 5). Triangulation also confers reliability to data in qualitative research (Denzin & Lincoln, 2005). With case studies, triangulation is seen as a way to contribute to a clarification of meanings "by identifying the different ways the case is seen" (Denzin & Lincoln, 2005, p. 454). It is also conceived as "a validity procedure

where researchers search for convergence among multiple and different sources of information to form themes or categories in a study" (Cresswell & Miller, 2000, p.126). In this particular study, I used triangulation with the objective of providing trustfulness to the research and its findings. I also addressed the issue of reliability in the data collection by ensuring that the respondents answered the same questions based on their occupation and knowledge of the project.

If for the document analysis most of the information was in English and French, I had to use three different languages (English, French, and Wolof) to collect data through a survey, interviews and focus groups. Consequently, for the data that were expressed in Wolof and French, I had to do the transcription in French before translating into English. The reading of the full transcriptions allowed me to grasp the main trend of the different narratives. In this reading exercise, I started by using a pencil and underlining the major ideas that emerged from the data. I first strived to find short codes that reflected the meaning of each segment of the interviews and focus groups transcripts. This search of meaning involved "breaking data down into bit, and then 'beating' the bits together (Dey, 1993, p.31). I engaged in a close study of the data by processing with a line-by-line coding. After reading and annotating the transcripts, I compared the narratives of the farmers, ICT specialists, project consultants, app developers and others in search of similarities and contrasts. For the specific case of the farmers, I compared their accounts in the interviews and focus groups with the results of the survey data either for validation or for finding contradictions. With the importance given to gender equality in the FAO project, I also took into consideration that aspect in the data analysis. Not only did I strive to have an equal number of men and women farmers in the survey (51 versus 51), in-

depth interviews (7 men versus 5 women), and focus group discussions (5 men versus 5 women), but I also analyzed the data comparing the narratives of women and the accounts made by men.

After looking for short codes that were reflected through the narratives and documents, I decided to group them into categories that enabled to reduce the number of data to analyze. Later I grouped the ideas into themes referring to major elements of the analysis. As Saldana (2009, p. 13) puts it, a theme represents "an outcome of coding, categorization, and analytic reflection". As for the quantitative aspect of this study, the survey questionnaires were coded and analyzed with SPSS. The analyses included the generation of frequencies and means to determine aspects such as ownership of land, years of farming, and ownership of mobile phones. T-test and chi-square analyses were used to differentiate between men and women in terms of land ownership, mobile ownership, mobile phone usages, etc. Even if it is drawn on a small convenient sample that cannot be generalized, the survey provides an illustrative picture of the 102 participants who answered the questionnaire. Although many of the respondents agreed to be named, I decided to anonymize all the participants of the study for more consistency.

Summary

In this chapter, I have described the methods used for studying the implementation of the FAO project in Senegal. As a single case study, the research employed a mixed method approach with the purpose of gaining thorough knowledge of the inception of the project, its development, and the constraints that hindered its performance. In addition to a survey that provides a snapshot of the use of mobile phones

in rural areas, I analyzed documents that detail the origin of the project, its objectives, and the expected results. In-depth one-to-one interviews with the stakeholders and group discussions with the potential beneficiaries shed light on the promises of the mobile app for agricultural development and the pitfalls that need to be overcome. In the next chapter, I will introduce the first findings of the study.

CHAPTER VI

FARMERS, ICTs, AND AGRICULTURAL PRODUCTION IN SENEGAL

The chapter addresses Research Question 1:

RQ1: To what extent is the national context offers an environment that is favorable to the implementation of the FAO project.

The findings are drawn from policy documents and interviews with state officials, ICT specialists, and start-up promoters. The chapter opens with a description of the development of ICT initiatives launched by state authorities to facilitate e-governance in Senegal. I explore various projects under the ambit of the ADIE and give insights of the situation of the telecommunication sector through an analysis of the role of the ARTP . Next, I report my findings regarding the specific agricultural sector programs being rolled out in the country and end the chapter with an overview of the activities developed by start-ups and the pitfalls that the promoters encounter.

ICTs for Governance

In *Le Mandat*, one of the first African movies produced in the national language, Senegalese novelist, and filmmaker Sembene Ousmane describes the misadventures of Ibrahima Dieng, a poor, unemployed, husband of two wives, and father of seven children. Dieng who lives in a disadvantaged district of the capital city, Dakar receives a money order from his nephew who migrated to France. In addition to the description of the post-colonial issue of migration, the movie which was first released in 1968 highlight the hassles that Senegalese citizens have been facing since the country became independent in 1960.

The plot of this movie revolves around the tribulations of Ibrahima Dieng who is unable to cash the CFA F 25,000 ($50) money order because of the lack of an identification card. At the Post Office, Dieng is told that he has just 15 days to find an ID card to cash the money order, failing which, the money will be returned to the sender. At the police station where he goes for an ID, Dieng is asked to bring a birth certificate, purchase a CFA Franc 25 ($0.05) fiscal stamp, and supply three passport-sized photos. Lacking a birth certificate, Dieng heads to the City Hall but realizes he could not obtain a birth certificate because he does not even know his exact date of birth. He then has to jump through different hoops of the Senegalese post-colonial administration and asks for the support of his acquaintances to overcome these hurdles. Finally, Dieng is swindled by a businessman named Mbaye, who not only cashes the money order but also takes possession of Dieng's house.

Beyond the description of the Senegalese post-colonial administration, Sembene's movie depicts different issues that characterized the country in the immediate post-independence era, and which are still relevant today: illiteracy, red-tape, corruption, and immigration among other challenges. Dieng's throes reflect the difficulties currently faced by most Senegalese in obtaining administrative documents. Badji (2019) noted that obtaining documents such as home or residence certificates, criminal records, testimonials to good conduct is a real obstacle course in Senegal because of the numerous steps that applicants have to make, including frequent visits to government offices.

However, important measures taken since the year 2000 have laid the foundations for e-governance and penetration of ICTs in the lives and activities of the population. In addition to the creation of the Agency for State Informatics (ADIE) and the Agency for

Posts and Telecommunications (ARTP) which represent the state main institutions for ICT development and uptake, other collective and individual initiatives have worked to promote ICT use in the specific sector of agriculture.

ADIE, the State IT Agency

From its independence in 1960 until the late 1980s, IT operations and initiatives of the Senegalese government were controlled by the IT section of the *Bureau Organisation et Methode* (Method and Organization Office), namely the coordination of a National IT Committee. It was only in November 1987 that the IT Committee was created with the mission of coordinating and controlling the computerization of the administration and institutions of the public sector (ADIE, 2020). Informant 40 who is an ICT specialist argued that, on account of its embryonic initiatives, Senegal has long been criticized for lacking a strategy document for its ICT policy. Starting from the year 2000 with the change of political regime, the country started thinking of setting in place an institution for the coordination of ICT projects.

In 2004, the Agence de l'Informatique de l'Etat (ADIE) came into existence as the government IT agency through Decree No 2004-1038 of July 23, 2004. ADIE was created to replace the DIE, *Direction de l'Informatique de l'Etat* (the State IT Division) which started its operations in 2001 and managed to carry out several projects related to IT development. These projects included the IT component of the National Program for Good Governance (PNBG) and the Program for the Modernization of the Information Services of the Administration (PMSIA) (Ndiaye, 2006). The DIE also contributed to the development of IT connections within the State, namely the Presidency of the Republic,

ministries, and public institutions such as the National Post Office and Gaston Berger University (Ndiaye, 2006).

The main obstacles facing the DIE included a lack of skilled human resources within the context of accomplishing its mission of national IT development. This reason underpinned its transformation into an agency as explained in the introductory report to Decree No 2004-1038 of July 23, 2004 creating the ADIE. The introductory report written by then Prime Minister Macky Sall also recognized the difficulties facing the DIE in its functioning which did not allow efficient and prompt responses to the demands of the administration. Through a transformation of the DIE into an agency, the authorities hoped to provide the new entity with the institutional framework and the autonomy necessary for the rollout of e-governance (Decree No 2004-1038 of July 23, 2006).

Since its inception, the ADIE has been responsible for designing an "e-governance" strategy that embraces of a series of priorities which include:

1) To provide the State with an information system and decision-making tool;
2) To provide citizens and companies with decentralized interfaces that allow an access to administrative services.
3) To sustain and secure government archives through the implementation of an electronic memory.
4) To set up performance indicators for information systems and ensuring their monitoring and evaluation.
5) To assess the impact of investments made in the ICT sector.
6) To contribute to good governance especially a promotion of e-democracy (ADIE, 2020).

Informant 6 who is a Project Coordinator at the ADIE declared that the digitalization of the Senegalese administration implies four aspects: good equipment, an organization that allows providing digital services, the existence of digital services, and the implementation of digital processes. In terms of equipment the ADIE strives for nationwide optic fiber coverage. Informant 6 explained that the agency had laid some 4,500 kilometers of optic fiber around the whole country. Its infrastructure includes the building of two datacenters with a capacity of 1,250 terabytes for hosting all the state databases. ADIE also provides the agents of the Senegalese administration with machines, computers, and accessories to facilitate their work. Considering the planned obsolescence of IT devices, these expenses are recurrent. As Informant 6 put it:

> We had a project that enabled us to provide computers to all the agents of the administration. It lasted between 10 to 15 years. This year we are doing less than that because the project has ended.

When it comes to communication between the staff of the administration, ADIE has implemented a system of mail management called SYGEC (Digital System for Mail Management) that has been in use in some ministries. As of November 2019, around 10,000 accounts with the extension *gouv.sn* were operational and used by the agents. The objective is to provide each member of the administration with a professional email account. For ADIE agents, for example the account name comprises the first name, family name of the individual followed by *.adie.sn*. For the Ministry of Health, the account of the staff members include *name, family name.sante.gouv.sn.* Each ministry has its domain name. Additionally, through CDMA technology, a telephony network that starts with the number 79 facilitates phone communication among agents of the administration. Moreover, a fixed landline that starts with the number 39 allows

communication between state services. The agency has also equipped twenty-two ministries with websites that use a graphic charter set up by ADIE agents. Among the achievements of the agency, the staff members testify to the creation of a unified file for the personal data of all the civil servants. The file combines databases related to salaries, digital identity cards, and information that allows for better management of missions, promotions, and other facts related to members of the administration. Informant 49, who worked as Communication Officer at ADIE praised the advantages that the system offers.

> This enables the state to master the salaries. Sometimes there were redundancies. It could happen that people who died continued to receive salaries. This allows to make predictions and plan for the recruitments.

ADIE also works for the dematerialization of administrative procedures. The objective is to allow citizens to accomplish administrative procedures online and enable members of the administration to process the requests made by citizens. In this respect, the agency has implemented a platform called *Teledac* for the dematerialization of administrative procedures. As Informant 49 put it:

> On our website, we have listed 750 procedures that need to be dematerialized. Every year, our objective is to dematerialize 100 procedures, which means that we need 7 years to finish dematerializing all administrative procedures.

Among the 750 procedures, only 22 have been dematerialized, which means that citizens can fill in the forms and provide the required information online. The procedures that have been dematerialized include demands for building permits, applications for the national administrative exam, delivery of baccalaureate degree, and applications for non-inclusion in the public service.

ADIE defines itself as the backbone of the Digital Senegal Strategy 2025. In recent years, its major operations have been articulated around a program called SMART

Senegal. Funded by China with $ 150 million, this program whose end was set for December 2020 includes five components: *Safe City, Smart Education, Smart Territoires*, *Smart Wi-Fi*, and a submarine cable project. *Smart City* aims at facing challenges related to public security. In this sense, surveillance cameras are put around different cities. The system which is managed by the Ministry of Interior consists of a supervision and command center for collating and processing all data recorded by surveillance cameras. The objective is to track down criminals in major cities. *Smart Education* consists of the provision of digital resources to higher education, primary, and secondary schools. In this regard, the agency has already laid fiber optic cables in the universities of Cheikh Anta Diop, Gaston Berger, Assane Seck, and Bambey. *Smart City* would allow connectivity to institutions and equip them with multimedia rooms. As far as *Smart Territoires* is concerned, it consists of the provision of user-centered services to citizens, the administration, and companies through the creation of "Citizen Houses" in the 45 departments of the country. In these houses equipped with free Wi-Fi, citizens will be able to carry out dematerialized procedures for services. In addition to the "Citizen Houses", *Smart Territories* include the development of mobile applications related to priority economic sectors of the Emerging Senegal Plan such as tourism, agriculture, transport, and land registry (ADIE, 2020). As of November 2019, ADIE was building 5 Citizen Houses in the regions of Thies, Fatick, Louga, Saint-Louis, and Kaolack and had plans for the regions of Tambacounda and Kaffrine. *Smart Wi-Fi* focuses on the modernization of municipalities through the provision of value-added services through setting up public Wi-Fi in places determined by the authorities. Informant 6 who works as Projects Coordinator at ADIE disclosed that:

> Sixteen *Smart Wi-Fi* spots have already been set out of the 84 that we plan to create. These places are more precisely in the capital-city, Dakar. The Wi-Fi spots are created but there are not yet operational. The places that we target are touristic sites.

The last aspect of the project is related to the landing of a submarine cable that would enable the country to access international bandwidth for fast Internet connectivity.

In terms of agriculture, it is worth mentioning the National Geomatic Plan which is the result of a collaboration between the Senegalese government and Canada. Launched in 2008, the project aimed at the production of reliable geographical data. Before this initiative, several geographical data were produced by different entities such as the National Agency for Land-use Planning, the Center of Ecological Follow-up, as well as Land Registry services. This variety in data production and duplication of functions posed a problem of information sharing among the entities. Informant 35 who is involved in the National Geomatics Plan explained:

> The state faced difficulty for the production of consensual geographical data, which led to the decision to have a national geomatic plan with the aim of creating a framework that allows the different entities to discuss geospatial data.

Through a state decree, the Inter-Institutional Group for Cooperation and Coordination in Geomatics (GICC) was set up for a coordination all the activities related to the production of geomatic data. ADIE presides over the GICC whereas the Secretariat is headed by the Agency for Land-use Planning, and the Deputy Secretariat is held by the Center for Ecological Follow-up. For the agricultural sector, the National Geomatics Plan does not provide data, but it could offer new perspectives. Informant 35 declared:

> We have a geo-database accessible via the link www.basegeo.gouv.sn. Currently there are no specific data related to agriculture. However, we could include in this base data related to the zoning of agricultural areas and their potential. These data exist at the level of the Ministry of Agriculture and could be shared with the geomatic community.

The Agency of Posts and Telecommunications Regulation

The ARTP came into existence through the passage of Law 2011-01 on February 24, 2011 establishing the Communications Code. The ARTP replaced the ART created in 2001 for telecommunications regulations (Ndiaye, 2006). According to Law 2011-01 of February 24, 2011, the missions of the ARTP include a general mission which consists of eight major objectives: 1) enforcing regulations, formulating advice, notices, and proposals to the President of the Republic and the government; 2) ensuring respect for the rules for healthy and loyal competition; 3) monitoring and ensuring compliance of telecommunications operators with their Terms of Reference; 4) ensuring equitable interconnection among operators; 5) ensuring the management and control of rare and critical resources including frequencies and phone numbers; 6) setting the framework for prices of telecommunications services; 7) coordinating the implementation of the policy for universal access to telecommunications services; 8) allocating authorizations and enforcing the application of the rules, the registration and management of domain names, and setting a mechanism for appropriate management (ARTP, 2020).

The interviews carried out with ARPT staff revealed the commitment of the agency to healthy competition in the telecommunications sector that comprises three operators that have global licenses (Orange operated by SONATEL, Expresso owned by SUDATEL, and TIGO which became FREE owned by Saga Africa Consortium Limited), three Internet service providers (WAW SAS, ARC Informatique, and Africa Access), and three MVNOs (You Mobil, Sirius Telecoms Afrique, and Origin SA). As a member of

the ARTP staff put it, these MVNO use the network of classical operators to offer services. Informant 38 who heads a department at ARTP declared:

> The MVNOs buy bulk services from operators and sell them to customers under their own brand name. It can be minutes of voice communication or data bundles.

Concerning telephony and Internet coverage of remote areas that are not profitable for telecommunications operators, in 2007, the Senegalese government launched the Fund for the Development of a Universal Service of Telecommunications. The country was divided into five zones and Matam was chosen for the pilot project with the operator Consortium for Universal Service (CSU) which commercialized the brand AYO. As Informant 1 mentioned it, CSU has the same obligations as the other operators:

> The only difference resides in the technology that is used. CSU uses WIMAX to offer Internet and voice services. It also sells a particular type of phone. The company has software that allows the customer to connect to their network through the Internet and to be able to make calls, be connected and have data.

Even if the regulators declared that the competition in the sector is healthy, they also recognized the dominance of Orange in different segments of the telecommunications market. Informant 38 said:

> We have identified 12 market segments in which Orange is the dominant operator even if in the segments of mobile phone and SMS, all the operators are equal.

Orange which has inherited the infrastructure of late national company SONATEL owns over 50% of fixed phone equipment. Consequently, telecommunications operators like FREE use Orange's infrastructure to offer fixed telephony services. In terms of Internet connection, after the development of 2G and 3G services, the country has embraced 4G technology and allocated licenses to Orange and Saga Africa Consortium Limited which owns FREE.

Despite various complaints of customers regarding Internet access, the staff of the ARTP ensures that there is overall compliance of operators with their terms of reference. For instance, the terms of reference for SONATEL dated back to 2011. However, with its acquisition of a 4G license its terms of reference were renewed in 2016 and the state asked the company to cover nine regional capitals in five years. In terms of population coverage, SONATEL had to cover 70% of the population by 2020, 85% by 2023, 88% by 2024, and 95% by 2025. The company was also tasked with covering the main roads and border villages. By the end of 2020, 4 out of 9 roads were supposed to be covered as well as 100% of all the border villages with more than 200,000 inhabitants. As Informant 1 put it:

> In terms of population coverage, as of December 2018, 62% of the population had access to 4G connection. For the border villages, it is an issue related to national security. Currently, the operator has ensured 98.60% coverage and the road axes have been covered, according to our estimates.

The ARTP carries out punctual monitoring campaigns to assess the compliances of telecommunications operators with their terms of reference and sends formal notices to those that fail to respect their commitments. However, as a member of staff disclosed, the agency does not have the function of law enforcement and does not intervene in the pricing policy of the operators.

The development of telecommunication infrastructure has prompted a series of initiatives in different ministries for expanding the use of digital technologies. In the next section, I present the projects implemented by the Ministries of Agriculture and Livestock, and the strategies developed by the National Agency for Meteorology and Civil Aviation (ANACIM). I will also introduce the other actors of the ICT for agriculture ecosystem which include private-public partnerships but also private entities.

E-subsidy

For the Senegalese Ministry of Agriculture, the Division for Agricultural Analysis, Forecast, and Statistics (DAFSA) plays a key function. Its agents are in charge of determining yields and national agricultural production through the use of quantitative methods such as surveys. Its studies also include an evaluation of the amount of input used by producers. Additionally, DAFSA provides information about the categories of people working on farms, the livestock headcount, and the equipment used. While the service has long been based on paper forms for its surveys, it has recently turned to smartphones with GPS, and the results are remarkable. Informant 27 who is an IT specialist at DAFSA declared:

> In the past, it used to take us 3 to 4 months to obtain an information. Now, in less than one month, we get the statistical data.

DAFSA also accesses satellite data with the Normalized Difference Vegetation Index to make interpretations about vegetation, water, and agricultural areas. For greater efficiency, since 2014, DAFSA has adopted *SurveySolution* , a web platform developed by the World Bank. The online platform hosts different modules that allow the conceptualization and distribution of questionnaires, taking photos, and recording audio files. It also enables remote data control and the collection of geographical information systems on grain areas, sizes, location, and distances.

Other IT resources for DAFSA include the use of SPSS, STATA, and R for the processing of the data collected. The dissemination of the information is done on platforms for the general public and professional sites such as the FAO *CountrySTAT* which details agricultural information from countries around the world. DAFSA and the

Ministry of Agriculture have their own servers located at the Ministry's headquarters in Diamniadio and not at the ADIE. According to Informant 27, this decision is related to confidentiality reasons.

> These are confidential data. Even with Survey Solutions which is a platform developed by the World Bank, we were asked to put the data in the Cloud. We decided not to do so because the Clouds servers are located in other countries and they may be subject to different legislations. Our main objective is to protect the data we collect.

A major instance of the use of ICTs for agricultural development took the form of a project called *e-subsidy* (e-subvention in French) initiated in 2012 by the Senegalese government with the support of the World Bank through its West Africa Agricultural Productivity Program (WAAPP). The objective was to streamline the subsidy policy for seeds, fertilizers, and equipment implemented by the government for increased agricultural productivity. The subsidy system consists of an amount of money provided by the state and it takes the form of tons of input and equipment distributed to farmers. However, at the end of the agricultural campaign, the traceability of the subsidized inputs from the providers to the producers has always been problematic. The project e-subsidy intended to bring transparency and accountability in the chain of input distribution. It consisted of a web-platform built for an interaction between the government, input providers, and producers. Every year, once the state decides the amount of money to be used for input subsidies, an invitation to tender is published and the providers that are selected receive notification. Through the Department of Agriculture, the Senegalese government sets up planning for input distribution with each input provider receiving planning for distribution in different municipalities. The distribution plans are also sent to the commission created in each municipality by the State representative. Each

commission is headed by a President and includes the Mayor and a village committee. The commission is in charge of receiving the inputs attributed to each producer with a delivery note. Once the commission receives the inputs, it then proceeds with sales to farmers. Since all producers cannot access the limited number of inputs, a list of beneficiaries is established under the supervision of local authorities. With the subsidy policy, a sack of seeds that normally costs CFA F 12,000 ($ 24) can be subsidized for up to 50% by the State and the producers pay only half the price.

The objective of e-Subsidy was to digitalize the whole process of subsidized input delivery. It started in 2012 with a census of the potential beneficiaries in the regions of Saint-Louis in the Senegal River Valley and Kaolack-Kaffrine in the Peanut Basin. After an initial objective of coding 20,000 producers, the project was scaled up to reach the national level for the coding of one million farmers. The coding process consisted of entering in a database the name of the producer, his/her gender, the village where he or she lives, a typology of the producer (village chief, private operator, member of a cooperative), the name of the cooperative of which the producer is a member, the producer's phone number, the area the producer dedicates to each crop, a geo-referencing of the area dedicated to the main crop, the amount of seed and fertilizer received the year before. The process eventually led to the coding of 700,000 producers in a database which also hosts data related to the providers of seeds and fertilizers.

Thanks to this database, once the Department of Agriculture publishes the names of input providers and the quantities they have to deliver, the information is sent via SMS to all the committee chairpersons and each committee has a clear idea of the number of seeds or fertilizers that it will receive. The Agency for Posts and Telecommunications

allocated the short code 21555 for sending the information. Once the provider delivers the inputs, the committee chairperson should automatically send a SMS using the same code, informing that the input is delivered and stating the quantity received. The chairperson has then to write a specific formula that reads "*Bon*" space followed by the amount received. Once all the committees have received their inputs, DAFSA which has the mobile phone numbers of all the potential beneficiaries in its platform then sends them grouped information and they all get informed. DAFSA also sends to each producer the amount of seed or fertilizer he or she will receive. Once the producer gets the subsidized input, he or she has to validate by entering the formula "*Bon*" space and the amount received.

Even though no study has yet been carried out to evaluate the efficiency of the e-subsidy project, the system faced several pitfalls. One of the shortcomings is related to the low literacy of the producers and some committee chairpersons who often failed to accomplish the required steps of the process which included sending an SMS for validation. Another factor is linked to the standard of living of the beneficiaries who generally own basic mobile phones with low memory that are not able to receive many SMSs. Most producers often receive hundreds of promotional SMS from telecommunications operators. As Informant 27 explained:

> We always send our SMS. However, since many producers do not have the reflex to erase the SMS they receive from telecommunications operators, the memory of their phones becomes easily full. So, they do not receive the SMS sent by our system.

At the DAFSA, the staff believes that illiteracy greatly accounts for the hindrances faced by the promoters of the project. Informant 27 declared:

> Because of the high levels of illiteracy, many beneficiaries found it hard writing the word "Bon" , putting a space, adding the amount received and validating it. This was a big issue. In many cases, we had confirmation from the committee which had received the inputs; we were then obliged to call the producers individually to ask them to validate the information.

Other problems were related to the delay by some committee chairpersons to send an SMS of confirmation. The novelty of the system is seen by some as one of the causes of the lack of prompt reaction. So, even if the producers did not pay for sending the SMS, their engagement with the project fell short of the expectations. Informant 27 mentioned that:

> Sometimes the producers were not even willing to validate the action they had done. Maybe they did not receive enough information about the project and were not familiar with the system.

After the pilot phase supported by the World Bank (2012-2013), the e-Subsidy project was taken over by the Ministry of Agriculture from 2014 to 2017. The platform continues to exist even though it is no longer used for the distribution of agricultural inputs.

SIGEL, the Livestock Information System

In Senegal, livestock presents itself under different aspects. Along with a traditional breeding system conducted by pastoralists who lead their herds throughout the country in search of grass, a new form of animal husbandry is swarming in urban and peri-urban areas with the emergence of businesspeople, technicians, administrative agents, and many segments of the youth who have become adepts of intensive livestock production. Even if the situation is not all rosy, the country has made great strides towards self-sufficiency in terms of poultry production. Along with Dakar and Thies that had long been epicenters of intensive livestock production, Saint-Louis, Touba,

Ziguinchor and even the remote region of Kedougou have emerged as new poles for poultry farming.

The boom in the livestock sector with the entrée of new actors and novel production forms have been accompanied by the adoption of information and communication technologies. ICTs such as mobile phones are of great use by cattle breeders in Senegal. According to Informant 18 who is a state official at the Ministry of Livestock, between 95 and 100% of shepherds and cattle breeders have a cell phone. Social media such as WhatsApp contribute to information sharing among livestock producers. Through audio, video messages, and photos, different actors encourage each other to try fodder crops and new techniques. WhatsApp facilitates information sharing about animal vaccination for the control of the diseases that plague the sector. The example of the WhatsApp group called *Nema* is illustrative of the use of social media by women working in the livestock sector. Informant 18 revealed that:

> After a training organized by the Food and Agriculture Organization, women who are members of the National Directory of Women in Livestock, DIRFEL, have started producing fodder crops. Through the WhatsApp group called *Nema,* they daily exchange thousands of messages about these crops including audio, video, and photos that encourage women to try particular crops. This created some sort of emulation among women.

In addition to social media, the Ministry of Livestock has implemented the *Systeme d'Information de Gestion du Secteur de l'Elevage/* Livestock Information Management System (SIGEL), a digital system for the management of the livestock sector. The system covers the entire activities of the Ministry and includes a livestock market information system known as *SIM-Betail*, but also modules on animal health, Health Control, animal movement and vaccination. The system which is hosted by the ADIE consists of a website and an app for android phones. Funded by CILSS, the Inter-

State Committee for Drought Control in the Sahel, the market information system for livestock known as *SIM-betail* (or SIM-B) is a sub-regional program launched in 1991 to disseminate information related to prices, offer, demand, and market attendance (SIMB-Senegal, 2020). Between 1991 and 1999 the program focused on collecting data on 15 markets in Senegal, however, since 2018, the system has been providing information about 30 weekly livestock markets in Senegal and benefits from the aid of PRAPS, the Regional Program for the Development of Pastoralism in the Sahel region (SIMB-Senegal, 2020). The mobile app and the website of the livestock market information system provide information on the number of cattle, sheep, goats, camels, donkeys, poultry, and pork but it also collects data on livestock feed supplies, animal hides and skins, meat, and milk prices (SIMB-Senegal, 2020). Informant 18 noted that:

> This market information system works through smartphones and tablets that are given to field agents who follow the markets and instantly send information that goes into a server. The manager can then do the analysis and produce a bulletin on the different markets. So, as you can see, it allows for faster, more reliable data.

SIM-Betail facilitates access to statistical data on livestock markets that are published in a monthly bulletin distributed by the Ministry of Livestock. Although the project was launched in 1991, it is still in its test phase and its website needs a lot of updates.

The Ministry of Livestock's information system includes modules on animal health and disease control that allow extension workers who are equipped with smartphones to send information at the central level. Informant 56 who operates as IT specialist at the Ministry of Livestock disclosed that:

> In the past if there was a suspicion of disease, the extension agent used to make a sampling, and send it through the public transportation system. An agent of the

> Ministry would pick the sampling at the Beaux Maraichers car station. Then the sampling was sent to a laboratory for analysis. It could take 2 to 3 weeks, or even one month. Now any time there is suspicion, we automatically get informed at the central level when a photo is sent by the livestock agent through his or her smartphone.
>
> With the module for vaccination, extension workers provide timely information

about the number of heads that have been vaccinated, the categories of livestock vaccinated, and the number of males and females.

Great efforts have also been deployed for curbing cattle theft. Tests for putting microchips on horses have provided promising results. Different companies suggest the use of electronic chip loops as well as systems for geo-locating stolen herds. However, the cost seems prohibitive for the Ministry. Nonetheless, an efficient information system is necessary for dealing with animal theft but also for the provision of relevant statistical data on the sector. In this sense, the start-up Daral Technologies could prove useful. This firm seeks to offer a Livestock Identification and Traceability System (LIST) made of a mobile app and a web platform. The objective is to facilitate the exchange of information via SMS between cattle breeders, veterinary doctors, and law enforcement officers in case of theft. The system also intends to allow the identification of farmers and their livestock, and to provide statistical data about the livestock sector (daraltechnologies.com, 2020).

ANACIM

The National Agency for Civil Aviation and Meteorology (ANACIM) is at the forefront of the promotion of ICT use for farmers and fishermen. In addition to the use of radio and television to disseminate weather information, ANACIM has built a mobile application called *Meteo Senegal Officiel*. If for fishermen the number of annual deaths at

sea prompted the design of the new tool, for farmers the drastic effect of climate change served as a justification. The app which is accessible through Google Play Store contains 11 sub-sections:

1) Ongoing alert: this part of the app informs about the current alert sent by ANACIM. The alert may be green, yellow, or red depending on the level of danger. A red flag calls for absolute vigilance. When the flag is yellow, the actors must be vigilant whereas the green flag indicates that there is no immediate danger.
2) Cities weather: this part gives information on the weather and rain forecasts for the cities of Dakar, Thies, Mbour, Louga, Linguere, Saint-Louis, Podor, Diourbel, Kaffrine, Kaolack, Fatick, Tambacounda, Bakel, Matam, Kedougou, Kolda, Ziguinchor, Cap-Skirring, Sedhiou, and Nioro. The weather forecast covers three days.
3) Weather bulletin: this section provides more detailed information about the weather conditions in the cities but also in major departments.
4) Listen to the weather forecast: this provides avenues for listening to weather forecast in Wolof or French.
5) Tidal predictions: this section provides information about the high and low tides along the coast.
6) Seasonal forecasts: the information in this section is related to the general forecast for the whole season in terms of temperatures, sea levels, and rainfalls.

7) Vigilance along the coast: this section displays a green, yellow, or red flag depending on the level of danger along the coast. It can also show signs indicating the presence of dust or wind.
8) Rain/temperature map: this part shows the map of the country with figures indicating the amount of rain and temperatures recorded the day before in major cities of the country.
9) News: in this section, ANACIM gives news on workshops, training, seminars as well as other news items related to the Agency.
10) Contact us: in this section, the user can send a message to the staff of ANACIM.
11) Legal notices: this section provides information about the owner and editor of the app and its contacts.

In addition to the information provided by the app, ANACIM sends information through SMS. Informant 5 who works at the Department of Weather Information Systems at ANACIM declared that the app and the SMS service are complementary:

> They complement each other. For the SMS, the text is in French. So, it is destined to people who can read. With the app, for those who cannot read in French or local language, there are images that help to understand and a voice system in Wolof and French.

Before launching this information system, ANACIM organized touring seminars around the country to train fishermen and farmers for a better use of weather information. After each seminar supported by the USAID through its COMFISH (Collaborative Management for a Sustainable Fisheries Future) project, the participants gave to ANACIM staff their phone numbers that are then stored in a database. This practice makes it possible for the agency to send SMS in case of emergencies to 500 information

relays. In case of tide alerts, the information relays raise a green, yellow, or red flag along the coast to inform the fishermen about sea level and conditions.

Besides the national broadcasting system and private commercial radio and television stations, ANACIM has also signed a contract with the Union of Community Radios and trained its members for better dissemination of weather information. Thanks to the financial support of donors, ANACIM pays for the SMS and the vocal messages. As a public agency, it cannot require payment from part of the users. The staff of the Agency agrees on the necessity to find a business model that would allow to offer these services and support the maintenance costs for the infrastructure that provides weather information.

In addition to the government initiatives, several public-private partnerships and private enterprises have come into existence to offer digital services to farmers, cattle breeders, fishermen. Before describing major start-ups that have been created by young people for the provision of agricultural information services, I will first present CTIC-Dakar, an ICT incubator born on a public-private partnership that has given birth to many of start-ups in Senegal.

CTIC-Dakar

CTIC-Dakar was conceived as an incubator for IT and mobile entrepreneurs. It came into existence on April 19, 2011 as a non-profit organization initiated through a private-public partnership. Its founding members include the Senegalese government through entities such as the Ministry of Telecommunications and Digital Economy, the Ministry of Economy, Plan, and Cooperation, and ADIE, the state IT agency. The other

founding members are OPTIC (Organization of Senegalese ICT Professionals), an entity of FICTIS (the Foundation of ICT Incubators in Senegal) which belongs to the Senegalese Employers' Association but also telecommunications company SONATEL-Orange and donors such as the World Bank, the German cooperation (GTZ), and the Center for Enterprise Development of the European Union.

CTIC-Dakar serves as an ICT hub and a detector for young entrepreneurs with innovative projects who are offered training, technical and strategic support for success in their initiatives in exchange for financial payment. Informant 51 who ranks among of the authorities of CTIC-Dakar underscored that:

> These young people with business ideas, do not know how to create an enterprise, how to create an idea, how to structure the idea. We offer academic content with working tools that will serve them when they start their businesses. We prepare them for operational management, organization management, the creation of a business plan, financial management, legal aspect, commercial management, and marketing.

This training supplements the deficiency in the curricula of the education system in Senegal which lacks content related to entrepreneurship. Many students who have graduated from school and do not have a job intend to become IT entrepreneurs, without receiving appropriate training. In addition to a 3-month training, CTIC-Dakar works alongside start-ups for a period of two years and becomes part of their board members. Informant 51 revealed that:

> Everything is subsidized. We ask about CFA F 90,000 ($180) for each start-up. But the training of people with business ideas is subsidized up to 100% by development partners. The participants only pay the membership fees which are about CFA F 30,000 ($60).

In eight years of existence, CTIC-Dakar has supported 174 start-ups and studied over 2,200 projects. The areas of intervention range from e-health to e-agriculture, to

recycling and various fintech services. The organization claims a survival rate of 80% of enterprises after two years of incubation.

CTIC-Dakar faces difficulties related to the scarcity of funds from the state and other donors. As one interviewee put it, “the functioning of CTIC-Dakar should be taken in charge by the founding members and their partners. But it is not the case.” CTIC-Dakar’s financial stream derives only from the programs its holds thanks to the support of partners.

M-Louma

M-Louma ranges among the start-ups incubated at CTIC- Dakar. It was conceived in 2011 by a young IT engineer . The *M* stands for mobile and *Louma* is equivalent to a weekly market in Wolof language. The mission of the start-up is to provide agricultural products and connect producers and customers in the value chain. The services offered include *Louma Mbay* (*Louma* means weekly market; *Mbay* means agriculture) which operates as a virtual marketplace for the sale of agricultural products as shown in Figure 13 below.

Figure 13 Screenshot of Louma Mbay
(Source: M-Louma website)

Informant 3 who holds a leadership position at M-Louma mentioned that another service available on the platform is *Xam Sa Mbay* which interconnects major actors in the agricultural value chain such as producers, input providers, banks, decentralized funding services, buyers, and agricultural services. The objective is to provide accurate and timely

information and advice to the different actors in the agricultural value chain. As informant 3 put it:

> *Xam Sa Mbay* is a platform that deals with the issue of information asymmetry. If you are a producer when you connect to this platform, you know where the inputs are, how to find them. For producers' organizations, the platform allows their members to express their needs in terms of inputs, and everything is aggregated at the central level. *Xam Sa Mbay* operates also as a facilitator for banks and micro-finance institutions that want to advertise their products to people who need funding.

The platform also integrates means of payment that allow the actors to do a transaction. Another sub-component of M-Louma is *Meteo Mbay* for the sharing of the weather forecast for agricultural producers and *Meteo Guedj* dedicated to fishermen and which provides information about swells and currents at sea.

M-Louma works through four different systems: a web platform (www.mlouma.com) , SMS services, an Unstructured Supplementary Service Data (USSD) system, and a payment method through Chatbot WhatsApp. M-Louma exemplifies the difficulties faced by start-ups intervening in the agricultural sector. In the beginning, it was a web application used by farmers to market their products. The promoters of the start-up chose the village of Rao in the Saint-Louis region and the village of Potou in the region of Louga as pilot areas. However, on account of the lack of Internet connection producers in Rao had to travel 25 kilometers to Saint-Louis and those living in Potou had to cover 30 kilometers to go to Louga to be able to find an Internet connection that allows them to post their products online. Moreover, the business model was not profitable for the start-up since the producers did not pay. After winning an international contest organized by Orange, the telecommunication company decided to open its APIs (Application Programming Interfaces) to M-louma. This included access to

the USSD, SMS, and billing systems. For the start-up, the result was remarkable in terms of revenue. Informant 3 made the following declaration:

> When we launched the web application in 2013 until we started the USSD system, it was a 100% web application. We had 500 users who accessed the platform, but these 500 users did not pay anything because we did not know how to make them pay. Our business model was not clear. So, for 3 years, we got no revenue. When we launched the USSD in 2016, which completes the web application, we had 100,000 users of the platform before the end of the year. So, look, in 3 years we had only 500 users and with the USSD system, in less than 1 year we had 100,000 users.

The USSD allows the promoters of the start-up to overcome the lack of Internet connection in various areas of the country. The producers who have phone credit have just to dial #112# and be guided through the system to 1) have information about prices, 2) be in contact with or have information about a producer, 3) publicize their products, 4) receive alerts, 5) recommend the service, or 6) have a presentation of the service.

Meteo Mbay is an important component of the USSD offer which was developed thanks to the support of USAID and which provides producers with information about rainfalls. Informant 3 revealed:

> We have organized the producers as managers of manual pluviometers. After it rains, each manager of a manual pluviometer accesses the platform through short code #112# and provides information about the quantity of rain collected, the phenomenon noticed (wind, dust, etc.) and the date of the rain. Once the producer validates this information, the system sends the information to the producers who are related to this pluviometer. This allows the producers to track the collected data.

As Informant 3 put it, *Meteo Mbay* helps producers know when the quantity of rain is favorable for doing the seeding or other activities such as spreading fertilizers. Additionally, the tool also helps to smooth the relationships between producers and the National Fund for Agricultural Loans (CNCAS) which only compensates producers in case the rains are deficient or fail. Informant 3 declared:

> Sometimes when the producers subscribe for an insurance policy with the National Funds for Agricultural Loans, this institution makes it clear that if at the end of July, the producers do not have 50 mm of rain, they will get compensation, but the producers did have not the means to know the amount of rain they get in July. So, with this system, they can know that. This motivates them more to subscribe to our services.

As a consequence of the interest they see in the services, producers accept to pay for it. In 2019, 70% of the 5,000 producers who worked with M-Louma paid with their phone to receive alerts on rainfalls. Informant 3 said:

> Producers pay CFA F 50 ($0.1) to post their products online for 30 days. As for those who are looking for products, the fee is CFA F 60 ($0. 12). To receive alerts about rainfalls and weather forecasts, the amount to pay depends on the location and varies between CFA F 1,000 ($2) and CFA F 1,500 ($3) for the whole rainy season. In some areas in the South where the season is longer compared to the North, producers receive more alerts.

The areas of intervention of M-Louma include the departments of Bignona, Ziguinchor, Sedhiou, Bounkiling, Kolda, Velingara, Medina Yoro Foula, Nioro, Kaffrine, Koungheul, Kaolack, and Foundiougne, Tivaouane. As of November 2019, the start-up claimed to be working with 10,000 producers in these areas. For the period 2018-2019, the turnover of the company was estimated at CFA F 20 million ($40,000).

Soreetul

Soreetul which means in Wolof "it is no longer far" is a digital platform launched in September 2014 by a young female IT design engineer for the marketing and distribution of processed agricultural food, a sector largely dominated by women. Informant 13 who is a member of Soreetul explained:

> Traditionally women work in the processing of millet, turning it into *couscous*[1], making *thiakri*[2], traditional dishes learned from our grandmothers, With the

[1] African dish made from tiny steamed balls of semolina flour.
[2] A steamed-cooked Senegalese dessert made from millet often served with curdled milk or yogurt.

> support of the Institute for Food Technology, the work has been professionalized. The main sticking point related to distribution, the marketing of products and branding. Soreetul helps to bridge this gap.

In Senegal, the sector of cereal processing has long been dominated by women. As of October 2019, among the seventeen small-to-medium size enterprises that worked with Soreetul, only one was owned by a man. To these partners the start-up offers two business models. The first model is a deposit-sale system where the women give the products to the start-up which first puts it in storage, sells it online and returns the money after deducting its portion of service charges. The second model is a buy-sell model arrangement. With the difficulty for many women to ensure the packaging and branding of the products, *Soreetul* buys produce in bulk, re-packages it before selling online.

The products listed on the start-up's online platform ranged from cereals processed into *couscous, arraw*[3], or *thiakri*, to fruits and vegetables processed into jam and canned syrups but also fish and cosmetic products. In addition to its online platform, *Soreetul* hosts a physical shop where products are displayed. The sale of products provides women groups a monthly revenue which varies between CFA 250,000 ($500) and CFA F 300,000 ($600).

Even if the start-up seems to be doing good business, at the beginning, *Soreetul* which is headquartered in the capital-city, Dakar had difficulties to convince the women 98% of whom live in rural areas. Informant 13 revealed:

> To convince them, we put forward the human aspect and made it clear that we intended to help them. We also used some women as ambassadors. Five women groups used to process local products and export in the sub-region and even to Europe, but they never tried online sales. We first worked with this niche of

[3] Small balls of flour cooked as a porridge.

> women and these women, in turn, convinced others who were reluctant to work with us at the beginning.

With six full-time employees and three part-time workers, Soreetul has added another service to its offerings. In addition to its e-commerce platform, the start-up provides catering services based on local agricultural products. It also works with international organizations for the marketing, sale, and promotion of local products through the production of videos on food recipes.

Bayseddo 2.0

Bayseddo 2.0 is another start-up founded by a young IT graduate who holds a master's degree in Computerized Management. It is a digital platform that allows producers who own land to access funding from investors. Informant 37 who is a shareholder of *Bayseddo 2.0* explained that the idea behind the company's formation was supported by some research insights. In Senegal, banks are reluctant to advance loans to farmers. For financial institutions, investing in agriculture is a risky enterprise on account of the lack of visibility and the necessity of close credit monitoring to avoid losing investments. Other risks are related to the possibility of drought, floods, locust invasion or destruction of crops by domestic or wild animals. Moreover, agricultural products are highly perishable which pushes fund owners to refrain from investing in the sector. Consequently, only 5% of bank funds go to the agricultural sector. According to Informant 37 another reason underpinning the formation of the start-up is that access to land in rural areas has become a long and harsh process for private businesspeople. By

contrast, foreign multinationals continue to grab hundreds of hectares of land with the support of local authorities.

Bayseddo 2.0 was launched to overcome these difficulties. The name *Bayseddo* which, in Wolof language, means "*Cultivate and share*" refers to a traditional system of funding through which producers who have crop land receive money from parents and relatives for purchasing agricultural inputs (seeds, fertilizers, equipment). At the end of the agricultural campaign, the revenues from the harvest are shared among the parties. With the support of digital technology, *Bayseddo 2.0* connects farmers who have land but have not access to funding and individuals who have money and want to invest in the agricultural sector. Informant 37 revealed:

> We have a Web platform (www.bayseddo.com) where investors put their contacts, name, email, as well as the amount they want to invest. We then send them the projects in which they can invest.
>
> The promoters of the web platform have picked rice and onions as the focal crops.

As explained by Informant 37, the existence of a market for consumption of these products spurred the interests of the start-up founder. In Senegal, the annual rice imports are estimated at nearly CFA F 2 billion ($ 4 million) and 1,000 tons of onions are consumed every day. To offer guarantees to investors, Bayseddo *2.0* subscribes to insurance policies with the National Company for Agricultural Insurance (CNAS) and signs a contract with agricultural consulting companies which ensure the monitoring of each project. At the end of each campaign which lasts between six and 12 months, the revenue is shared between the parties and the producer receives at least 50% of the revenue. Informant 37 said:

> For example, we know that to cultivate one hectare of rice, we need CFA F 450,000 ($900). If we have a turnover of CFA F 800,000 ($1,600), we deduct CFA F 450,000 ($900) which goes back to the investor who provided the initial funding. With the remaining CFA F 350,000 ($700), about 50% goes to the producer, and the rest is shared between the investor and us.

According to Informant 37, about 98% of the people who invest in *Bayseddo 2.0* are Senegalese citizens. They include individuals living in the country and the diaspora. The return of investment varies between 10 and 25% depending on the amount provided. In 2018, the promoters of the start-up operated on 308 hectares and employed 170 people. Its turnover was estimated at CFA F 32, 500,000 ($65,000).

DICTAF Corporation

DICTAF Corporation was set up in 2016 by two young Senegalese graduates who nourished a passion for agriculture and information technologies with an initial personal budget of CFA F 5 million ($ 10,000). Even if for many people DICTAF refers to DICKO and TAPHA the names of the founders, it really stands for Domains of IT, Communication, Transport, Agriculture, and Finance. Focusing on agriculture and ICTs for a start, DICTAF offers a variety of services which include designing agricultural projects, marketing for agricultural products, organization of seminars and workshops, and sales representation for seeds, fertilizers, equipment, and crop protection products (dictafcrop.com, 2020). DICTAF Corporation also grows crops in different areas of the country.

However, the start-up is also known for its digital solution called *SOS Agri*. Articulated around a web application and a USSD system, *SOS Agri* has three components. The first component is a system that sends alerts in case of emergencies

such as pest invasion, plant diseases, and needs for technical support. With this system, a farmer who faces a problem in his or her crop land or has a question can send an alert using the USSD system which does not require an Internet connection. The alert can be made using local languages or in French. It may also be sent through SMS or a web application. On receipt of the alert, DICTAF Corporation geo-localizes the producer and answers the question. If the problem cannot be solved remotely, the start-up sends one of its agronomist engineers.

The second segment of *SOS Agri* is an online shop that allows producers to access seeds. The platform also serves as a window for showcasing agricultural products. The third component of *SOS Agri* is related to artificial intelligence. With a smartphone, the producer can take a photo of a diseased plant and send it to the system. The app facilitates the diagnosis of the plant and gives the name of the disease and the type of treatment that is adequate as well as the posology. According to Informant 39, one of the founders of the start-up, the mobile app helps overcome the difficulty of covering vast areas to answer producer's requests.

> We used to receive 50 to 60 phone calls every day. We could not handle that, and we could not move all the time. We could not travel from Dakar, to go Kaffrine, then Matam, then Saint-Louis. Financially, physically, and technically it was impossible.

For DICTAF Corporation, *SOS Agri* contributes to greater efficiency. The downloading of the app is subject to payment. Users who send alerts pay CFA F 25 ($0.05) which is the cost of the SMS. In case they send a vocal message, the price is CFA F 100 ($0.2). The costs for the online shop vary between CFA F 25,000 ($50) and CFA F 100,000 ($200) for company owners who want to show and sell their products such as seeds, fertilizers, crop treatment products, and equipment.

DICTAF Corporation claims to be working with a network of 15,000 producers. On its farm located in Menguene Boye, in the Northern part of the country, the company has created 22 permanent jobs along with seasonal employees. The start-up has deployed drones as tools for precision agriculture. Informant 39 stressed on the importance of drones:

> Drones save time and energy, and they enable precision. Without a drone, it may take you one hour to diagnose five to 10 hectares of crop land. With a drone, the diagnostic is done in less than five minutes and you can see places with plant discoloration, places that need water. To expand fertilizers, producers do not need to go over many kilometers with five to 10 liters of liquids and repeat it 10 to 15 times a day. With drones, we CAN apply fertilizers on 50 hectares in a short period.

Geomatica

The use and promotion of drones is a core activity for Geomatica, a start-up launched in 2017 to offer geomatical solutions. Its services include remote sensing which allows close monitoring of the environment, knowledge about land use, and information about ecosystem evolution. The start-up also works in the area of cartography and geo-localization. The demands for such services come from policy makers, municipalities, NGOs, farmers, and ordinary citizens. For policy makers, the request may consist of inquiring into the number of health centers or other infrastructure that exist in a territory. When it comes to citizens, services of geo-localization help to gauge distances between different places. The services provided by Geomatica are based on the satellite image, aerial photographs, and drone images. If for satellite images, websites such as *Earth Explorer* and *Sentinel* allow free access, others such as *Pleiades* that provide high-resolution images requirement payment. In addition to the provision of GPS for geo-

localization, Geomatica hosts a cartography service that enables policy makers to access maps for better management of territories and natural resources.

For the sector of agriculture, Geomatica has among its customers farmers who often work on large crop lands. Informant 31 who occupies a high position within the start-up management declared:

> Farmers often say, 'I don't know the area of my crop land' or 'I don't know the health condition of my plants', or 'I would like to know the average yield that I can get'. Geomatica allows bringing answers to these inquiries.

Geomatica believes its services would contribute to precision agricultural practices. The access to high-resolution satellite image ensures relevant estimates of yields of the grain areas for each crop. The use of algorithms in the North of the country made it possible to evaluate the number of land crops for each agricultural campaign. Geomatical solutions also allow to determine the health condition of plants in the farms, to know the places where the plants are growing well compared to other spots. Other services that Geomatica may provide to farmers include its fleet of drones (See Figure 14 below). The start-up has five drones that offer real-time and high-resolution view of crop lands. Comparing drones with satellite images, the staff of Geomatica explained that during the rainy season the presence of clouds makes it difficult to obtain high-resolution satellite images. Drones that can fly under the clouds offer better visibility. Moreover, they afford money-saving advantages, relative to expensive high-resolution satellite images.

Figure 14: The promoter of Geomatica holding one of the start-up's drones (Source: Layire Diop)

Discussion

In this chapter, I intended to answer Research Question # 1: To what extent is the national context favorable to the FAO project?. Through an analysis of the interviews with state officials, ICT specialists, and start-up promoters, I have offered an overview of the situation of ICTs in Senegal and the level of development of telecommunication infrastructure in the country. Great strides have been accomplished since 2000 with the election of President Abdoulaye Wade who championed the promotion of ICTs at the national level and was the leading voice of the Digital Solidarity Fund at the international level. His successor Macky Sall who took the reins of power in 2012 resolved to afford Senegalese opportunities for maximally harnessing the potential digital technologies. ICT development occupies a central place in his Emerging Senegal Plan. With a budget estimated at CFA F1, 361 billion ($653 million) (Ministry of Posts and

Telecommunications, 2016), the Senegal Digital Strategy 2016- 2025 aims at achieving more equity and inclusion in the access to digital technology. It obviously appears that a sort of technological determinism is nurtured by the authorities who do not spare efforts for a coverage of the population and the territory with telecommunications services.

In terms of telecommunication infrastructure, Senegal has connections with international networks via cable connection through projects such Africa Coast to Europe (ACE), an optical fiber submarine cable serving 24 countries of the West coast Africa and Europe but also the South Atlantic 3/West African Submarine Cable (SAT-3/WASC) which links Spain and Portugal to South Africa and various West African countries. Optic fiber infrastructures are also developed by telecommunications companies as well as other international entities such as the Organization for the Development of the Senegal River (OMVS). It is estimated that between 90 to 95% of the population and 80 to 90% of the territory are covered by telecommunications companies.

In Senegal as it is the case in many developing countries, many hopes are pinned in the potential that ICTs offer. This finding aligns with the Modernization Theory and the advantages attached to ICTs and the media in the development process. In the same way as Daniel Lerner (1964) and Wilbur Schramm (1964) posited for mass media, the development of telecommunications services is seen as a springboard for the improvement of the living and working conditions of citizens. In line with Sen's Capabilities Approach, authorities in Senegal apprehend the potential of ICTs in the functionality of the institutions and the delivery of timely services to the citizens. With the financial support of China, the State IT Agency (ADIE) strives to make e-governance a reality through the implementation of the SMART Senegal project and its five

components: *Smart City, Smart Education, Smart Wi-Fi, Smart Territoires,* and a submarine cable.

Despite the pitfalls which take the forms of low Internet speed and lack of coverage in rural areas, ICTs contribute to improving people's lives. Start-ups such as *Soreetul, Bayseddo 2.0, M-Louma* offer a variety of mobile apps that provide agricultural producers with substantial economic resources. In the same way, the services offered by the state through the National Agency for Meteorology and Civil Aviation help alleviate the effect of climate change and global warming. By providing producers which weather forecasts and rainfall predictions, these services allow the beneficiaries to better organize and schedule the activities based on the information received. In this sense, ICTs help in the improvement of people's functionings and capabilities (Sen, 1999). Functionings and capabilities refer to things that people value doing or being. The different start-ups described in this chapter illustrate how ICTs increase farmers' ability in making choices. Producers who get relevant information about the market can make informed decisions about whether to sell their products or not; they can also decide to sell online or to travel to the closest market to sell the product. At the macro level, ICTs provide producers some opportunities to better organize their lives. This is in line with the categories of freedoms defined by Sen (1999). The capabilities acquired through the ownership and use of ICTs are conducive to empowerment which Kabeer (1999) defines as processes through which those who were denied the ability to make choices acquire that ability.

The services offered by the ICT start-up promoters and also state institutions include e-commerce, funding opportunities, weather alerts, geographical information systems, animal health, to mention but a few. It is therefore clear that the app that the

Food and Agriculture Organization intends to roll out already exists in different forms in Senegal and is implemented by young promoters who contribute to job creation and agricultural productivity. However, issues of cost, illiteracy, network availability and Internet speed remain big challenges that hamper substantial investment returns.

Summary

This chapter offers answers to the first research question: To what extent is the national context favorable to the Food and Agriculture Organization project?. Through an analysis of documents, interviews with state officials, ICTs specialists, and start-up promoters, I have presented insights into efforts in Senegal for bolstering ICT infrastructure and equipment. After the deployment of 2G and 3G, telecommunications companies have adopted 4G technology for better services in terms of voice, video, and data. At different levels of the state, the government IT agency strives to make e-governance a reality. At the sectorial level, the Ministries of Agriculture and Livestock have implemented strategies for the use of ICTs in different projects. However, the results have not been as great as expected. For e-Subsidy, illiteracy and low standard of living underpin the lethargy of the project. As for the projects of the Ministry of Livestock, their sustainability is questionable on account of the vast sums of money they require. In this chapter, I have also shown that many start-ups are already offering a variety of apps that deliver the same services as the one that the Food and Agriculture Organization wants to roll out through its project entitled “Digital Services and Agricultural Inclusion in Africa”.

In the next chapter, I will analyze the extent to which the site of study is favorable to the FAO project. This will be done through an analysis of survey data on

farmers living in rural areas but also on an analysis of data from interviews and focus groups of farmers who were involved in the implementation of the FAO project.

CHAPTER VII

RURAL AREAS: REALITIES AND CHALLENGES

In this chapter, I offer an answer to Research Question 2:

RQ 2: To what extent is the local context of Tambacounda favorable to the FAO project.

The chapter presents the current situation of rural areas in Tambacounda and the challenges farmers face in that region of Senegal. I also present farmers' use of information and communication technologies with a particular focus on mobile phones. The chapter is informed by a survey of farmers living in the municipalities of Koussanar, Sinthiou Malem and Tambacounda but also in-depth interviews with farmers who participated as testers to the FAO project. The data also derive from interviews with authorities and individuals involved in the promotion of agriculture in the region.

Based on the answers provided by the respondents, I first present the general problems of the agricultural sector in Tambacounda. Then I introduced the characteristics of the farmers and their information-seeking and information processing patterns. The chapter also lays out some differences between man and woman farmers in terms of access to land, education, and the use of information and communication technologies.

Land

Farmers are commonly defined as people who rely on the land for subsistence. As strange as it may seem, in Tambacounda, the majority of the farmers mentioned access to land as the major issue that they encounter. As one respondent put it , for decades, local

authorities have decided not to allocate land. At the national level, a commission for land reform has even been set up to afford equal access to land for citizens but, it has not yet contributed to making things better. Although land grabbing is not widespread in Tambacounda as it is in other areas of Senegal, farmers complained cumbersome land tenure procedures and difficulties in accessing farmlands. Among the survey respondents, only 62% own crop land.

With the increase of the population size and density and the rise in the demand for land, many farmers are compelled to overcrop the same parcel of land for decades, which negatively affects agricultural productivity because of the poor nutrient status of the soil. Informant 45, a man farmer in his seventies revealed that he was obliged to find his way to obtain a new crop land.

> Nowadays, there is no good land in the village where I live. I talked to the village chief and he allowed me to find a place deep in the forest. I went to the forest and cut different trees to have a spot to grow crops. I cannot stay without farming and the land that exists in my village is not fertile anymore.

In addition to deforestation, the difficulty to access land leads to the displacement of people. If Informant 45 walks seven kilometers from his village to reach the new crop land he has cleared in the forest, others have left their villages altogether. Informant 58 another man respondent stated:

> I know people who have left our district and moved to remote villages to access fertile lands to grow crops.

The difficulty in accessing land affects both men and women. However, the number of women who cannot access land is much higher, compared to men. Among the 102 farmers who answered the survey, only five men (4.9%) do not own a land compared to 34 women (33.3%) . As illustrated in Table 3 below, overwhelmingly most men have

land and a huge portion of the women do not. A chi-square tests comparing the data for men and women found that the differences are statistically significant. If for men, the difficulty to access may be related to the decision of the authorities to put a halt on land distribution, for women the situation is quite different. According to the women respondents, cultural structures prevent them from owning land. Informant 20 explained that:

> The crop lands are occupied by men. They inherit it from their fathers who inherited it from their grand-fathers, who in turn inherited it from their great-grand fathers.
>
> Men's occupation of land is confirmed by men respondents. Informant 58 confessed that:
>
> What we give to women is only one hectare for market gardening. They do not grow crops in large areas as we do. Women cultivate vegetables and additional resources for their children.

Informant 20, a woman in her fifties explained that this practice emanates from a long tradition which asked women to only work in their husbands' compound, to just grow vegetables behind the huts of their husbands' house. Survey data comparing the number of years that men and women have been farming show that the mean year for men is 27.04 while that of women is 16.71. On average, men have been farming for 27 years whereas for women the experience is about 16 years.

As an illustration, none of the women interviewed declared having their own crop lands. In general, only women associations are allocated land for market gardening. A case in point is the association called Galle Aynabe Women in Livestock which gathers 150 women who have been allocated only three hectares for growing vegetables. The same situation is faced by Informant 60 and her association of rural women living in 10 villages and which only received five hectares of land from the municipality.

The case of Informant 25, a woman in her sixties is indicative of the difficulties that women face in acquiring croplands:

> I am the eldest sibling in our family. My brothers used to grow crops on the land that belonged to our father. Since my children were raised in my father's house, they used to cultivate the land along with my brothers. When my father passed away, my brothers permitted my children to cultivate on a spot of the land for my benefit, but I do not have my own parcel of farmland.

A man member of the farmers' regional association makes a correlation between the structure of the African society and women's access to land. In this society, a woman must not raise her voice in front of her husband, on the family farm, or in front of the village. Informant 48 who is a man clearly expressed the general mindset:

> If you are a married rural woman whose husband owns a family farmland, why do you need to own your own land?

Even though most of them do not own crop land, women are very active in the agricultural sector. As revealed by Informant 19, a woman participant:

> Women have to work on their husband's land. They have to help them. Currently, people are harvesting peanuts and women spend the whole day in the crop lands gathering peanuts. In the end, they collect the grains left in the soil which can be 2 to 3 big sacks of peanuts. So, men grow peanut, but women are in charge of processing it.

In the region of Tambacounda, the difficulty to access land may be an explanation to the small size of crop lands. According to the survey data, the average size of the land is 2.06 hectares. Roughly 54% of the farmers have land the size of which varies between one hectare and two hectares. It also appears that 20% of the surveyed farmers have less than one hectare, and 26% have more than two hectares of land (See Table 3 below).

Table 3: Comparing men and women in terms of land ownership, years of farming, and farm size

	Men	**Women**	**Chi Square/T-test**
Land Ownership	95.10%	66.7%	Significant
Years of Farming	27.04	16.71	Significant
Farm Size	2.31	1.82	Significant

Equipment

Along with access to land, farm equipment appears as the second major challenge facing the farmers. The argument is that most of the equipment used is obsolete or rudimentary. Informant 59, a man respondent declared:

> The equipment that we use dates back to the period of Senghor[4]. We use seeders and "houssines"[5] that are over 40 years old. There is no new equipment. There is no equipment apart from the tools made by local blacksmiths.

This assertion contrasts sharply with the national policy of equipment provision which consists of making annual distribution of agricultural tools and equipment to farmers. As a state official put it, since 2012 the government provides to farmers in the country 1,000 units which include "houssines", seeders, and tillers. The annual equipment is subsidized for up to 70%. For example, for a seeder that costs CFA 150,000

[4] This refers to the first President of the country, Leopold Sedar Senghor who presided over the country between 1960 and 1980.
[5] A French colloquialism that means a machine used for ploughing

($300), the state pays for CFA F 90,000 ($180) and the producer pays CFA F 60,000 ($120). Other types of equipment are tractors, power tillers, and combine harvesters.

For Informant 48, a senior member of the farmers' association, great efforts have been made by the government in terms of tractors.

> Compared to the year 1995 to early 2000s, there has been real progress. We used to have only one to two tractors for the whole region. The government started the distribution of tractors about five years ago and currently in each municipality, there is at least one tractor.

However, for the whole region, only 12 tractors were available in 2019. Even if some other projects and programs help in providing tractors, the number of tractors and other equipment given by the state appears inadequate, in the estimation of many respondents. Informant 58, a patriarch stated:

> In the district of Koussanar which is made up of the municipalities of Koussanar and Sinthiou Maleme, there are only four houssines, which is not enough and leads to problems.

Informant 32 who is a young farmer took the same stance:

> In the district where I live there is no tractor given by the state. People who have tractors paid them out of their pockets.

In addition to these grievances, producers also deplore the lack of information in the distribution criteria. Informant 40, a man participant asserted:

> We do not know the criteria for the distribution of the equipment. It is often said that the equipment is given to large producers, but I do not know the criteria. Maybe if I had known the criteria, I would have requested for one tractor.

Inputs

Although seeds and fertilizers are subsidized by the state, farmers mentioned certain constraints that limit the efficiency of subsidy administration. As Informant 40 put

it most farmers cannot easily access fertilizers which are often made available between May and June, typically periods of the year when farmers have difficulties making ends meet. Although the authorities have subsidized the inputs for up to 50%, the bag of fertilizers sells at CFA F 6,000 ($12) and CFA F 7,000.($14), which seem expensive for many. In 2019, the state distributed between 3,000 and 4,000 tons of fertilizers and 4, 000 tons of peanut seeds. With the long practice of agriculture on the same space of land for many years, great sections of the soil have lost productivity. Therefore, only the provision of farmers with certified seeds and fertilizers can help improve the yields. For the farmers, consistent efforts should be made at this level by state authorities. Like many other men respondents, Informant 57 argued that access to certified seed is not an easy task:

> Today farmers cannot access certified seeds. They just use the seeds that are available.

In addition to access to seeds, there is another issue related to their management . As Informant 45 disclosed, most farmers have difficulties managing their harvests, leading to high post-harvest losses. First, they do not have places where they can store the crops and often pile the harvest in huts and straw shelters. Building warehouses for keeping the harvest would help ensure food security and avoid any deterioration. Second, the construction of warehouses helps them save the production and have seeds with good germination capacity that promote cropping during the next planting season.

Deforestation

Logging is a very rampant practice in Tambacounda. With the scarcity of crop land, a great number of farmers have cut large amounts of trees to obtain a spot for

agriculture. Even the classified forests which are protected by the state are not spared. Informant 9, a woman in her 60s confessed:

> There are deserts everywhere now. There is a lack of places for agriculture. Many people are now trying to get a crop land in the classified forest and the forest cannot accommodate them all. They just cut trees to have a land to cultivate.

Even if they are partly accountable for the current deforestation, farmers have a clear conscience of the effect on their livelihood. As Informant 20, another woman put it

> Deforestation can be considered a cause of rain shortage. Trees are what attract the rains.

Deforestation also impacts cattle-breeding. Informant 25, another woman who breeds sheep and goats contended that:

> Cattle-breeders used to take their herds to the classified forest where there were many pastures. Now they have difficulties finding places where the herds are allowed to graze. There are private crop lands everywhere around the classified forest.

A consequence of this deforestation is land erosion with the runoff of rain waters which damages many crop lands. With the absence of trees at various places, rain waters drain off most of the lands which are deprived of humus and other nutrients. Some of the farmers are conscious of their responsibility and complicity in this situation, but they also argue that the state should stop granting permits to people who cut trees for the production of charcoal. Charcoal sale is a revenue-generating activity in many areas of Tambacounda, and different actors are involved in the operations. Informant 40, a man respondent pointed out the responsibility of the state and indicated pathways for alleviating the damages to the forest:

> The state should subsidize butane gas so that its price goes down. This could have an impact on wood cutting and the charcoal trade. People buy charcoal because they cannot afford butane gas which is more convenient.

Rainfalls

Climate change represents a serious issue in most rural areas. Even if farmers do not complaint about the rise in temperatures, they have noticed drastic changes in the rainfall pattern. Informant 19 explained that in recent years, she has noticed great variations in the occurrence of rains. For example, in 2019 she and her husband experienced a very tricky situation:

> This year we first sew the grains after the first rains in June and then there was a long delay. Our plants started to wilt. Fortunately, in late August, the rains came again, and we decided to plant seeds again. Then the rain stopped again and all our seedings were ravaged by worms. We were obliged to find other seeds when the rains came back later.

For Informant 60, another woman, it is a real challenge for farmers to know whether it will rain or not and in 2019, many farmers were so puzzled by the delay in rainfalls that they sold their seeds thinking that the rainy season was over. Informant 58, a man in his fifties found a correlation between the difficulty of farmers to predict rainfalls and the current rates of deforestation.

> When we were children, our parents could guess the time for rainfalls by watching the trees. If they saw that some trees had a certain appearance, they would say that it was going to rain and they would start to prepare accordingly. However, today those trees do not exist anymore, and we can no longer tell when it is going to rain. There were also birds that announced the arrival of rains. Nowadays, those birds no longer exist. The whole forest is gone.

Not only are farmers experiencing delays and variations in rainfalls, but climate change has also caused disturbances in the farmers' habits. Informant 58 added:

> It had never rained here in October but for the past three years, it has rained until October. Now we are using early seeds that ripe very fast to adapt to the disturbances of the rainy season.

Farmers appreciated the efforts made by the National Agency for Meteorology and Civil Aviation (ANACIM) which has launched a system of rain alerts through SMS, but they also called for more precision in the rain and wind forecasts. As Informant 29, an extension worker revealed:

> When we get the information and it says that it is going to rain in Tambacounda, they do not tell with precision where the rain will occur. This causes delays in the work of the producers. Sometimes producers say that they are not going to the field because there is going to be a thunderstorm, or they are ploughing or hoeing because it is going to rain tomorrow. It often occurs that the forecast does not come true.

Other issues

The different challenges facing the rural areas explain the continuous decrease in yields. Informant 57 revealed:

> In normal times, on one hectare of land, the yield varies between two and three tons. Now we cannot even have 800 kilograms on one hectare.

Along with the previously mentioned themes, farmers confessed to facing other issues related to the access of funding for agricultural production. Informant 34 a man in his sixties explained that the average funding that farmers get from the National Bank for Agricultural Loan is CFA F 1.5 million ($3,000). In his eyes, this amount may be very low, relative to the investments that farmers plan to make. In addition to the frequency of bushfires, the invasion of crop pests represents another issue as explained by Informant 45 who almost lost all his production in 2018

> I grew the millet variety called *souna*[6] on three hectares, but I lost almost everything. I only got eight quintals because there were parasites that ravaged by crop land and devastated half of the field.

Along with cattle transhumance which often leads to disputes between cattle-breeders and farmers, animal wandering is decried by the respondents who deplore the destruction of fields caused by the phenomenon. Cattle-breeders also face animal theft as a recurring challenge despite the decisions of the authorities to toughen sentences on such crimes. Participants to interviews and focus group discussions also revealed that with the spread of deforestation, many wild animals that used to live in the forest have now lost their habitat. Informant 40 confessed that the forest used to provide food to wild animals such as warthogs and monkeys. However, with the practice of tree-felling, it is frequent that wild animals invade and destroy farmers' crops in search of food.

For a better profit of the production, most of the farmers agreed on the necessity to equip the region with agro-processing centers. Given the wide variety of crops grown in Tambacounda, it is unfortunate to notice that, apart from the cotton company SODEFITEX, there is no other entity dedicated to the processing of agricultural products. Moreover, farmers also stressed the importance of accessing information especially information related to the availability of seeds and fertilizers. They also indicated that the marketing of agricultural products represented another big concern and called for a reduction of the taxes and the availability of information on market prices for a better profit from their labor.

[6] Type of millet

Mobile Phone in Rural Areas

As was the case with the previous section, the information in this section derives from the survey data but also the in-depth interviews and focus group discussions. It provides insights about the use of mobile phones by men and women in rural areas, the number of years they have been having a phone, the functions they mostly use, and the constraints to mobile phone use in rural areas. The section starts with a presentation of the characteristics of the farmers and a comparison of mobile phone usage across gender.

Wide Penetration

Mobile phones have largely penetrated the lives of farmers. The majority of the surveyed farmers (90%) own a mobile phone and 8.8% have more than one mobile phone. Only 40 farmers (39%) have been having a phone for less than five years compared to 61% who have had a phone for a longer period. Roughly 26% of the farmers have been having a phone for 10 years or more. Even women like Informant 20 have a close relationship with mobile phones:

> I definitely cannot stay without having a mobile phone. It helps me do a lot of things.

Informant 45, one of the respondents of the men focus groups discussion even declared:

> I have two cell phones. I even had three phones, but I lost one.

The availability of more than one phone is explained by the desire to benefit from the offerings made by telecommunications companies. Informant 34 informed that he has four Sim cards for different networks: Tigo, Expresso, Kirene, and Orange.

> Tigo offers a lot of bonuses to its customers and Expresso does the same thing. For the Orange Sim card, I need it because of its service called Orange Money which allows me to make money transfer.

Despite the penetration of cell phones, most farmers own basic or feature mobile phones. Roughly 63.7% of the surveyed farmers have a basic or feature phone compared to 26.5% who own a smartphone and 9.8% who do not have a cell phone.

> Even if Informant 45, a man respondent, has two phones, both are feature phones.

> It's just for calling and answering calls. I can also receive and send messages. But my phones do not help me much in my work because I cannot use any application.

Informant 40, another father of a family declared that at least seven cell phones could be found in his house and most of them are feature phones. For many respondents, the cost of smartphones prevents many farmers from accessing them. Surprisingly or not, women represent the portion who has the least access to mobile technology. The survey data show that only three men (2.9%) do not own a mobile phone compared to seven women (6.9%). The number of women who do not have a mobile phone is twice as high as the number of men who do not have a mobile phone. For many women like Informant 19, the lack of financial means explains this situation:

> I cannot afford a mobile phone now. If your husband is poor and has limited resources, you use the money you get to buy food instead of a mobile phone.

To communicate with others, Informant 19 uses her daughter's phone. Informant 60, another woman participant does not own a mobile phone either. In her household, neither she nor her co-spouse has a mobile phone:

> I do not have a mobile phone. People who want to talk to me have to call my husband's number.

If for some women, the lack of a phone is related to financial means, for many others their husbands prevent them from having a mobile phone. Informant 25 revealed:

> In many villages, men do not want their wives to have a mobile phone. If the mobile phone rings, the husbands check the mobile phones and the women have to explain who is calling, why the person is calling and sometimes there are lots of disputes between women and their husbands because of mobile phone ownership. So, now may women have decided not to have mobile phones to avoid any fight or dispute with their husbands.

The survey data offer indications about the lack of phones among women. To the question "why you do not have a mobile phone?", 20% of men who do not have a phone explain that their phone is broken compared to 10% of women. However, 20% of women who do not a mobile phone explain that the lack of a phone is due to financial reasons, compared to 10% of men who do not have a mobile phone. On the same question, 40% of the women who do not have a phone believe that other reasons that explain that they do not have a mobile phone. Jealousy and the desire of control of their husbands can be ranked among the other reasons that prevent women from acquiring mobile phones.

The survey data also illustrate that men are more familiar with mobile phones than women. The means for men's ownership of mobile phones is 8.54%, compared to 4.55% for women.

Phone Usages

Both men and women recognize the usefulness of mobile phones. Informant 9, a woman in her seventies explained:

> It has been a long time since I started having a mobile phone. At that time, the phones were very big. I used it to call people and to answer calls.

In addition to the connection between people, a variety of themes come up in the analysis of mobile phone usage by farmers. They include social connection, information, marketing, weather information, money transfer, and online payment.

Social Connection

It emerged that 93.1% of the surveyed farmers declared that they use their mobile phones to connect with their friends and families. Informant 34 who holds one feature phone and a Tecno smartphone explained that his devices help him in different ways. They serve for connecting with families, friends as well as workers in the field:

> I can stay in my crop field and call my wife who is at home to know whether lunch is ready. This is one thing. Second, sometimes I can send my children to the welder and call the latter to tell him that I have told my children to come and see him.

Informant 25 who is a mother in her fifties confessed:

> I cannot imagine my life without a mobile phone because nowadays, there is insecurity everywhere. When your child is somewhere, you can call him or her over the phone to know their whereabouts. When your children go to school to Tambacounda or Dakar, or very remote places, you need a mobile phone to talk to them, hear from them, know if they are safe and sound.

In addition to the connection with people, mobile phones contribute to better coordination of agricultural activities. Informant 58, a man farmer, declared:

> Mobile phones are very useful for the work that we do. As a farmer, if you have a mobile phone and your employees have mobile phones too, you will be able to know the level of progress in the agricultural work. You will not need to move all the time. If the employees tell you over the phone that they need something, you can send it to them.

The situation is alike for cattle breeders. Informant 59, a man farmer of Fulani origin who owns cattle said:

> A cattle breeder can call his children at any time to know where the herd is, what is going on, and give them advice.

Not only do mobile phones help farmers in the daily activities, but they also help them face challenges such as bushfires. Informant 59 added:

> Sometimes we call the Service of Water and Forests to inform them that there is a bushfire in a place located 40 or 50 kilometers away. Thanks to mobile phones, we can contact the fire brigade.

Information

Information is another theme that comes up from the survey, interviews, and focus groups. According to the survey data, 72.5% of the farmers use their mobile phones to know what is happening around them. In this sense, mobile phones serve to allow farmers to get informed about happy events and unhappy occurrences. Informant 58 explained

> Mobile phones are very important. For example, I can call someone who is 20 kilometers away and ask for information. Without mobile phones, I would not be able to get that information quickly.

Informant 50, a woman who is active in milk production explained how a smartphone she got from a friend living in France opened a new world to her:

> It was very useful to me. I installed WhatsApp which allowed me to receive information from our association for women working in livestock. I used to

> receive everyday information about what's going on. I was informed about lots of events. Since I lost the smartphone, I look like a blind person.

Informant 50 revealed that she got information about livestock, cows, milk, and training sessions from the WhatsApp group of women in livestock. She argued that for each WhatsApp group, the reliability of the information delivered depends on the group administrator.

> In our WhatsApp group the administrator makes sure that everything that is published is useful to us. Sometimes other members can publish certain information and she intervenes to say that such a thing is not suitable for the platform.

Informant 48, a senior member of the regional farmers' association revealed:

> If it were not for this interview, I would be using my mobile phone to get information. Information is power. I don't want people to come and tell me what happens. I want to know it by myself. The information I look for is related to the weather forecast during the rainy season. I also look for useful information for development. Anytime there is a meeting of the Council of Ministers, I look at the measures that are taken and which relate to our sector. I also look at political information.

Agricultural Extension

As an authority of the Ministry of Livestock put it, mobile phones contribute to agricultural extension. More precisely, they allow reaching areas that are not often covered by extension workers. On account of the limited number of extension workers, many producers have difficulty accessing the right information As explained by Informant 29, one of the two extension workers that I interviewed, the number of extension workers is low compared to the communities they have to cover:

> Normally, there is one extension workers in each municipality but there is often a combination of two rural areas. It happened to me to intervene in two rural communities. Currently, in my duty post, I work with 1,200 to 1,500 producers.

His colleague, Informant 21 made the same argument:

> I am the only extension worker for the municipality of …. , which is larger than the region of Thies. I work with 87 farmers organizations. I was obliged to cover the municipality of … where there is no extension worker.

The discussions revealed that a municipality like Neteboulou which consists of 66 villages has no extension worker. According to the extension workers, mobile telephony could help overcome that difficulty but also the constraints related to mobility. Informant 21 confessed:

> It is very tiring. I have been working in the municipality of … for 19 years. Imagine a district that is as large as the region of Thies and which has a very rugged terrain. There are lots of ravines that we cross with our motorcycles. Mobility is a real problem. So, ICTs such as mobile phones help us cover certain zones.

The extension workers argued that the 30 liters of gas that they receive every month is very low on account of the number of kilometers they have to cover, Informant 21 believed that an average of 50 to 60 liters of gas would be appropriate for a more efficient job. Sometimes, to solve their mobility problems, extension workers employ particular tactics. Informant 21 declared:

> Sometimes we move to the weekly markets. They are ideal places for meeting a maximum of producers and know their needs.

According to Informant 29, mobile apps do not present a threat to the profession of extension workers. They rather contribute to more efficiency in their work. The same argument was made by an authority at the Ministry of Livestock who gave the example of a WhatsApp group set up by the women working in livestock that allows the exchange of thousands of daily messages which include sound, audio, and image. These messages encourage women to try new crops, adopt new techniques, or vaccinate their animals.

According to Informant 19, a high-ranked state official, this illustrates how mobile apps contribute to expanding the activities of extension workers:

> Extension workers used to go to the villages without images. Now with mobile phones, images and sound are sent. Also, in extension and farm advisory services, the technicians can convince the producers, but we found that the producer is more convinced by what his or her colleague producer says. If a producer says "I tested this plant; it was successful", and sends the pictures through a mobile phone, the other producers would believe that and would like to do the same thing.

Marketing

The story of Informant 20, a woman who is active in milk production is indicative of the contribution of mobile phones in the marketing of agricultural and livestock production:

> Sometimes I can be at home and receive a phone call from someone who is in Tamba and wants to buy two buckets of curded milk. Each bucket can contain five liters of milk. The person comes to pick up the milk and goes to Dakar to sell it. Thus, mobile phones are very important in our activity. I receive a lot of orders through my mobile phone.

Informant 40 took the same stance. He explained that as a man farmer, he particularly uses his mobile phone for agricultural marketing:

> For example, if there are people in Touba who want to buy peanuts, I contact them via my mobile phone. During the campaign for agricultural marketing, some collectors come to buy peanuts at the prices set by the government, but they wait for several months without paying us. So, if there are private traders who live for example in Touba, they can contact us by phone and make a deal for buying our peanuts. These traders often pay cash. This system is more profitable for us. It allows us to have cash for sustaining the needs of our families instead of waiting for months before being paid.

The capability of bargaining and marketing offered by mobile phone is strengthened by the potential of apps such as WhatsApp. For women like Informant 20 who are members of the association for women working in livestock, their WhatsApp group allows them to better market their products. Not only does the association send the

prices of products such as peanuts and millet via WhatsApp, but members can also publicize their products and search for buyers. WhatsApp also helps farmers send private messages to providers. Informant 20 explained that:

> In the past, when I needed the sachets in which I put the curded milk, I would have to commute to Tambacounda to buy them. Now, whenever I run out of my stock of sachets, I just have to send a message that tells my supplier that I need the product. The provider would then inquire as to the quantity needed and then hire a motorcyclist who delivers the sachets to the bus terminal. One of the drivers will bring it to me in my village. Once the provider has given the sachets to a driver, he will send a message on WhatsApp telling me that he has brought the product to the garage. So, I will go and take the product from the driver as soon as he arrives in my municipality. When I receive the sachets, I send a WhatsApp message to the provider to inform him that I have received the products.

Other usages

The survey data as well as the interviews and focus group discussions, revealed different other uses of mobile phones which include money transfers, online payments, access to weather information, and pricing and financial estimation. The survey data showed that 32.4% of farmers use their phones for money transfer, which represents the third popular usage of mobile phones after the maintenance of connections with family and friends, and for accessing information. With the development of *Orange Money* by telecommunication Orange, many farmers have adopted mobile money transfer because of such factors as speed, convenience, and safety. Other money transfer services in Senegal include Wari and Wave. As explained by Informant 34, a man participant:

> I often receive money transfers through *Orange Money* on my mobile phone. If I hear a beep, I understand that someone has paid me or that the money has been deposited into my mobile wallet.

Online payment is another important function of mobile phones even if only 16.7% of the survey participants use their phones for that purpose. Informant 20, a woman participant, testified:

> My son can use his phone to pay bills. Just two days ago, he paid our electricity bill through his mobile phone.

She also revealed how her phone help her receive payment.

> Sometimes I bring stuff to Dakar for sale and go back to my village. From my village, I can know whether it is sold or not. Once it is sold, they transfer me the money via Wari or Orange Money.

In the same way as online payment, a low number of farmers (15.7%) declared using their phones to check the weather forecast. On the contrary, farmers have a high propensity for using for their phones to take photos (25.5%). Also, on account of the low quality of their phones and their limited financial means, only 14.7% of the farmers use their phones to watch videos.

Sources of Information

Although mobile phones are widespread in rural areas, they do not represent the main source of information for farmers. Offered the possibility to choose among different options their main sources of information, only 39.2% of the surveyed farmers admitted getting information related to agriculture from their mobile phones. Surprisingly or not, radio constitutes their main source of information (91.2%). The important role of radio was stressed by the respondents during the interviews and focus group discussions. Informants 45, 59, and 57 who are men respectively said:

> Radio gives us the information we need. It gives us several kinds of information. It is really important to use. For new technologies, we buy them before learning how to use them. This is not the case for radio (Informant 45).

> Radio is everything for us. It represents our ears and our eyes. I listen to all the newscasts (Informant 59).
>
> I have two radio sets. There is a radio set for my home and a pocket radio that I always have with me (Informant 57).

In addition to the national radio station and private station Al Kuma FM, community radios which use local languages have the winds in their sails in the Tambacounda region.

Radio is followed by families and friends (85.3%) and NGOs (76.5%) as the other primary sources of information. At a very lower level, television ((35.3%) and lead farmers (32.4%) appear as secondary sources of information related to agriculture. Only 2.9% of the farmers declare to receive information from other sources.

Internet Connection

Only 2.9% of the farmers access the Internet through broadband connection whereas 22.5% buy Internet data bundles and 66.7% get a connection through other ways. The survey data also revealed that a great majority (67.6%) of farmers do not spend money on the Internet every week whereas 16.7% declared to spend CFA Francs 2,000 ($4) per week for Internet connection and 2.9% spend CFA Francs 5,000 ($10) a week to have Internet connection. Only 3% acknowledged spending more than CFA Francs 5,000 ($10) per week on an Internet connection.

Gender and Mobile Phone Usage

To the question “how often do you use the voice call function of your phone”, 35.9% of men and 27.2% of women answer that they use it more than 4 times a day. Roughly 10.9% of men and 13% of women use it at least once a day. The survey results

also show that men send SMS more often than women do. For example, 11 men (12%) send SMS four times a day compared to 4 women (4.3%). The data also reveal that 7 men (7.6%) send two to three SMS a day compared to 2 women (2.2%). Among the farmers who never send SMS, 21 are men (22.8%) and 31 are women (35.9%).

The group statistics show that there are differences in the use of Facebook for men and women. Women do not use the app daily. Only 2.2% of women use it between one and three times a week. As for men, 3.3% use Facebook on daily basis and 2.2% use it at least once a week. Among those who do not use Facebook, 37 are men (40.2%) and 42 are women (45.7%).

There is a difference when it comes to WhatsApp use for men and women. 13 men (14.2%) of men use it at least once a day compared to 5 women (5.5%). The data also show seven men (7.6%) use WhatsApp at least four times a day compared to 3 women (3.3%). It also appears that 4 men (4.4%) use it at least once a week compared to 1 woman (1.1%). Among those who do not use WhatsApp, 31 are men (33.7%) and 38 are women (41.3%).

The interview and focus group discussions revealed that both men and women use WhatsApp more than any other social media platform. Informant 20, a woman who is active in milk production confessed:

> I am a member of many WhatsApp groups. I am a member of my Hal Pular family group. I have joined the cattle breeders national WhatsApp group. I am also member of another group for cattle breeders in Tambacounda. In addition to that, I am a member of the farmers' WhatsApp group.

Neither men nor women use YouTube very often. The data show that 39 men (42.4%) and 44 women (47.8%) have never used YouTube. Only 3 men (3.3%) use it

once a month compared to zero women. Among the respondents, 3.3% of men declare to use YouTube only once a week while no woman uses it ever weekly.

Women in rural areas do not use Instagram. None of the woman farmers surveyed declared using the app. Only 1.1% of men use it once a month and 1.1% use it once a week.

Constraints

The survey offered the respondents the possibility to select the three major constraints to mobile use in rural areas. The options included lack of electricity, poor network coverage, lack of awareness, financial means, digital skills, the language of the technology, illiteracy, updated information, and other challenges.

Network

The survey data revealed that 85.3% of the farmers consider poor network coverage as one of the three major challenges to the use of mobile phones in rural areas. Even if the network offered by telecommunications companies is deemed satisfactory, for many farmers a lot of efforts need to be done by the other companies. Informant 34, a man respondent confessed that three telecommunication networks are available at the level of his village, but access is not guaranteed.

> If you are 20 kilometers away or even between 16 to 18 kilometers away from the village, you lose the networks. Sometimes people climb on top of trees to have access to a network. If you are 5 kilometers from the village, you cannot connect to the Internet. For example, when we are in our fields, the connection is very slow.

As a government official in the Tambacounda region revealed in some areas at the frontiers with other countries, telecommunication companies in the neighboring countries are doing much better than local operators. Informant 14, a state official declared:

> As soon as you get to the frontier with the Gambia, you receive a welcoming message from the Gambia on your mobile phone. You receive this message when you are still in the Senegalese territory. When you go to Richard-Toll, in the North of the country, you receive messages from Mauritania. The same thing happens when you get near the Malian border with Malitel. This means that there are problems. There is a need to have better coverage.

Many respondents revealed that farmers located within the Gambian border have Gambian SIM cards. Informant 14 also testified:

> When you go to Makacoulibatan, some people have Gambian SIM cards. There are areas in Makacoulibantan where I can only call at night to be able to get information from someone. They do not have a good network in the daytime. When you go to Koumpentoum, it is impossible to have a network. You can call for hours, and the calls do not go through.

According to one respondent, connection issues are not only specific to rural areas. In the regional capital also, the problem is real. Informant 40, a man participant said :

> Even in the department of Tamba, there are areas where people are compelled to go next to the main road in order to have a network.

Finances

Along with network problems, the lack of financial resources ranks among the major challenges to the use of mobile phones in rural areas. It is cited by 75.5% of the farmers as one of the three constraints. Even if many respondents declared that in rural areas, mobile phones have penetrated most segments of the population, the reality is that

most people use feature phones because of their limited means. According to Informant 9, the situation is more complicated for women.

> Women may want to have a mobile phone but sometimes they do not have the financial means neither do their husbands. They do not have children who can buy one for them. So, they cannot afford a mobile phone. All the income they get is spent on food for the families. For these women, a mobile phone is not a priority.

Electricity

Access to electricity is seen by 67.7% of the farmers as one of the three major constraints to mobile phone use in rural areas. Informant 19 explained that the lack of electricity in her house caused her to lose the only mobile phone she had.

> I used to have a mobile phone but since there is no electricity in our house, I would take it at a shop located near our house to charge the battery. One day someone pulled out the SIM card and took the phone away. When I came back to take the phone, the shopkeeper told me it was stolen.

Informant 19 also explained that to avoid the mishap that occurred to her, many villagers take a car and go to the car station where they can get their phone battery charged in exchange for payment of CFA Francs ($0.4). To face the low electricity coverage, many rural dwellers resort to solar energy. Informant 9, another woman declared:

> Some people install solar panels, and you pay them a certain amount every month. I used to have that, and it helped me charge my phone and the other phones in our household. The system allows also to turn on three lamps and to see at night. Every month, I paid CFA Francs 3,500 ($7).

In other villages deprived of electricity, affluent people like Informant 40 have their solar panel that costs between CFA Francs 35,000 ($70) and CFA Francs 40,000 ($80), and which allows charging their phone batteries. He mentioned:

> There are small solar panels that are sold in our community. That's what we buy and look for a battery that we charge. This allows us to charge our mobile phones. We particularly look for motorcycle batteries that do not cost too much. Once the sun comes out, we connect the panel so that the battery gets charged. After that, we just have to connect the charger of the mobile phones to the battery. That's how we charge the batteries of our mobile phones.

Informant 40 also explained that other people have to travel up to the municipality of Sinthiou Malem to charge their mobile phone. As for Informant 34, he gave details about the cost of energy:

> People who have solar panels ask for CFA Francs 100 ($0.2) or CFA Francs 150 ($0.3) for charging a phone's battery, which is not always easy to afford for a father of a family like me.

Illiteracy

According to the survey data, illiteracy represents a major constraint to the use of mobile phones in rural areas. It comes up that 37.3% of the farmers cite it among the three obstacles that prevent wider use of mobile devices. It is worth mentioning that illiteracy is a crucial issue in rural areas. The survey data revealed that a majority (59.8%) of farmers have not been to French school. Among the respondents, 22.5% have attended primary school and 14.7% studied up to secondary school. 2% of the farmers received post-secondary education and 1% did other studies. In addition to being illiterate in French, most of the farmers cannot read or write in their native language. Roughly 70.6% of the surveyed farmers cannot read in their native language and only 29.4% can do so. In the same way,71.6% of the farmers cannot write in their native language compared to only 28.4% who can do so.

Many of the interview and focus group respondents refer to other people to read or write messages. Informant 19 who has not been to school reckons on her children and neighbors to understand the messages she receives:

> When it is about to rain or when the wind is threatening to blow, we often receive messages. I show them to my children, or my neighbors and they tell me what the messages are about.

Informant 25, another woman is in the same situation.

> We have a WhatsApp group for women pastoralists. Any time there is an event, we receive messages in our mobile phones. For me, the messages are sent into my son's mobile phone. Any time a message is sent, he comes and tells me "Mummy, this message is for you". He reads the message and tells me what it is about. Also, there is a relay who works in our women's group. She has a smartphone and is always willing to share the information she receives with me.

Even if illiteracy is seen as an issue, many farmers who have not been to school have acquired some knowledge thanks to the use of mobile phones. Informant 20 explained the support she gets from her children.

> I have children who go to school. Anytime I receive a piece of information that I do not understand, I show it to them, and they explain to me. As they have been explaining to me many things, I have ended up understanding the meaning and content of many messages. Now I can receive certain information and understand the meaning without even referring to my children.

To overcome the issue of illiteracy, extension workers have found a way to disseminate the weather information sent by the National Agency for Civil Aviation and Meteorology. Informant 21, one of the extension workers revealed:

> Unfortunately, many people can neither read nor write. So, we try to sketch the forecast on indicative boards located at different places. For example, if there is a big wind, we try to caricature it. If the weather agency predicts rain or thunder, we try to represent that through images and put that on the boards. We then implant those boards at precise places that are very busy. This helps people who cannot read or write. This information is provided every week.

Other challenges

In addition to the four major constraints (poor network, financial resources, electricity, illiteracy), lack of awareness is cited by 14.7% as a constraint, followed by the lack of digital skills (4.9%), the language of the technology (2.9%), and lack of up-to-date information (2%). Beyond these constraints listed on the survey, 8.8% of the farmers mentioned that there are other challenges to the use of mobile phones in rural areas.

Willingness to pay

Strange as it may seem, a large majority of the surveyed farmers (85.3%) are willing to pay to access agricultural information on their mobile phones whereas 14.7% do not want to pay. Most of the farmers accept to pay between CFA F 500 ($1) and CFA F 1,000 ($2) per month. More precisely 37.3% are willing to pay CFA F 1,000 ($2) and 33.3% accept to pay CFA F 500 ($1). Only 9.8% are willing to pay CFA F 2,000 ($4) and 14.7% do not want to pay anything.

Informant 25 explained that women like her often buy Internet connection to join WhatsApp groups. They can do the same thing for accessing agricultural information on their mobile phones. In the same way, Informant 20 another woman asserted that if a farmer buys an Internet pass for CFA Francs 2,000 ($4) with the telecommunication company Orange, he or she can have a connection and communicate on WhatsApp for one month whereas for the telecommunication company Expresso, the monthly pass costs CFA Francs 1,000 ($2). However, other respondents like Informant 9, another woman take a different stance

> Farmers are not rich people. When the rainfalls are abundant, they can have income. If there is no rain, they cannot afford certain things. This is the problem. If you are not a civil servant, if you are not employed, you cannot afford certain things even if you have the will to do so.

Discussion

The objective of this chapter was to provide answers to Research Question 2 (RQ2) "To what extent is the local context favorable to the FAO project?". Through data obtained from the survey, interviews and focus group discussions it appears that there exists a variety of challenges facing farmers in Tambacounda. If I had to range farmers needs based on Maslow's pyramid, access to land would be regarded as a top priority. The difficulty to access land is more pronounced for women who face social and structural issues that deprive them of land ownership. Even if the social values that underpin this situation are not easy to overcome, local and state authorities need to see to it that land reform is implemented that would benefit all rural dwellers. The expansion of land grabbing across Senegal is a reality that focuses the attention of many NGOs and has caused various farmers protests in the country. Securing farmers' land would contribute to wrangle problems related to food insecurity, rural exodus, and migration.

The data also indicate poor quality of agricultural equipment. Despite the efforts made by the government and the support of NGOs, most farmers continue to plow their fields with obsolete or locally made equipment which does not guarantee high productivity. Access to inputs is also another thorn in the side of farmers who often use the seeds and fertilizers that are available no matter what the quality is. The issue of climate change exacerbated by deforestation represents another challenge for farmers who, more than ever before, need access to relevant information about weather forecasts and rainfalls.

On another register, despite the potential embedded in them, mobile apps do not represent the major source of information for farmers in Tambacounda. As is the case in many regions in Africa, orality dominates social life and transcribes itself in various ways. In this respect, it is worth mentioning the prominent role that radio plays in people's access to information about agriculture. For 91.2% of farmers, radio represents the primary source of information. The importance of orality appears also in the other primary sources. For a great number of farmers, their families and friends provide relevant information to their activities (85.3%). As a state official put it in general farmers emulate what friends and family members do. At a third level of the sources of information come NGOs staff who implement different projects in rural areas. Mobile phones just appear at the fourth place of the sources of information followed by television and lead farmers.

The ranking for mobile phones can be explained by the variety of constraints that hamper mobile use in rural areas. Most of the rural dwellers have basic phones that are primarily used for connecting with family and friends and getting informed. However, access to a network is a serious issue for mobile phone owners. The situation is not specific to rural areas but even extends to certain urban zones. In such a context, rolling out mobile apps for farmers to increase agricultural productivity may not attain significant results. Financial means represent another great challenge for farmers. It comes up from the data that most farmers cannot have smartphones because of a lack of money. Even if most of the respondents declare being ready to pay to access agricultural information on their mobile phones, this positive attitude could be related to social desirability. Studies show that farmers do not want or do not often have the means to pay

for digital services (Lohento & Sotannde, 2020). In most of cases, due to their digital illiteracy they do not grasp the value of the services or argue that they do not have the financial means to afford digital services.

The rolling out of mobile apps for farmers can be challenged by the lack of electricity in many rural areas. In Senegal, the rural electrification rate was estimated at 39.98% in 2017 and 42.3% in 2018 (africacheck.org, 2019). Even though the government has made great efforts and managed to provide electricity to 2,300 villages between 2012 and 2018 (africacheck.org, 2019), the vast majority of rural areas are still in the dark at night. For these segments of the population, only solar panels offer some alternative in exchange for financial investments. It goes without saying that for people who cannot access electricity, charging the battery of their mobile phones can be a real challenge.

As crucial as the other constraints, illiteracy constitutes a major issue not only for the region of Tambacounda but for also many rural people across the country. With an illiteracy rate estimated at 54% and which affects 62% of women, Senegal has lots of strides to make for access to education for all. The surveyed data revealed that 59.8% of the farmers have not been to French school. In such a context, projects like the FAO initiative that consists of rolling out mobile apps should include vocal or oral messages that farmers can understand. Not only are many farmers illiterate in French but also most of them cannot read nor write in their mother tongue. Investing in education for all is essential. Returns on investment for ICTs can only be profitable when they are accompanied by investment in infrastructure and human capital. Therefore, ICT development and usage should go along with adequate investment in complementary

infrastructure such as education and skills (Pohjola, 2002; Dewan & Kraemer, 2000, Fernandez-Portillo et al. 2019).

Summary

In this chapter I offer answers to Research Question 2 (RQ2). To the question "To what extent the local context of Tambacounda is favorable to the FAO project?" , it is easy to answer that mobile apps could contribute to agricultural extension, raise farmers awareness, and foster productivity. However, constraints such as illiteracy, lack of financial means, connectivity, and electricity can hamper the development of mobile app usage. Additionally, farmers in Tambacounda face other structural and situational difficulties such as access to land, equipment, inputs, funding, to name but a few, that cannot be overcome by just clicking on the icons of a mobile app.

In the next chapter, I will explore the strategy deployed by the FAO staff for the implementation of the project. This chapter will be based on the analysis of data from the in-depth interviews with the FAO staff, the consultants of the project, the app developers, the state focal points, but also the farmers who had been chosen as testers of the app.

CHAPTER VIII

PARTICIPATION IN ACTIONS

My objective in this chapter is to address the following research questions (RQs):

RQ3: To what extent has the FAO used a top-down approach versus a bottom-up approach in the rollout of the mobile app?

RQ3a: To what extent have local farmers, including women, been involved in the project planning?

RQ4: To what extent does the project address the local farmers' needs?

RQ4a: Are gender or other identity biases evident?

The first section of the chapter provides a description of the mobile interface and its different segments. In the second part of the chapter, I explain the way FAO worked with the consultants, app developers, and government focal points. The chapter's third section focuses on the participation of farmers in the project. While the first section of the chapter involves a description of the mobile app, the other segments are informed by in-depth interviews with the FAO staff, the two consultants of the project, two among the three developers of the mobile app, government focal points, two extension workers, but also interviews and focus groups discussions with the farmers.

A Progressive Web App

The inception of the project "Agricultural Services and Digital Inclusion in Africa" took place in Rome in late 2015. The idea of then-Director General of the United Nations agency Graziano Do Silva was to use the resources of the IT division of the FAO

in Rome to provide knowledge to farmers working in the fields in Africa. As Informant 15, a FAO staff member put it:

> We have been asked to be as close as possible to family farmers, to be complementary to extension workers in the field. This was the commitment we had at the start of the project in early 2015.

The option consisted of an app with four components: Weather and crop calendar, Feed and cure your livestock, Agrimarketplace, and E-nutritious food. The FAO decided to hire two local consultants and three local app developers who suggested the creation of a progressive web app considered to be reliable, fast, engaging, and flexible (FAO, 2017). As explained by one respondent, progressive web apps are suitable in areas like the Tambacounda region where Internet connection is problematic. These apps enable and facilitate the storage of web downloads onto mobile phones. Informant 41, one of the app developers disclosed:

> When you go to Tambacounda, you may be in areas where there is no Internet connection. You may be in an area where you have 3G and then move to an area where there is only 2G or no connection at all. With the progressive web app, when you have a piece of information in the app, let's say…I open the app and I see that peanut is sold and bought at certain prices. Once I have this information, it will remain even if I lose the Internet connection. So, for one week, even if I don't have an Internet connection, anytime I open the app, it will show this information.

Another advantage of progressive web apps is that users do not need to download them. Informant 41 also explained:

> Currently, to download an app, you go to Play Store or Windows store, enter the name of the app and download it. With progressive web apps, you only need to share the link on WhatsApp. Once you click on the link, you access the app and when you click twice, it suggests you install it.

In addition to those benefits, the downloading of progressive web apps does not require a lot of bytes, Internet data storage space, or download speed. Informant 36, who also worked on the development of the app explained:

> It is not like WhatsApp which can be about 50 Megabytes. For a progressive web app, with 2 megabytes, you can download the app.

If for Senegal, the option was for a progressive web app, for Rwanda the choice was to use RapidPro, an open-source software developed by Rwandan firm Nyaruka and which allows interactions through SMS. In the case of Rwanda, the FAO Digital Services Portfolio opted for RapidPro because many farmers do not have smartphones but, rather basic feature phones.

In the initial conception of the app, the farmer who accessed the app were asked to provide their names, surnames, and phone number as well as the country code. The farmer could also use the app without prior registration. The farmer's account profile included information about the number of livestock they have, their main crops of interest, their location, and the types of weather and crop calendar information they would like to receive as shown in Figures 16 and 17 below.

Figure 15: Registration page for farmers

(Source: FAO)

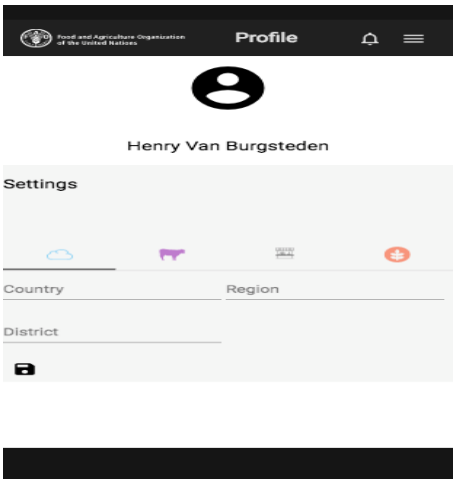

Figure 16: Farmers' profile page

(Source: FAO)

To provide a better understanding of the app content, four icons were chosen to represent the four components: a cloud surrounded by blue color for the Weather and

Crop Calendar, a cow in a purple background for the Cure and Feed your Livestock component, a market stall in a yellow environment for the Agrimarket place section and an orange plant for the E-nutritious food part (See Figure 18, Figure 19 and Figure 20 below). Informant 36 gave some explanations about the selection of the color palette and the visual language of the app interface:

> We chose those colors with the objective of a progressive appropriation of the code by the users. For example, if they see the orange color, they will know that this information is about food. If they see the cloud in the blue background, they wil understand that is about the weather .

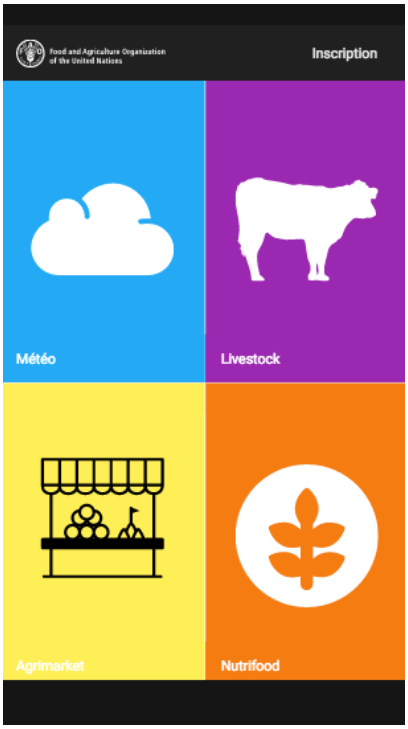

Figure 17: The four icons for the different sections
(Source: FAO)

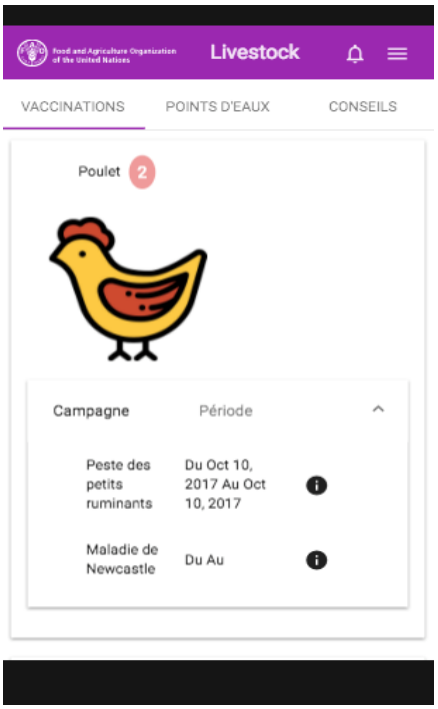

Figure 18: Information in French on the vaccination period for chicken

(Source: FAO)

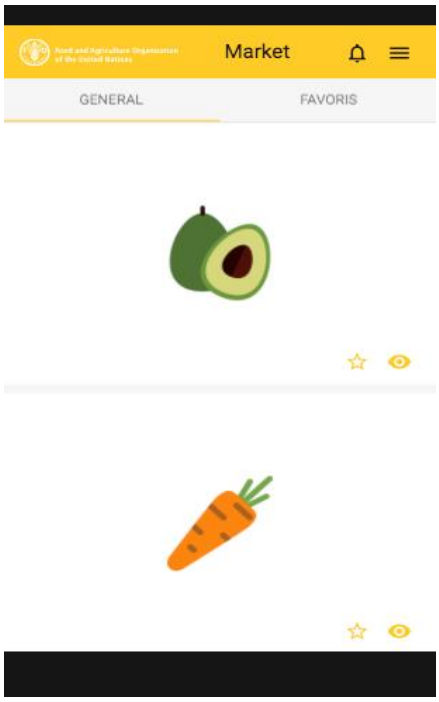

Figure 19: The Agri Marketplace section of the app

(Source FAO)

Local contribution and local content

Many respondents recognized that the decision to create and roll out the app was imposed on the country by FAO. However, they also admitted that the local consultants and developers contributed significantly to the design and the implementation of the project. As Informant 36, an app developer put it.

> There were developers in Italy, but also developers in Senegal and Rwanda. Even if we had to adopt the FAO standard in terms of app development, the decision-making for the design was open.

Informant 41, another app developer stated:

> They (FAO staff) gave us the Terms of Reference and as we were here in the country, we said 'Okay, this is good for you, but we have seen something else which could be much better'. So, there was a liberal approach to decision-making. We discussed everything. It was a very open process.

However, Informant 36 provided more details about the decision-making process:

> It was the developers in Rome who decided what information to highlight, and what structuration to choose for the app. Even though the developers in Senegal gave their opinions, the final decision was taken by the developers working in Rome.

Despite these considerations, the UN agency provided some leeway to Senegal for the selection of the pilot zone. The choice of Tambacounda for launching the project was made by the consultants based on their knowledge of the country. The latter explained that the choice of Tambacounda as the pilot region was justified by the presence of large numbers of farmers and cattle-breeders but also the region's high poverty rates. However, the existence of various projects initiated by the FAO was the main trigger. Informant 13, one of the consultants of the project declared:

> In Tambacounda there were many other projects such as the "School Farms" that FAO was developing. So, there was a real presence of FAO in the region. Since the project was just for one year, we decided to go to Tambacounda where there

were already actors, and where the FAO already had active projects. It was easier to have resource-persons on the ground to help roll out the project.

After the identification of the pilot zones, the app developers and consultants of the project established relationships with the government and several ministries (notably, the Ministry of Agriculture, Ministry of the Livestock, Ministry of Digital Economy, etc.) appointed focal points who would represent them in the various meetings and serve as liaisons. The project managers also set off to meet the beneficiaries in the region of Tambacounda (See Figure 21 below). As Informant 13, one of the consultants put it:

> We embarked on a fact-finding and a need assessment field mission to first discuss with the farmers, to identify their needs, what they need in terms of information.

Informant 24, another consultant of the project added more details:

> We went to their homes to discuss with them, to do some focus groups, to ask them lots of questions. We had a form that allowed us to understand the difficulties they were facing. We also asked questions about the projects they have benefitted from, what did these projects bring to them in order to avoid repeating past project mistakes. We also asked questions about the types of mobile phones they use, how do they use them, what do they look at in the phones. Do they have kids? Do they have literate children? We wanted to understand all these aspects.

Figure 20: One of the app developers in a village in Tambacounda in October 2017 (Source FAO)

Workshops

After gathering valuable information, the project managers decided to go back to Tambacounda and held a workshop to introduce the initiative to a restricted number of farmers selected as testers. To ensure gender balance in the number of participants, 25 men and 25 women were chosen as testers with the support of the regional office for agricultural development (DRDR) and the local service for agricultural extension (ANCAR). Informant 13, one of the consultants explained:

> We chose the farmers thanks to the assistance of the DRDR who sent us a list of farmers. We specified that we wanted to have 50% of men and 50% of women but the choice was done by the DRDR with the support of ANCAR.

After receiving the list of testers, I found that six farmers including three women were chosen for the municipality of Tambacounda, for the district of Koussanar the number was 24 farmers including 12 women. However, for the district of Missirah, 9 names of men producers appear on the list versus 10 female names. Despite the desire to ensure gender equality, Informant 14, one of the high-profile state officials confessed:

> For the FAO project, there was 40% of women and 60% of men. Among the 50 participants, 20 were women.

Informant 19, a female respondent also confirmed that there were more men than women during the workshops. According to her:

> The reason may be related to the fact that the project is about agriculture and women are not well involved in this sector. In my opinion, men are those who dominate in this field. This may explain why a great number of women did not come to the workshops.

The different meetings with the FAO staff and the project managers sought to inform the beneficiaries about the initiative. As Informant 46, an FAO staff member testified:

> During the first workshop, we introduced to them the overall objective of the project. We did a hands-on workshop. We had cards that represented the different icons of the app. The objective for us was to understand for example how information on the weather should be displayed. We listened to them and they even corrected us on certain aspects.

One respondent confirmed that the first meeting with the testers allowed farmers to bring objections to the project design. For example, in the initial version of the app conceived by the FAO, the information was presented in French and English. The workshop with the testers led to the inclusion of local languages (See Figure 22 below). Informant 24, one of the consultants revealed:

> The first time we went there they told us "You have done a good presentation, but we would rather have the content translated in local languages. Our children may translate for us, but we would feel much comfortable with local languages". Then we took that option.

Informant 41, one of the app developers even stressed the crucial push of farmers for the adoption of audio messages:

> Initially we said that we were going to present the information in many languages, whether it is Wolof, Pular, etc. However, we realized that there were people who could not read Wolof or Pular. So, literacy in Wolof or Pular was not taken into consideration. Then we decided to add audio podcasts. These are suggestions that we got at the local level and we integrated it into the app.

The testers even expressed their views regarding the design of the icons. Informant 36, one of the developers confessed:

> I remember when we put the image of a cow without horns in the first version of the app, the farmers told us that in Senegal, a cow without horns is ugly. They think that cows with horns are of better quality.

Informant 24, one of the consultants revealed:

> In the first design we decided to represent weather information with the image of the sun and one of the farmers asked "why have you given blue color to weather information? We don't care about the sun. What we want is the rain. The weather should be shown with the image of rain". This was very interesting. We did not

think about that. This is not something that we do not think about too much because in Europe weather information is often represented through the image of a sun.

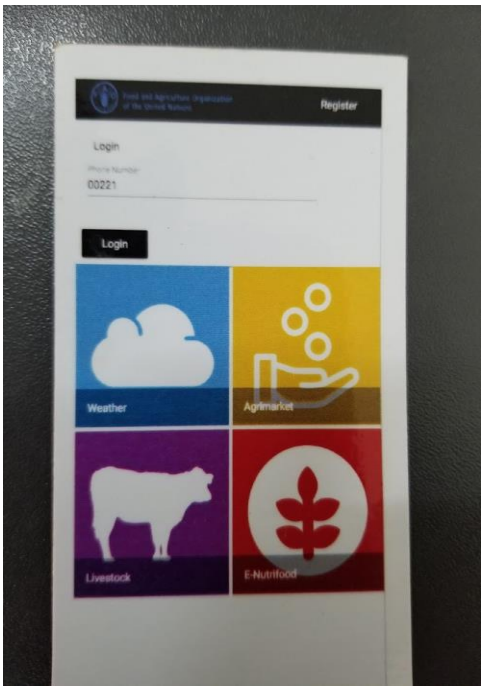

Figure 21: An example of the cards shown to the testers during the first stakeholder workshop

(Source: FAO)

During the second workshop with the farmers, the FAO brought 50 smartphones to test the app at the venue of the meeting. Informant 36, one of the developers stated:

> We brought mobile phones to know how the final user is going to interact with the app, how he or she is going to use it, what are the difficulties with using it. There was the need to consider all these factors and concerns.

The smartphones were given to the producers who were then divided into groups to test the app. However, during the focus group discussions and interviews, many farmers revealed different glitches that hampered the success of the tests. Informant 45, one of the male farmers revealed:

> They did not bring enough smartphones. They could not give the phones to some and not the others. So, they divided us into groups.

Informant 58, another male participant declared:

> They told us to form groups of 4 and 5 people and they showed us the app on the smartphones but for some of the phones, the app was not accessible.

Informant 34 and Informant 57, two other men took the same position:

> I had my smartphone during the test, but I could only see the icons. One of my neighbors who is very savvy about mobile phones could not access it. We could not go beyond the icons (Informant 34).

> Most of us could not use the phone they brought. I was in the same group as this man but the smartphone that was given to our group did not work. So, FAO took back the phones (Informant 57).

Informant 29, one of the extension workers who took part in the test found one more explanation for the problems that the farmers faced during the workshop.

> Most of the farmers had difficulties using the app because they are illiterate. When we did the test, it worked for some and not for others.

Informant 40, one of the male testers argued that even if the farmers had the app it would be very difficult for them to use it. Most of the testers do not even know how to get the app on their phones. However, he added that the difficulties were not specific to the farmers only:

> During the last training, the trainers themselves had problem using the app on the smartphones that they had brought. The app worked on some smartphones and not on others.

Another bias that came up through the discussion was related to the language of expression during the workshop. Informant 9, a woman of Fulani origin explained:

> Most of the people who led the discussions in the workshop spoke either French or Wolof. People who are literate and had mobile phone were able to understand the explanations. Since I am illiterate, I did not understand too much. The only language that I speak is Pular. I do not even understand Wolof very well.

With the different technical glitches faced in the test phase, farmers and extension workers who participated in the meetings concluded that there has not been a practical test of the project. FAO promised to come back with more smartphones that would be given out to the farmers for validating the project. Unfortunately, the project came to an end and the farmers did not have the chance to test the app by themselves.

The App and Farmers' Needs

The large majority of the farmers have a positive opinion of the FAO projects. In the one-to-one interviews as well as in the focus groups discussions, men and women expressed the improvements it could bring into their daily lives. Informant 25, a female respondent explained:

> This project is very important. You know changes occur all the time. In the past, our ancestors used to say that if you see the trees blossoming, it is a sign that the rainy season is approaching. They always reckoned on particular events to know when the rains were going to fall. Nowadays, there are changes in the way people study nature. So, the FAO provides us with new knowledge.

Informant 60 a female pastoralist affirmed:

> The training allowed us to know things that we ignored. They taught us about the weather. They had a screen that showed us what the sky looks like when it is raining. They told us also that one side of the country may be windy whereas the other is not. For pastoralists who use to move their cattle, the app can let them know that the wind that is blowing somewhere can be dangerous for their herds. The training helped me recognize that information and I could understand which direction to take to allow my cattle to avoid a wind that blows hard.

Informant 20, another woman took the same stance:

> Before the FAO staff came to train us, when we had sick cows, we were not used to separating them from the healthy ones. They taught us that we should not put the sick and the healthy cows together. The sick cows should be in quarantine, eat, and drink until a veterinary doctor comes and check them. Now whenever a cow is sick, we put it aside to avoid contamination of human beings and the other cows.

More precisely, Informant 40, a male participant praised the benefits that the component of the app called Agrimarketplace could bring to farmers:

> For example, after harvesting my production of peanuts, I want to sell it. So, I can watch on the app and know the prices in the *louma* of Sinthiou Maleme. I can then compare the prices with those in the *louma* of Altou Pass or Dawabi. If the prices charged at the louma of Altou Pass are better then, I can get in touch with the people there. They can then come and pick up the products; otherwise, I can bring it to them.

Informant 57 who is active in animal husbandry also expressed his position appreciation of the component called "Cure and Feed your livestock":

> If a livestock breeder has animals that are sick, he could call the veterinarian and inform him about that or he could call the department of livestock.

Informant 19, who leads a women association that owns a crop land stressed the importance of the component of the app related to weather information:

> The weather agency knows whether there will be enough rains or not. If farmers do not have appropriate information, they can do the seeding at the first rainfalls thinking that it will continue to rain. They may lose their seeds if the rains stop for a long period. So having an app that tells farmers when to do the seeding is very important.

In the same vein, Informant 59, a male farmer is convinced that the section of the app that provides information about nutritious food and the way to protect the harvest is very useful:

> It is difficult to store millet and peanuts. Sometimes some peasants use products designed for protecting cotton and apply those on peanuts to keep them well protected. These products are often dangerous. It is poison. The component of the app that gives farmers information about appropriate crop protection products is a good thing.

Similarly, Informant 20 believed that the app that the FAO planned to roll out could contribute to women's empowerment:

> This could empower women very well. It could increase our knowledge because women are benevolent. We can disseminate the knowledge in our groups and associations. A woman may be in a village and send you information about a successful experience and you do the same thing. When a woman achieves something great, she often wants her colleagues to do the same thing.

The farmers also appreciated their involvement in the implementation of the project and the procedure used by the managers. Informant 58 declared:

> They did not come and say: "here is what you have to do". It was an exchange between them and us.

Informant 45 held the same opinion:

> The workshop was very enriching for us. For example, most of us did not understand how rainfalls occur. We had no knowledge of the weather and the experts who came to the workshop explained it all to us.

Despite the excitement expressed by the farmers, one member of the FAO calls for more caution when it comes to analyzing farmers' attitudes towards projects initiated by international organizations. In general, producers just adhere to projects without much objection, with the sentiment that they do not have much to lose. The respondent could not certify that the project was based on a clear expression of a need for a mobile app by farmers.

A Top-Down Approach

Despite the efforts deployed for the involvement of the beneficiaries, many respondents denounced the approach taken for rolling out the mobile app. Informant 24, one of the consultants declared:

> The decision for the implementation of the project was taken in Rome. The choice of the country, the choice of the content, the terms of reference for the development of the developers, the developers, managers, those who gave the directions were in Rome, that's it. The government was committed. The

> commitment through the discourse but the decisions were already taken. It was just a fake participatory project.

To engage more local stakeholders in the project, suggestions were made to work with national start-ups that were offering the same services. Informant 24 even added:

> We tried our best to convince the FAO headquarters to involve local entrepreneurs in the project. We told them ”there are so many entrepreneurs and applications in the country. Let’s work with them. In doing so, we will facilitate the collaboration between the government and the private sector”. The answer was “no-no”.

Many respondents believed that, instead of launching a new project, FAO could have partnered with start-ups that have been working in this field since the early 2010s. Such a recommendation formulated by many participants to the project was put aside. Informant 13, another consultant for the project said:

> Unfortunately, this was not taken into consideration. I don’t know the reason, but it seems that they wanted an app made by FAO.

For many respondents, the point is that the capacity and experience of local start-ups that could help save time and money in the implementation of the FAO project. Informant 24 revealed:

> For example, *M-Louma* which has been operating since 2013 as an agricultural commodity exchange system that sends market prices to farmers via SMS. *M-Louma* has been in partnership with telecom company Orange for 3 to 4 years and it has developed a digital solution called *Xam Sa Mbay*. It has even worked with USAID on its app *Natal Mbay* and now *M-Louma* covers the Northern part of the country. We also suggested a collaboration with Daral Technologie which works on cattle rustling and animal health. Unfortunately, our ideas were discarded.

The consultants and project managers even organized a meeting with local start-up managers with the perspective of understanding the services they provide but also studying the possibility of collaboration. The initiative angered the UN agency’s high-level authorities. Informant 24 who worked as a consultant for the project confessed:

We received complaints from the FAO headquarters, and we were told not to organize this kind of meeting anymore without informing them. So, we did not have leeway for actions. We were in Senegal and we could not anything without the authorization of the FAO top authorities in Rome, which was paradoxical. We did not like that.

Informant 13 one of the consultants confessed that the project was purely top-down:

In reality we just developed the app because apparently at the FAO headquarters

the objective was to have a portfolio of FAO apps with the FAO brand.

Informant 36, one of the app developers took the same stance:

In terms of decision-making, it was a top-down approach. However, in terms of the construction of the app itself, it was a bottom-up approach. The building of the app was done in collaboration with local actors, but the structuration of the project was directly imposed by Rome.

Informant 14, a high-ranked official at the Ministry of Agriculture declared:

It is a top-down project. It came from the top to the bottom. This is why when the project managers came, there was a lot of discussions between them. The producers themselves provided much information to the project and the project managers should have given them feedback in order to allow the producers to know the improvement that have been made , and then see whether the project could be validated or not but there was no validation.

Figure 22: Women farmers during the workshop in Tambacounda in November 2017

(Source: FAO)

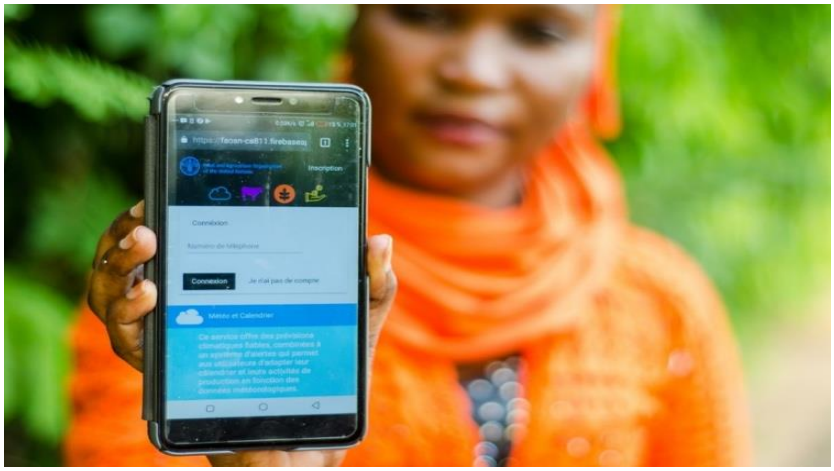

Figure 23: A woman farmer showing the app during a workshop in Tambacounda (Senegal) in November 2017

(Source: FAO)

Figure 24: Two women farmers using a feature phone during a workshop in Rulindo (Rwanda) in November 2017

(Source: FAO)

Discussion

The objective of this chapter was to address RQ 3, RQ3a, RQ4 and RQ4a. Research Question 3 asked: To what extent did the FAO use a top-down approach versus a bottom-up approach in the rolling out of the mobile apps? And Research Question 3a was: To what extent have local farmers including women been involved in the project planning?

The participants in the study agreed that the FAO had its own agenda which consisted of rolling out a mobile app for African countries. As one respondent put it, the common feeling was that the project was imposed on the country which has to adopt it by any means. This approach contrasts with FAO's classic model of communication known as Participatory Rural Communication Appraisal (Melkote & Steeves, 2015) which includes communication between project managers and the beneficiaries. As noted by Melkote and Steeves (2015), the PRCA methodology which encompasses visual material and qualitative methods such as interviews and focus groups fosters the participation of the different actors and ensures the sharing of knowledge and experience.

Given the different steps taken in the implementation of the project called "Agricultural Services and Digital Inclusion in Africa', it is clear that the intention was to ensure the involvement of the beneficiaries in the implementation of the app. In addition to focus groups organized in the villages, three other workshops were held with farmers who served as testers of the app. These workshops which many participants described as open and friendly represented platforms to gain feedback from the farmers.

Even if it can be assumed that the FAO has enough data and knowledge about the realities in rural areas, the study does not show that mobile apps represent the most relevant tools for reaching out to farmers in Senegal's rural areas. On the contrary, radio and interpersonal communication still constitute the most preferred and used ways of communication. The commitment of the United Nations' agency to building its own app explains why radio and interpersonal communication were not given priority. The underpinning motivation was to take advantage of the wide use of mobile phones in rural areas to provide agricultural services.

The top-down approach taken for this project explains why the recommendations formulated by the consultants to the project who called for involvement of local start-ups could not meet with the assent of FAO officials. A collaboration with these start-ups would allow them to learn from their mistakes and avoid offering services that are already provided in the country. The FAO project was based on a progressive mobile app that allows farmers to keep information even if they do not have access to the Internet. This format which consisted of a link that is transferable to mobile phones does not require downloading the app and does not necessitate lots of bytes.

This option also helps overcome the lack of connectivity that prevails in many rural areas. However, if for Rwanda the project managers worked on a model that could be adapted to feature phones, for Senegal, farmers could not access the app without a smartphone. Therefore, despite the advantages that are inherent to the progressive web app, the lack of financial resources for affording smartphones could expunge the benefits that are expected from the project. As Murugesan (2013) suggested, in Africa software

developers should build apps that can be used in feature phones because the majority cannot afford smartphones.

In lieu of building an app that can be used in feature phones, the progressive mobile app allows farmers to get accurate information for a limited period. If for aspects such as nutritious food, and information about how to cure and feed the livestock, the progressive mobile app seems a good option, for information about product prices and weather which varies very often, farmers need to access to the most recent updates.

Despite these remarks, it is clear that the FAO project managed to give its approach a participatory connotation. Tufte and Mefalopoulos (2009) conceived that participation can be ensured at four stages of a development project: 1) the research stage; 2) the design stage; 3) the implementation stage and 4) the evaluation stage. In the case of the FAO project, the managers ensured the participation of the beneficiaries at the research and design stages. However, on account of the short period that the pilot phase, the implementation, and evaluation stages did not take place. Moreover, even the meetings and workshops with farmers during the research and design phases occurred after the FAO decided to create a mobile app for farmers in Senegal and Rwanda.

This means that the farmers did not express the need to have a mobile app; it was the UN agency that decided to build an app for African farmers and chose the four different components. As one respondent put it “The managers wanted an app ‘branded’ FAO”. This signifies that the decision to have an app was strong for the UN agency and the research that the staff did before the creation of the app could not change much in the will of the project managers. The four components being the same for the different

African countries, the consultants, developers, and testers did not have much say in this respect.

The involvement of the farmers cannot be seen as passive participation because the feedback they provided was taken into consideration in the design of the app. However, it was neither participation by collaboration nor empowerment participation. As described by Tufte and Mefalopoulos (2009), participation by collaboration implies horizontal communication and capacity building for the different stakeholders. With the FAO project, the farmers were not at the same level of information as the managers. For example, during the interviews and focus groups, most of the farmers were asking for the smartphones that the project managers promised to give them to test the app themselves. Also, the respondents did not even know that the project was transferred to another region instead of Tambacounda. This form of participation is not empowerment participation which implies the involvement of the beneficiaries in the decision-making. In empowerment participation, the beneficiaries should be considered as equal partners, and their opinions matter in the decision-making process. As stated above, the farmers, the consultants, and the app developers could not divert the FAO from its objective of building an app. As one respondent confessed “it was a fake participation”, since the decision to have the app was already decided by Rome.

This explains why the project managers excluded any collaboration with local start-ups which were already offering the same services. The way farmers were involved in the project overlaps what Tufte and Mefalopoulos (2009) call participation by consultation. With participation by consultation, the project implementers answer the questions asked by the beneficiaries, but they are not obliged to take into consideration

the input that they give. White (1996) as well as Cooke and Kothari (2001) already stressed that many projects that claim to use a participatory approach are in reality top-down. The FAO project can be ranked in this register. Paraphrasing Cooke and Kothari (2001), it may be argued that participation was imposed on the beneficiaries to support the goals of the FAO.

In terms of the involvement of local women, the project managers strived to have an equal number of men and women in the different workshops. However, many participants revealed that the number of women who took part in the meetings was low compared to men. This can be explained by many factors. One of the most trivial explanations could be the lack of time on account of the multiplicity of household tasks that women have to tackle. Patriarchy may also represent an underlying cause. Even if most of the women testers were leaders of associations, in general women's attendance at certain meetings depends on the goodwill of their husbands. In case the latter opposed their participation, it goes without saying that women would be missing. The lack of financial means and mobile phones, as well as the lack of interest in the project may also be a factor accounting for why many women did not attend the workshops in the same number as men. Despite this consideration, it is worth mentioning that the two consultants of the project were women even if all the three app developers hired by the FAO were men.

Another important objective of this study was to investigate whether the app could contribute to improving the living and working conditions of the farmers. Research Question 4 (RQ 4) was: To what extent does the project address farmers' local needs? and Research Question 4a (RQ 4a) was : Are gender and other identity biases evident?

The farmers who have been involved as testers recognize the improvements that the mobile app could bring in their daily lives through the different services it offers in terms of access to markets, information for curing and feeding the livestock, information about the weather, and the nutritious aspects of crops and food. As Brugger (2011) put, the improved achievements, reduction of cost, and effectiveness that derive from the services offered by mobile apps underpin their viability. In this sense, it is hoped that the FAO project could last long and contribute to the betterment of the farmers living and working conditions.

The farmers' expectations about the potential of the app justify their willingness to pay for it. Most of the participants in the focus group discussions and interviews acknowledged that most of them were already spending money to access the Internet and apps such as WhatsApp. They could do the same thing if it appears that the FAO app brings positive changes in their living and working conditions. This finding is in line with the position held by Jensen (2007) and Abraham (2007) who found that Indian fishermen are ready to pay for mobile apps on account of the increased profit they are likely to get from them. Qiang et al. (2011) made the same argument and stated that, in addition to income and level of education, willingness to pay for a mobile app is dependent on the services provided. Qiang et al. (2011) also posited that farmers with low levels of education were less likely to pay, especially when the benefits take time to show up. Informant 30, who works as an ICT specialist for the Technical Center for Agricultural and Rural Cooperation (CTA) in the Netherlands also suggested that, because of their lack of financial resources, farmers need evidence about the potential of digital technology to boost agricultural production before they accept to pay for mobile apps.

Taking this aspect into consideration, I argue that the inclination to pay for the FAO app expressed by the testers may also be related to a social desirability factor on account of their involvement in the project.

The app that the FAO intends to roll out, especially its component called Agrimarketplace could help overcome information asymmetry that have a negative impact of transaction cost for farmers (De Silva & Ratnadiwakara, 2008). A large swath of literature stresses the impact of price information on farmers' performance (Nakasone, 2013; Mitra & Sarkar, 2003; Fafchamps & Hill, 2008).

In a context marked by a low number of extension workers, the FAO project could open new horizons. Accessing agricultural information on a mobile app could lead to an optimization of the work achieved by extension workers. Aker (2011) found that mobile apps help reduce the cost of information dissemination, expand the geographic scope and scale of agricultural extension institutions, and allows better communication between farmers and extension workers.

The faith in the potential of the FAO project to boost productivity in rural areas is similar to the belief that the proponents of Modernization Theory such as Lerner and Schramm had in the capacity of mass media to foster development. Lerner and Schramm argued that exposure to media messages from the West could lead people in Third World countries to abandon their traditions and embrace modernity. In the same way, the use of the FAO app with content that links farmers with markets, weather, nutritious food, and livestock information opens up windows for changes in the life of the beneficiaries.

The views of farmers regarding the potential of the FAO app are indicative of the freedoms they hope to gain from its usage. The possibility to access market prices, a weather and crop calendar, and information about nutritious food and livestock health could allow them to live the lives they value. The new tool would grant them some freedom to make the choices that allow them to help themselves and others. The category of freedom that this app could imply can be ranked under what Sen (1999) called economic facilities, which refers to the possibility to access economic resources. For Sen, the ownership of resources, their availability, the conditions of exchange which include the prices and the conditions of the market determine the economic possibilities that a person may have. Understandably, the provision of farmers with information about the prices in the different markets, livestock health, nutritious food, and weather forecasts affords them some freedom to make the right decisions. The information about how to cure and feed the livestock and nutritious food also provides users with practical knowledge that could help them live better. This can be related to what Sen calls social opportunities, which contribute to people's private lives and their participation in social and economic activities.

Moreover, the accurate information obtained from the market prices ensures transparency guarantees which are related to openness in transactions as expressed by Sen (1999). In the same vein, the fifth category of freedom which Sen called protective security could derive from the FAO project. The advice and information provided through the app could help farmers take appropriate measures against risks such as food insecurity. In other words, the optimal use of the mobile app could improve the *functionings* of the farmers, which refers to their doings and beings. This could also

enhance their capabilities, which refer to the opportunities and the freedom to achieve the functionings (Sen, 1999). Large possibilities of making choices would be ideally introduced in case the app was used without any technical, financial, social constraints.

However, the project came along with a series of biases and assumptions that were related to gender, languages, literacy, access to mobile phones. Although the project was gender-sensitive and the managers strived to ensure equal participation of men and women, there is an evident gender bias with the content of the app. The app did not contain a specific component that is explicitly designed to address women's particular needs. Men who are the most active in agricultural fields compared to women are more inclined than women to use the app on account of their interests in all its different components such as information about markets, weather, livestock, and nutritious food. Participants in the workshops revealed that women were more interested in the segments of the app related to nutrition and livestock. The low dimension ascribed to women's needs in the content of the app denotes a general trend in terms of Internet governance and app development. Jensen (2013) described Internet governance as "a sphere that perpetuates male hegemony in general and hegemonic business masculinity in particular" (Jensen as cited by Gurumurthy, 2017, p. 11). The same remark can be made regarding the development of mobile apps which are in general designed to cater to men's needs. In the typical case of the FAO mobile app, its content is not gender-specific, but it is more likely to be used by men on account of its major focus on agriculture.

As far as languages are concerned, in its initial phase, the app contained only information in French and English. The top-down approach explains the option to only focus on foreign languages for the rolling out of the app. It is clear that in a country

where the majority of the population cannot read or write in French, using that language as the instrument for accessing information about agriculture can be problematic.

Objections made by farmers during the workshops led to the inclusion of local languages such as Wolof and Pular but also the adoption of audio messages. This finding is in line with the hypotheses posited by Brugger (2011) who argued that the viability of a mobile app project depends on the availability and accessibility of the services, the value of the content, and its impact. Language and literacy barriers are key aspects of mobile app availability and accessibility. Providing the information in languages that the users can understand represents a key success factor in the promotion of mobile apps.

Bias also appeared in the organization of the workshops where the most used languages were French and Wolof. One of the respondents revealed the difficulty for some participants to understand the messages delivered during the workshops. Although Wolof stands out like a lingua franca, there are still remote areas where the inhabitants communicate in a different local language. In a region such as Tambacounda, where large segments of the population are of Malinke origin, languages such as Diakhankhe and Bambara should be taken into consideration in the provision of agricultural services.

The project planners assumed that farmers have easy access to smartphones, which explained that they promoted an app designed for this category of phone. In reality, even the testers, most of whom are leaders of the farmers' associations were not able to afford smartphones that could allow them to test the app by themselves. The lack of smartphones is much evident for women who are often deprived of financial resources. At the time I met them for interviews and focus group discussions, the testers

were still expecting to receive the smartphones that the FAO promised to distribute to them.

On another register, in terms of the app's components, if it is true that farmers can have difficulties accessing markets and weather information, the relevance of information about how to feed and cure the livestock is questionable. Cattle-breeders who have a long tradition of animal husbandry should necessarily know the ways and means to sustain their cattle. In the same way, the content of the app that explains the nutritious aspect of different crops seems to neglect farmers' knowledge in this respect and calls into question their eating patterns.

Summary

In this chapter, I have provided answers to Research Questions 3, 3a, 4, and 4a. The data from the interviews and focus group discussions reveal that the FAO conceived the project called "Agricultural Services and Digital Inclusion" which consisted of an app designed to be used by African countries. In the research and implementation, the United Nations agency employed a top-down approach even if it also adopted a form of participation known as "participation by consultation" by involving the farmers in the research and the development of the app. However, the design of the app could not be changed by objections made by the farmers, consultants, and app developers. The FAO wanted an app for its services and discarded any collaboration with actors such as start-up managers that are offering similar services in the country. Even if the developers and consultants took part in various sessions with the FAO staff in Rome, the latter had the final say regarding the content. Women were involved in the different workshops, even though their presence was inferior and their participation less so, compared to their men

counterparts. A description of the content of the app shows that the FAO project is in line with local farmers' needs. However, gender and other identity biases are evident.

CHAPTER IX

THE CONSTRAINTS

In this chapter, I offer answer to Research Question 5:

RQ 5: What social, cultural, political constraints explain the transfer of the project to ANCAR?

My objective in this chapter is therefore to explore the causes that underpin the failure of the implementation of the FAO project since the pilot phase was launched in 2017. Information in this chapter is derived from interviews with the project managers, consultants, app developers, focal points, and ICT specialists in Senegal. I have also included insights from interviews with an ICT specialist in Rwanda. In light of the data obtained from the interviews, it appears that the FAO project came across several obstacles that impeded its implementation.

Typology of the hurdles

The rollout of the project came across various impediments that led to a lethargy after the pilot phase. The hurdles were related to the multiplicity of focal points, a lack of commitment and leadership, the location of the pilot area as well as bureaucracy and the top-down approach of the initiative.

Focal points

With its transversal dimension, the FAO project was not just of great interest to the Senegalese government. Its content had cutting-cross implications required the collaboration of diverse ministries and entities which designated focal points entitled to

represent the institutions at various meetings and visits. The ministries, government departments, agencies and many allied organizations involved in the project design and rollout included the Ministries of Agriculture, Livestock, Telecommunications, the National Aviation and Meteorology Agency (ANACIM), the Food Security Commission (CSA), the Executive Secretary of the National Council for Food Security, and the State IT agency. The multiplicity of stakeholders caused serious coordination issues to the FAO staff. As Informant 15, a senior FAO staff member put it:

> When I went to Senegal, I had to attend six different meetings. Sometimes, I met different focal points together. When I finished a meeting, I had to speed up to attend another meeting at another ministry. It was very difficult.

Informant 13, one of the consultants also deplored the multiplicity of the focal points. The situation was all the more complicated as each ministry has its methods and procedures:

> We had seven focal points. We had many focal points here whilst in Rwanda there were not as many focal points. In Rwanda, there were not as many ministries involved in the project as was the case in Senegal. Here each ministry has its way of doing things. Each ministry has its budget, this also is what made things complicated. In Rwanda, the more compact organization has helped.

Informant 24, another consultant for the project explained the difficulty faced when came the time to draft and sign the Letters of Agreement (LOA):

> Even when we did the LOA (Letters of Agreement), the contracts, each ministry had to do something, and we signed separate LOAs while at the beginning we wanted to have only one LOA. In this LOA, each actor had something to do as deliverables; but we could not agree on that and as a consequence, each ministry had a specific contract with FAO and had to implement specific activities.

Staffing

Another difficulty raised by the project managers related to staffing concerns. One of the key implementers explained that a lot of arrangements had to be made to coordinate and allow the app developers to be on the same page and sing from the same song sheet. Such coordination caused needless delays in the execution of the project. Informant 15 declared:

> We had some difficulties with our local developers. They came each one from a different unit, a different startup. We decided not to hire independent people; we wanted to hire a small, and nimble young company. The developers had to be working together before I came to visit. You know it's very difficult to put three young engineers, developers, creative artists, who had never worked together, and all of sudden they had to start a project that was going directly to high-level ministers. That was a real issue.

Informant 36, one of the developers explained how they managed to find creative solutions to some of these challenges:

> We adopted a very flexible methodology. Every morning we had a stand-up session, from 8 to 8:30 am. The teams in Rwanda also were connected every morning through Skype Business with the FAO staff in Rome. At the end of the day, we had a debriefing session where we summed up the activities of the day. We reviewed what has been well done and outlined, what have been the difficulties. Throughout the project, we maintained this culture of daily information sharing.

Informant 41, another developer took the same stance:

> We had a way of doing things. Some decisions that were taken at the global level; there were also decisions taken at the hierarchical, local, and situational levels here. However, we had to synchronize everything. These morning meetings allowed everybody to get informed, to collect all the opinions and make good decisions.

The site

In addition to the difficulty of coordination between the implementers and focal points, many respondents consider that the choice of Tambacounda as the pilot region was an enormous mistake. Since the pilot phase was scheduled for just one year, the geographical remoteness of the project site located 467 kilometers (about 290 miles) from the national capital city of Dakar was a major challenge. As Informant 15, one of the key project managers at the FAO explained:

> It was not our decision. Tambacounda was chosen by the local authorities. We suggested that the site should not be so far from our office in the capital, but the choice was done. When I went to Senegal, it took two days to go to Tambacounda and come back. So, the week was almost over, and I was not able to work with the people in the ministries in Dakar. Anyway, that was the experience. It was not the case with Rwanda which is a very small country, and Rulingo, the pilot site in Rwanda is one hour drive from the capital Kigali.

The remoteness of the pilot site in Senegal was also deplored by Informant 41, one of the app developers:

> It was complicated. When we were hired as developers, the choice was already made. We did not have the choice. I think that they could have chosen another town that is not far from Dakar. I do not know why Tambacounda was chosen.

In addition to the remoteness, Tambacounda is a huge region of 59,602 square kilometers and it appeared more complex than expected. Informant 13 , one of the consultants declared:

> I said it is a complex region because it is a very big area . The farmers are scattered in different zones. There was the need to plan the workshops very early to allow the farmers to be present, making it complex.

The complexity of the region impacted the way the workshops with the farmers were carried out. Informant 24, another consultant said:

> During the workshops, we had to do many translations: first from English to French, then Wolof, Pular, and Bambara or Mandingue because in this region many languages are spoken.

Informant 14, a high-ranked official even revealed that the tests for the FAO were only done in the department of Tambacounda which hardly represents one-quarter of the region. The departments of Bakel, Goudiry, and Koumpentoum were not involved in the tests:

> The tests did not cover the whole region of Tambacounda. The participants came from three municipalities: Koussanar, Missirah, and Sinthiou Malem, and a small portion of participants hailed from the municipality of Tamba. All these four municipalities are in the Department of Tambacounda, which represents one-quarter of the whole region.

For this high-ranked official, the results of the tests cannot be representative of the whole region. Therefore, any attempt to scale up the project would be problematic on account of the different realities that the inhabitants faced in the other areas.

Another challenge that emerged from the discussions was the multiplicity of FAO projects not generally in Senegal, but more specifically in the Tambacounda region. In addition to the project called "Agricultural Services and Digital Inclusion in Africa", the UN agency has also initiated 150 school farms to teach producers best agricultural practices to mitigate the effects of climate change. It has also favored participation and communication through Dimitra Clubs established in different villages to find endogenous solutions to local issues such as bushfires, access to water, healthcare, etc. The FAO has also launched different projects related to climate change. As a high-ranked official in Tambacounda put it, the general impression is that everybody at the FAO has their pet projects. Informant 14 declared:

> There are just too many silos because it seems that everyone at FAO develops their projects and go alone. One day, I asked them to gather all the projects

> related to climate change and see how to work in synergy. This allows do a better job. If we do not do that, we will have many projects bringing different apps and at the end the producers are confused and do not know what to choose.

Within the same region, another project called CINSERE was launched by the USAID, the National Agency for Civil Aviation and Meteorology, the Research Program on Climate Change, Agriculture, and Food Security of the Consortium of International Agricultural Research Centers (CCFAS), and the Institute of Agricultural Research (ISRA), to provide weather information to bolster resilience and increase agricultural productivity. One of the respondents even stressed the multiplicity of the initiatives within FAO and the lack of synergy among the entities that work on the same issue of climate change. Informant 14 stated:

> There are many projects on climate change within the FAO. ANACIM also develops a similar program with CINCERE. I think that people should collaborate at the top level before implementing it at the bottom. Every time, they come, I ask which FAO they are talking about because they come with different projects related to the same issue.

Data Collection

In the pilot phase of the FAO project, the app developers were in charge of collecting information from different ministries and entities for upload in the app. For some entities such as the Commission for Food Security, data about the prices in the different markets sent by agents in the fields were provided every week. The information contained in an Excel spreadsheet was given to the app developers whose job it was to extract the market prices for inclusion in a database. For the Ministry of Livestock, the app developers had access to catalogues that provided information about diseases that affect the livestock, disease signs, and symptoms, first-aid measures, and disease treatment or management protocols. The catalogs also contained vaccination calendars, the locations of the

vaccination activities, and the applications and indications for the different vaccines.

Weather information was obtained from ANACIM and an open-source platform called Open Weather. Informant 41, one of the app developers declared:

> The information was not provided regularly. Initially, many ministries did not produce the required information. Then we had to set up a way of proceeding that varied from one source to another. It was very difficult to synchronize everything. This was a real bottleneck.

Informant 36, another app developer gave more details about the problems encountered:

> We used to go and collect the information, because doing so via emails was too cumbersome. First of all, before you get the information, people make you go around and around, you have to look for the person who has the information, to see how to convince that person to give it to you.

According to the respondents, data collection was not an easy task. Informant 24 who worked as a consultant for the project said:

> It was not easy. Some of the entities were more responsive and we used to organize interactive sessions with the focal points. Others were not responsive to our emails and phone calls.

Informant 36, one of the app developers found a way around the difficulty to get data from ministries:

> In some cases, the ministries did not even have the data even though they'd committed to doing so. I believe that this is not the fault of the government. For this project, there was no available budget for the production of the data. Also, there was not enough participatory approach that would push the ministries to produce the data.

In the same vein, Informant 24, one of the consultants disclosed:

> I have noticed that the government does not provide the ministries with enough money. It looks like that the ministries are obliged to look for other sources of revenues. So, in the end the Ministries start writing projects funded by

> international cooperation and organizations. This represents an obstacle to a collaboration between the government and the start-ups. That may be why the ministries do not want to provide state data. They may think "These guys want to make money from our data, we can use the data to make money". So, on account of the fact the government does not give much money to ministries, they create their projects like start-ups and NGOs. It is very complicated.

Informant 13, one of the consultants explained that the difficulty to collect data had an impact on the use of the app by farmers:

> Every time we went on a field mission, we had smartphones. We also installed the app on some farmers smartphones, but since there was no up-to-date information on the app, the farmers did not use it effectively.

Top-Down Approach

Many respondents explained that the top-down approach of the project represented a major issue in the implementation of the project. Informant 24, one of the consultants explained:

> As I said, the decision for the implementation of the project was taken in Rome. The choice of the countries, the choice of the content, the terms for the development of the app, the managers, those who gave the directions were in Rome, that's it. The government was committed; the commitment appeared through the discourse, but the decisions were already taken. They were just told what to do. Do you understand that? It was just a fake participatory project.

Informant 24 also deplored the fact the UN agency decided to stick to its project and refused not to collaborate with the locals to reinforce the already existing mobile app services:

> Today everybody is developing applications. You cannot think that you are going to develop an app and when you come everybody will use it.

The same argument was made by Informant 14, a state official:

> Apparently at the FAO headquarters in Rome, they wanted a portfolio of apps with the brand FAO. That was a major limitation.

Informant 41, one of the app developers stressed the difficulties they faced

regarding the decision-making process:

> There were often conflicts of authority. As app developers we were involved in the field. I don't accept being asked to do something that the population will not use. Sometimes the discussions could last a whole day. Fortunately, we had a dynamic team that was open to our suggestions, but we had to fight a little bit.

On account of the top-down approach, the FAO did not take into consideration that an app with four components would be complicated to use. It would be more preferable to offer one service at a time. Informant 46, an FAO staff member confessed:

> As the saying goes, 'you should not bite off more than you can chew'. I think that an app with four components was too much. For a pilot phase, the focus should have been on one component and after an evaluation, FAO would see how it worked.

One of the app developers raised some of the mishaps that stemmed from the top - down approach of the project. Aspects such as the translation of the messages in local languages were not taken into consideration. Informant 41, one of the app developers declared:

> In the beginning, we did not plan to do any translation in local languages. It was during the implementation that we realized the necessity to include that but there was not a budget for that. So, we had to do it with our means. We had to negotiate with people who could do it without any financial charge.

Bureaucracy

Another issue that was closely related to the top-down approach to the project was bureaucracy. The project managers in Senegal deplored the delay noticed in the coordination of the activities with Rome. Informant 24, one of the consultants noted:

> Bureaucracy at FAO was a big issue. It takes one month to organize one field mission, and you need hundreds of signatures; you have to run back and forth. Everything becomes difficult. You cannot carry on working on the project because the focal point at the headquarters does not respond, or does not take a

> decision, or they give you decisions that are against your will. When you try to organize something there are hundreds of administrative steps; you have to wait for five signatures to organize a simple mission. It was not easy. It was very hard.

Within the FAO staff, some explanations were found for the delay in the coordination of the activities. One respondent confessed that, in general FAO projects are implemented without much intervention from Rome. For the project called "Agricultural Services and Digital Inclusion in Africa", the point was that it functioned on Field Budget Authorizations (FBA) given by the LTO (Lead Technical Officer). For many projects, the FAO country representative is the LTO. However, for the mobile app project the LTO was in Rome. Informant 46, an FAO staff member made this revelation:

> That was the particularity of this project. There was one single colleague who had the authority to do everything, approve expenses, write directly to the General Manager, etc. Even many people who had the competence to intervene refused to do so. This explains some of the delay. However, that is not the general rule with the other projects.

This respondent also explained that in general, each FAO project has one or two consultants who are also called project coordinators because they are in charge of coordinating the activities. More importantly, each project is implemented under the supervision of administrative authority from part of the government. The Lead Technical Officer (LTO) of the project can be the country representative or a member of the FAO regional bureau. In most cases, the FAO country representative is also the Budget Holder. However, if the budget holder is at the Headquarters in Rome, delays and difficulties may occur when early actions are not taken to express financial needs.

Leadership

Another issue encountered in the implementation of the project was a deficit of leadership. The diverse entities that were involved in the project did not agree about

which institution should play the leadership role. Informant 13, one of the consultants who appreciated the commitment of the Ministry of Agriculture through its division called DAFSA, elaborated on that issue:

> The problem was that from the outset, there was a problem of leadership. Since FAO is an international organization to promote agriculture and ending hunger, the parent ministry is the ministry of agriculture. However, because the project included agriculture and technology, the Ministry of Telecommunications wanted also to play a leading role. This is where we had tensions and at a certain moment no one wanted to take the lead. We continued on and on, and no one took the lead role.

This leadership issue is understandable on account of the bureaucratic approach that the project took. As one FAO staff member testified, the project managers signed Letters of Agreement with many ministries, which is not often the case for other projects. Traditionally, FAO signs a letter of Agreement with one single national counterpart which can be either the Ministry of Agriculture, the Ministry of Fisheries, or the Ministry of Livestock. Therefore, the project agreement is set up with the Senegalese government through one of its entities, which is the tutelage ministry. After the signature of the agreement, a steering committee is selected to implement and supervise the execution of the project.

Another high-ranked official linked this leadership issue with the situation that FAO was going through at that time. During that particular period, FAO staff members were focused on the move of the subregional office for West Africa from Ghana to Senegal. This transfer was one of the deliberations of the FAO conference in 2013 which called for the creation of an office that would tackle the issues facing the subregion more efficiently. One of the respondents also confessed that during that period there was not a strong leadership from part of the FAO because the UN agency did not have an official

representative in Senegal. Its activities were rather coordinated by an interim representative.

Commitment

For most of the respondents, even if the government stated its commitment through the designation of different focal ministries, there was not a total appropriation of the project by the actors. As Informant 24, another consultant put it:

> I do not mean that there was no commitment to the project. The problem is that there was not a strong commitment, yes. We had a focal point with DAPSA, which is the Department for Agricultural Analyses, but DAPSA also had similar projects, and then there was not too much commitment to the FAO project. We did not feel the presence of the government in the project.

Informant 24, one of the project consultants stressed that the lack of commitment specially showed up when came time to meet with state officials.

> As consultants, we felt lonely. At the institutional level, we could not access to the Ministers, who are the real decision-makers. When the FAO IT official came from Rome and wanted to meet with the Ministers, it was very difficult. We used to write letters but there was no way we could access the Ministers whereas the FAO IT official wanted to meet the decision-makers, even the President of the Republic but it was not easy.

In an interview carried out in the first phase of the study with Informant 15, an FAO IT official, the latter expressed that particular concern:

> Nobody is the coordinator. This is the problem that we face, because each time I go there, I have to talk with six different units.

The lack of commitment can be linked with the absence of a national leader for the project. On account of this situation when the project ended in late 2017, the FAO was obliged to extend it until May 2018, but no national institution took it over.

According to Informant 14, an official of the Ministry of Agriculture, it was up to the FAO to ensure the institutional anchorage for its project:

> The app should not come and stop. This is the main issue with many projects. There is a need for an institutional anchorage. I always say that to project and program implementers. You come, you present, and you go. After that, there is no follow-up. In the end, the project fails.

According to this respondent, the institutional anchorage can be played by state entities such as ministries or agencies:

> The big issue is that people should not bring us projects and programs, and later go without leaving an institutional anchoring. The issue is to be connected to institutions that last; this means state institutions. When you come, organize workshops with fifty farmers and then you go away without any validation, it is a waste of time and money.

The Duration

The FAO pilot project lasted for one year. At the end of 2017, an extension was obtained until May 2018. According to many respondents, the duration of the pilot phase was too short. Informant 13, one of the consultants:

> The FAO project was so short that many things had not been taken into consideration. It took time to coordinate the activities, and everything was delayed; the ministries did not have time to roll out all the activities before the end of the project.

Another respondent stressed the complexity of the project which required more time to be successful. Informant 24 who also worked as a consultant for the project said:

> A project likes this one cannot be executed in one or two years. It is an innovation project. So, there is a need to have time. The minimum is two or three years to implement a good test project.

The short duration of the pilot project was denounced by the different focal points and local agencies. Informant 13 stressed the difficulties to carry out all the scheduled activities before the end of the project.

> When we went on field mission with the FAO team from Rome, the trips were also extremely short. You need three days to go on a mission from Dakar and Tambacounda. It is a long distance. When you get there, you spend one day or two with the farmers but also with local agencies; it was very short, and local agencies mentioned that many times during our field missions.

For many respondents, the specificities of rural areas necessitate a long period of training before the implementation of mobile app projects. Informant 27 who worked as a focal point of one of the ministries insisted on the lack of skills, low level of literacy, the deficit of network and financial means.

> Most of the time, with such projects, the beneficiaries are illiterate. For this kind of application, when you have to use it first of all there is a cost. The cost is the access to the network. The beneficiaries should be at ease in using the information. If you do not have the skills, and you are not literate, you tend to abandon it.

According to Informant 27, the beneficiaries need to be well trained to allow them to know how to enter the app, what information to look for, how to interpret the information when they get it, and how the information can serve them in their daily lives.

> Sometimes the beneficiary becomes tired and says "no, I have problems affording food. I need to pay CFA F100 or 200 for an Internet connection. I would better find food for my family". All these aspects explain the importance of good training of the farmers.

The short duration of the pilot project explained the lack of practical tests of the mobile app. None of the farmers have had the chance to use the app on their own. The FAO bought 50 to 60 smartphones and used some of them during the workshops. However, they did not even have the opportunity to meet again with the farmers to

hand out the smartphones that would allow them to test the app by themselves.

Informant 13, one of the consultants confessed:

> There was the need to return to better train the agents of the ANCAR to allow them to train the farmers more effectively. However, there was not enough training for an appropriation of the project, and then came the end of the pilot phase. There was no more budget. That is it.

According to Informant 14, an official of the Ministry of Agriculture, the efficiency of the app cannot be assessed without a practical test by the farmers:

> If they had bought those devices and given them to the Regional Office for Agriculture, to the Livestock Service, or the Office for Water and Forests, we would be able to do the tracking. With a small device, we would be able to track the number of times the farmers have used the app, but this was not the case.

Telecommunications companies

Telecommunication companies were supposed to play a determinant role in the implementation of the project. According to the respondents, the project managers reached out to the three existing service providers for a partnership in the delivery of the mobile app. Only one of them showed interest in the project. That company accepted to offer free SMS for six months, but the negotiations failed. Informant 24, one of the consultants who was in charge of setting a partnership with the telecommunications company revealed:

> They [the telecommunications company] wanted to support the FAO project provided that the name of the company appears on the app. FAO said “no” because it is a private company, and it cannot display its logo on the app. The authorities of the telecommunications company said: “ you don’t want us to show our name while we are offering free service to you”. So, the negotiations did not succeed.

According to Informant 24, the good will of the telecommunications company to support the project was related to its strategy to promote its network and brand in the

interior regions. The partnership would contribute to having better feedback about the impact of the app.

> The test was supposed to be free. Later, after a certain period of usage, the farmers would start paying. However, it the end we did not have an agreement with the telecommunications company.

Sustainability

In the analysis of many respondents, in the initial pilot phase, the FAO project did not appear to be sustainable. The UN agency recognized its difficulty to coordinate the same project in two different countries. Informant 15, a high-ranked FAO official declared:

> No, it was not sustainable for FAO. We used the money we got from our donors to organize workshops for capacity building and field missions. The main mistake was that instead of one country, we decided to intervene in 2 countries. Our initial budget was 3 million US dollars, but we got only 700,000 dollars and we decided to work in 2 countries with 4 contents. That was a big mistake.

Informant 13, one of the consultants took the same stance:

> We were the consultants and when we left the FAO, the project was not sustainable, not at all. The app was developed, the mobile phones were bought, but the farmers were not using them. After its one-year duration, the project was extended until May 2018. Then, since no local entity took it over, it came to an end.

For many interviewees, the lack of an institutional anchorage and the deficit of commitment explained such a situation. Informant 13 declared:

> There was the need to think about the durability of the project at the beginning and not at the end. There was a need to consider that from the start. Sooner or later FAO will not continue to manage the project, and the government will not. It was important to have an intermediary structure that could ensure the sustainability of the project.

Some respondents declared that they suggested a hybrid collaboration in which a separate agency would work with FAO and the government, for collecting data, updating the information, and ensuring the sustainability of the project. According to these interviewees, this third entity should also consider a monetization of the app. However, since FAO is an agency of the United Nations, its services are not supposed to be sold to farmers. Despite this consideration, many respondents argued that the farmers should be able to pay out of their own pockets to access the services. Informant 24, one of the consultants of the project said:

> I think that if they offer good prices, at the end of the day the farmers will pay because they need the services . If the service is good, if there is good information about the weather calendar, about the product prices, they will trust the information because it comes from their government. Telecom companies also have to take some risks by offering at least 6 months of free SMS. Then after 6 months, they can ask farmers to pay 60 % of the price. They have to invest in this project.

Informant 5 who worked as a focal point of a state agency argued:

> As they pay for fertilizers and pesticides that kill insects and rodents, why shouldn't farmers pay for an information service that allows them to improve their crop yields? They are already paying for services like this, why shouldn't they pay for information? Sometimes farmers do bad choices when buying pesticides, fertilizers, and other things; they do it because they do not access the right information, whereas with the app, they can even save a lot of money on many things**.**

Informant 13, one of the consultants put it in another way:

> First of all, when we went to see the farmers, we asked them questions about how they manage to have electricity. They said that they have a solar system to at least charge their mobile phones. They pay for that. They have cards. They charge the cards via Wari and Orange Money and that's how they get electricity. They know that it is important to have mobile phones and buy phone credit. We asked them all "if the application were interesting and important for you, would you be ready to pay for it", they all answered "yes". Now, the amount to pay was what remained to be discussed.

Cabinet Reshuffles

Even if it cannot be held as a major constraint to the implementation of the project, certain political occurrences impacted the organization of activities. Informant 15, one of the key project managers declared:

> There have been changes with new ministries and many complexities.

In fact, on September 7, 2017, a cabinet reshuffle led to the replacement of the Minister of Post and Telecommunications and the creation of a new ministry called Ministry of Telecommunications, Post, and Digital Economy. This political event which occurred during the pilot phase forcibly caused adjustments to the new circumstances. Another government change on April 5, 2019, was marked by the creation of a Ministry of Digital Economy separated from the entity in charge of communication. Other major facts included the replacement of the minister of agriculture and rural equipment as well as the minister of livestock. According to Informant 41, one of the app developers, those cabinet reshuffles contributed to the delay in the execution of the project.

> When a minister is nominated, it takes time to install new teams and collaborators. We had to reach out to new interlocutors.

Transfer to ANCAR

On account of the lethargy that followed the end of the pilot, many respondents appreciated the transfer of the project to ANCAR. That decision was the result of a request made by ANCAR to the FAO for support to a project called e-advisory services for the digitalization of agricultural extension services. As of Informant 11, a top official of ANCAR put it:

> On account of our limited humans, we faced a lot of difficulties to answer all the needs expressed by farmers. We decided to create a digital farm advisory service. Since we do not have the means for our policy, we addressed a request to the FAO for technical support and they gave us the project they had already developed.

The authorities of ANCAR hoped that the project will ensure the efficiency of agricultural extension and reach a large population. In addition to the initial four components of the app, ANCAR added a section on army-worm invasion. The officials also indicated that, contrary to the previous project, a steering committee comprising representatives of state institutions and the FAO would supervise the activities, but FAO will later withdraw from the implementation. To avoid the difficulties faced during the pilot phase, ANCAR will be the only institution to sign a contract with the FAO. Informant 8, an official at FAO West Africa regional office declared:

> There will be one single focal point. Even for the data that must be provided by ANACIM, we plan to have a sub-contract with ANCAR. So specialized operators will sign a sub-subcontract with ANCAR. For FAO, the global contract is only with ANCAR. ANCAR will be the only institution responsible for the success or failure of the project.

According to the respondents, ANCAR's veterinary doctors and agricultural engineers will provide specific data which will be validated by the steering committee. Other data will be provided by a company called Afrikinnovations. Informant 23 who holds a leadership role at Afrikinnovations mentioned that the services will be accessible via smartphones and basic phones through SMS. The budget of the new project is estimated at $70 million provided by FAO. The Peanut Basin represented by the Saloum natural region is the pilot zone and the content of the app will be translated in Wolof, Serer, and Pular. ANCAR authorities revealed that even if the first phase is public service, the producers will later pay to access the app.

Lessons from Rwanda

For most of the respondents, the failure of the project in Senegal was mostly the result of a lack of commitment. Informant 13, one of the consultants of the project argued that:

> I think this is due to a problem of pragmatism and work culture. The perception we had was that the Rwandan government was well committed. They wanted to pursue the project and implement the app. Our government was committed, they had the will but in terms of implementation and taking actions, there was a real problem.

For this respondent, the difficulties to access data led to this lack of commitment. Informant 12, one of the project managers in Rwanda explained that the project has been well implemented in that country. At the end of the pilot phase in Rulindo, the FAO provided $ 50,000 for an extension of the project in the whole country. The app was available on Google Play Store and the services could be accessed through SMS and a shared link. According to the Rwandan respondent, in late 2020, more than 11,000 people were using the SMS service. These users who were mostly farm promoters and extension workers had only to pay a registration fee of Rfr 12 ($0.012 or CFA F 6.62). Regarding Internet connection, bundles of Rfr 200 ($0.20 or CFA F 110) enable access to the link. Informant 12 believed that the possibility offered to farmers to use the app through SMS was crucial:

> We realized that among the farmers who participated in the workshops only 6 had smartphones; the others had feature phones. Therefore, we came up with a solution that would work for smartphones but also dummy phones through SMS.

In addition to French and English, the services are also offered in the local language Kinyarwanda and a team of extension workers is in charge of updating the content. Contrary to Senegal where the UN agency had to work with various entities, in

Rwanda the FAO signed a Letter of Agreement with the Rwanda ICT Chamber which is a component of the Private Sector Federation of Rwanda. The role of the Rwanda ICT Chamber is to ensure the promotion of the app which will later be handed to the Ministry of Agriculture. A steering committee had been set up to supervise the rolling out of the app and check the quality of the services. It is co-chaired by the Rwanda Information Society Authority and the Ministry of Agriculture. The other members include the ministry of ICT and the ICT Chamber for the private sector.

Discussion

The goal of the chapter was to address Research Question 5 (RQ5): What social, cultural, and political constraints explain the transfer of the project to ANCAR? Overall, it emerged from the interviews that most of the difficulties were related to management and organizational issues. The multiplicity of the actors who intervened as focal points for different ministries represented a major constraint for the implementation of the project. Contrary to Senegal where seven entities had their own focal points, in Rwanda the two relevant ministries involved in the project were the Ministry of Agriculture and Animal Resources and the Ministry of Youth and ICTs. The multiplicity of actors impacted the delay in the execution of the project but also explained the lack of strong leadership and commitment from the part of the state entities. Had the FAO signed a letter of agreement with one single entity, things would have been much smoother and better. In this regard it is worth mentioning that the transfer of the project to ANCAR is a promising initiative in the sense that ANCAR will be accountable for the outcome of the project.

Most of the project managers deplored the difficulties to access data which mostly stemmed from a lack of commitment of the entities involved in the project. As some of the respondents stressed, many of the state institutions nourished the dream of building mobile tools that would allow driving additional financial resources. The Ministry of Agriculture had long been working on a digital system for managing state subsidies and the Ministry of Livestock nurtures projects aiming at market information and a struggle against market theft. In the fisheries sector, ANACIM offers large swaths of information accessible through SMS. A stronger commitment from the ministries would consist of considering the FAO project as a priority for the empowerment of farmers and pastoralists. Instead of seeing it as a competing initiative that could thwart their plans, ministries and state agencies could work in synergy to reinforce the activities launched by the UN Agency for the digital inclusion of farmers. The lessons learned from their initiatives and the constraints encountered could have helped in the implementation of the FAO project. As Andrade and Urquhart (2012) put it, the implementation of ICT4D initiatives requires the collaboration and synergy of efforts of various stakeholders, including government entities. In case some of the stakeholders consider that the ICT4D projects go against their interests, they may refrain from collaborating or strive to put a stop to the implementation of the project.

It is clear that if the FAO has established an institutional anchorage for its project, it could set up an uncontested leadership that would facilitate the coordination of the decisions and the executions of the actions. Despite the LOAs signed with the multiple partners, there were no concrete actions taken by the ministries and their focal points. In this sense, it goes without saying that if the project originated from the Senegalese

government, the commitment of the different state entities would not have been a problem.

The lack of commitment from the part of the state institutions can be seen as a result of the top-down approach taken by the project. Whatever may be said, the project was born in the FAO headquarters in Rome. Even if the UN agency has solid knowledge of the rural areas in Senegal and Africa, the decision to have the mobile app did not come from the Senegalese authorities. The system of participation by consultation adopted for the project could not change much to the intention of the FAO to have a mobile app with four components designed for all African countries. However, although there are common issues shared by farmers in rural areas in Africa, there must be specific problems that are particular to certain regions.

Andrade and Urquhart (2012) clearly stated that ICT4D projects are underpinned by a modernist view that hypothesizes that granting technological instruments leads to material progress. Another assumption of the modernist perspective considers the beneficiaries as passive recipients of the technology. It is also assumed that ICT4D projects can only be implemented by people in a dominant advantaged position. Such perspective represents a political standpoint and scholars concur that ICT4D projects do not just represent the technical process, but their implementation constitutes a highly political process (Kuriyan et al. 2006; Andrade & Urquhart, 2012).

Most of the respondents stated that the FAO in Senegal has not achieved the expected results, and even some of the interviewees believed that its project for digital inclusion of farmers in Senegal failed. Many development scholars have stressed that failures of ICT projects in developing countries are commonplace. According to Heeks

(2002), about 80% of information systems in developing countries have failed. In the same vein, the World Bank's Independent Evaluation Group (2011) considered that the $4.2 billion that the Bank spent on ICT projects did not produce the expected outcomes. For Heeks (2002), failures of ICT projects can be ranged under three categories. The first category is what Heeks calls total failure. In this case, the initiative has never been implemented or a new information system is implemented before being abandoned. The second category is a partial failure which refers to an initiative for which the main objectives have not been reached and the project yields unwanted results. The third category represents the cases when the initiative is successful and does not produced unexpected outcomes. Following Heeks' description, the FAO project for the use of mobile apps by farmers in Senegal can be considered as a partial failure on account of the lethargy of the initiative and the lack of takeover from part of the local government.

Heeks (2002) defines the model for success of information systems. This model stresses on seven dimensions that help bridge the frequent gaps between information system designs and local user actuality. These dimensions include information, technology, processes, objectives and values, staffing and skills, management systems and structures, and other resources. In many regards, I can argue that for, the FAO project there was a real mismatch for many of those dimensions. In terms of information , the existence of bottlenecks at the level of many ministries did not help the app developers provide appropriate and relevant information to the farmers. The data did not flow smoothly from the ministries to the app managers; thence the lack of up-to-date information was a constraint that prevented an assessment of the relevance of the mobile app for the farmers.

In terms of technology, the difficulty for farmers to afford smartphones is worth mentioning. This represents a key constraint for the successful implementation of the project. In Rwanda where the initiative has given appreciable results, the SMS service is the component that yielded the most desirable outcomes. Even in that particular country, most of the users are extension workers and farm leaders who supposedly have a certain level of education and adequate living standards. For Heeks, the third dimension which is processes refers to the activities of users and others. In the typical case of the FAO project, the main activity of the users is agriculture. Even though, agriculture in Senegal is rain-fed, the services offered through the app go beyond the rainy season and include information about the marketplace and nutritious food. In this regard, there does not seem to be a big gap between the design and local use actuality.

However, when it comes to Heeks' fourth dimension which refers to objectives and values, it is noteworthy that practices such as patriarchy may represent a hurdle to an appropriation of the project by women farmers who, more than anybody else have trouble making ends meet. Even if at the level of staffing and skills, the people hired to work on the project were up to the job, it appeared that the management systems and structures of the project represented a big thorn in the feet of the participants who denounced the bureaucracy and concentration of the decision-making power in the hands of the FAO staff in Rome. As for the seventh dimension defined by Heeks, it refers to other resources and includes time and money. In the particular case of the FAO project, most of the respondents denounced its short duration. Moreover, the lack of money did not allow to take into consideration aspects such as the translation of the messages in local languages.

The findings in this chapter underscore the idea that the failure of many ICT projects is generally a result of a top-down approach. The FAO project did not emerge from the bottom but was rather imposed from the above by a powerful international organization. The literature shows that such initiatives do not always hold the promises of the flowers because they tend to leave some groups out of the benefits (Dodson, Sterling, & Bennett, 2012; Melkote & Steeves, 2015; Steeves & Kwami, 2017). Dodson, Sterling, and Bennett (2012), who studied the similarities of ICT-based development projects that failed, revealed that the top-down approach ranked among the central causes for unsatisfactory results. In this study that focused on research on ICT projects published in Information and Technologies & International Development (ITID) between Fall 2003 and Winter 2010, the scholars found that most of the projects were not participatory and were rather carried out in an environment marred with competition and politics.

The same statement can be made for the FAO project whose implementation in Senegal was marked by the intervention of different actors who did not show great commitment to the initiative. Zhu and Kindarto (2016) who did a study with 433 IT project participants in Indonesia concluded that leadership, decision structure, and team competence are the basis of the success of government IT projects. The authors argued that participative decision structure contributes to successful outcomes whereas hierarchical decision structure is associated with failure. The same argument could be valid for any ICT project. In the case of the FAO app project, most respondents regretted that the important decisions were made by the members of the agency working in Rome, which not only caused delays in the implementation but also frustration.

On another level, a success of the FAO would require an adoption of the app by Senegalese farmers which would depend on several factors. Franklyn and Tukur (2012) found that five elements affect IT adoption: access to IT, demographic, IT training/education, trust, and time. Access to smartphones and the cost of the services could influence the adoption of the FAO project. Socio-demographic characteristics such as age, education, gender, and income level represent other factors that need to be taken into consideration. For example, it can be expected that women who are often illiterate and have limited access to financial means would be the least portion of the rural population to access the app. For Franklyn and Tubur (2012), IT training/knowledge is another determinant factor for technology adoption. It can be assessed in terms of the type of training, the number of days of training, and the level of knowledge on IT use. It can be hypothesized that more training of the farmers about the benefits of the project would be necessary to facilitate its appropriation. Trust relates to the positive expectations of the use of IT.

In the case of the FAO project, the UN agency which has been working for a long time with farmers has built trust and confidence among them. In addition to this trust in the information, another form of trust relates to belief in the technology which has been associated with ease of use and benefits accruing therefrom. For Franklyn and Tubur (2012) time is another determinant of IT adoption, which refers to the fact the use of the technology will increase over time. For the FAO project, it could be expected that with the provision of relevant information, more farmers would use the app in the long run.

The issue of sustainability is central to many ICT project in developing countries. As described by Kisan, Dadabhau and Sing (2013), scholars have defined types of

sustainability: financial/economical sustainability, social and cultural sustainability, institutional sustainability, technological sustainability, and environmental sustainability. Each of these types of sustainability could have implications for the FAO project. Financial/economical sustainability would imply the ability of the project to engender income that allows facing the operational and maintenance costs. Financial/economical sustainability would necessitate making the cost of the app affordable to the poorest farmers. Even in Rwanda, where the app is offered at a very low price, only extension workers and lead farmers represent the largest parts of the users. This type of sustainability is all the more important as the fund donor will withdraw from the project sooner or later.

When it comes to technological sustainability, it refers to the availability and the durability of the technology. In the case of the FAO project, even if mobile phones are well penetrated in rural areas, the cost of smartphones remains prohibitive for many farmers and women in particular. According to Kisan, Dadbhau, and Singh (2013), technological sustainability is closely related to financial sustainability and includes finances and costs that are recurrent. In the case of the FAO, it comprises the costs of charging the mobile phones and purchasing Internet passes. On account of the lack of electricity, telecommunication networks, and Internet connection in various rural areas, this type of sustainability needs to be thought about. Also, the reluctance of telecommunication companies to support the initiative represents a serious hindrance to the fulfilment of the main objectives. As one respondent put it, for telecommunications companies , providing a telecommunications service to the population who do not have the means to afford the cost of the Internet would fall under the realm of their corporate

social responsibility. So, a collaboration with telecommunications companies to this project is essential for ensuring technological sustainability, even though there is need to find with them a business model that is suitable for all the parties.

Social and cultural sustainability refers to the provision of information that meets the needs of the farmers. This type of sustainability implies a consideration of local traditions, and empowerment of the disadvantaged people, conformity of the goals with the evolving needs of the beneficiaries. In this particular case of the FAO project, ensuring social and cultural sustainability means making sure that it is useful to the farmers. This would imply continuous monitoring of the issues facing rural communities but also making sure that marginalized groups such as women are not left behind.

The transfer of the project to ANCAR contributes to ensuring the institutional sustainability of the initiative. Such an anchorage would entitle ANCAR as the institution in charge of managing the activities during the implementation and in the post-project period. The act of choosing ANCAR, a component of the Ministry of Agriculture as the unique local institution for the implementation provides it some sort of legitimacy to deploy the activities and be accountable in the eyes of the state and the main donor. It can be expected that this transfer of the project to ANCAR would ensure the leadership that was lacking in the implementation of the pilot phase. The last type of sustainability which environmental sustainability does not appear in the FAO project. Environmental sustainability for ICT4D project occurs when information technologies are used at a large scale without plans for their disposal or reuse (Kisan, Dadabhau, & Singh, 2013).

Summary

This chapter relates to Research Question 5 (RQ5). The information in this section was derived from the one-on-one interviews with the project managers, consultants, app developers, focal points, and ICT specialists. It appears that management and organization issues, but also technical difficulties have led to the abandonment of the project before it was transferred to ANCAR in August 2019. The top-down approach taken by the implementers explained the lack of commitment on the part of many actors but also led to leadership problems and bureaucratic hurdles. The reluctance of telecommunication companies to support the initiative also represented a serious handicap that the implementers fail to overcome. In terms of organization, the multiplicity of focal points, the remoteness of the site, and the short duration of the pilot phase constituted other constraints for the project whose sustainability needs to be thought about.

The next chapter concludes this dissertation. In this final chapter, I will offer a summary of the major findings and describe the contribution of this study to theory and literature. I will also discuss the implications in terms of policy and make suggestions for future research.

CHAPTER X

SUMMARIES, IMPLICATIONS, CONCLUSION

This study was designed to explore the experience of the implementation of a mobile app project for farmers in Senegal. I adopted the case study undergirded by diverse theoretical lenses such as the Modernization Theory, the Capability Approach and gender approaches to development to investigate the implementation of the project by the Food and Agriculture Organization. In the preceding chapters, I have described the context of the study, reviewed the relevant literature related to the issue, introduced the theoretical framework, and analyzed the constraints that led to the lethargy of the project and its transfer to ANCAR. In this concluding chapter, I present highlights of the previous chapters and the major findings. I also outline a discussion of the contribution of the dissertation to theory and the extant literature. The chapter also explores the policy implication and makes suggestions for future research.

Summaries

In this section, I summarize the previous chapters that compose the study. Chapter One introduced the dissertation and set the stage by elaborating on how I came to choose this topic for my dissertation. As a son of farmers, I have always developed a keen interest in issues related to agricultural development. My area of focus which is development communication also implies the study of the impact of the information and communication technologies in development processes. The first chapter also offered a presentation of the background of the study and the problem statement. It also discussed the significance of the study and provided an overview of the methodology employed.

After explaining the delimitation of the study, I dedicated the last part of the first chapter to a definition of the key terms.

The second chapter of this study was dedicated to the research context. I started by offering an overview of the political history of Senegal. This section highlighted the geographical location of the country and discusses its historical past marked by the slave trade and European colonization. Even if the Portuguese were the first to set foot on the local soil, French occupation had been more impactful. After the country gained independence in 1960, French remained the official language, coexisting with local languages such as Wolof, Pular, Serer, Soninke, Jola, Mandingo. Arabic is another specificity of Senegal on account of the prevalence of Islam. It is estimated that 94% of the population are Muslim and live peacefully with a minority of Christians and Roman Catholics. I also stressed the high illiteracy rate (65%) which especially affects women (only 37.7% of women can read and write compared to 53.8% of men). In terms of politics, Senegal stands out as a beacon of democracy where about 300 political parties co-exist. The executive power is represented by the President of the Republic elected for five years whereas the National Assembly exercises the legislative power. As for the judicial branch it is vested in the courts and tribunals.

From the independence of the country to the 1990s, the Senegalese economy mainly based on agricultural and groundnut production was characterized by a fluctuation of the GDP. A notable aspect for the economy was the Structural Adjustment Programs imposed by the Bretton Woods institutions which led to massive job cuts, a reduction of people's purchasing power, a deterioration of the education and health systems. The regime change in 2000 ushered in a new era marked by the development of infrastructure

and improvement in economic production. The Senegal Emerging Plan launched in 2012 intends to foster a betterment of the living conditions of the population by 2035.

In this chapter I also stressed the place of agriculture on Senegal's economy. Since the country became independent, Senegalese agriculture which is mainly based on peanut production has been marked by a stagnation of the yields and a decrease of the cultivated lands. The New Agricultural Policy (NPA) launched in the 1980s did not reach its objective and was replaced by other projects including the Great Agricultural Offensive for Food and Abundance (GOANA) initiated by President Abdoulaye Wade. Since 2012, the Senegal Emerging Plan came along with the Program for the Acceleration of the Pace of Agriculture in Senegal (PRACAS) aiming at an intensification of cereal production and irrigated agriculture

After the political and economic overview, I elaborated on the problem of ICTs in Senegal which dates back to the year 1859 when the first telegraphic line was introduced in the country. I then described the expansion of mass media in the forms of newspapers and radio, first promoted by the French settlers to contribute to the domination of the population. Television came into existence in the early 1970s and remained a stronghold of the state until the years 2000s. However, the development of computer applications was a priority of the country right after Senegal became independent in the 1960s. Although the emergence of the Internet in Senegal dates back to the 1980s, the regime change in 2000 fostered an era of ICTs development and promotion characterized by the liberalization of the telecommunications sector. The Digital Senegal Strategy initiated under the tenure of President Macky Sall has the intention to reduce the digital divide in the country. In addition to the inequality of access to ICTs for rural and urban dwellers, a

gender digital divide prevails at a national level and reveals great disparities between men and women in the access and use of ICTs.

In chapter three, I reviewed the relevant theories that inform this dissertation. The chapter began with a definition of development communication followed by a presentation of the modernization perspective, which conceives development as a Westernization, top-down approach to communication. The Modernization Theory ascribes a powerful influence to mass media and ICTs. The modernization paradigm which was later accompanied by the diffusion of innovation theory and social marketing did not achieved the expected results despite the vast sums of money invested for technology transfer and infrastructure development. Critiques of the approach suggested the Dependency Theory which challenged the Euro-centric approach to development. Dependency theorists considered the underdevelopment of the Global South as a consequence of exploitation from developed countries. They denounced the free flow of media products from the North and called for the creation of alternative media. Like the modernization paradigm, the Dependency Theory was criticized for considering Western countries as the cause of all the evils facing developing countries. A major shift was brought by Paulo Freire who suggested a dialogic approach to communication. Such an approach led to the emergence of what is generally referred to as participatory communication. Despite the critiques that it garners, the Modernization Theory still underpins the majority of ICT4D projects

The other theory that informs this study is the Capability Approach developed by Amartya Sen (1999) who sees development as freedom. Sen defines five categories of freedom that complement each other and contribute to reinforce a person's capabilities:

political freedoms, economic facilities, social opportunities, transparency guarantees, and protective security. When it comes to ICT4D, the Capability Approach insists on the impact of technologies on the capabilities of human beings in society. I used this theoretical framework to inquire in what way the managers of the FAO project hoped to enhance the capabilities of farmers through the use of a mobile app. The study is also informed by gender and development theories. I offered a review of feminist critiques of development which took the forms of WID, WAD, GAD, postcolonial feminism, and intersectionality approaches.

Chapter four of the dissertation focused on the relevant literature that informs the study. I started the chapter by highlighting the contribution of ICTs to development through a description of the specific impact of telecommunications for finding markets, delivering products, or fostering several electronic operations. Whether social development is defined in terms of economic growth (Donner, 2004; Abraham, 2007; Jensen, 2007), sustainable livelihood (Molla & Al-Jaghoub, 2007; Khan & Ghadially, 2010), or individual capabilities (Kivunike et al.; 2009; Olatokun, 2009), it can be fostered by the promotion of ICTs. The second part of the literature review focused on the use of mobile apps in agriculture and covered the sectors of market information and e-commerce, agricultural extension, and mobile money. The third part of the literature review was dedicated to the gender digital divide and more specifically to the inequality of access to ICTs for men and women. The chapter ends with the five research questions that I intended to answer in the dissertation.

Chapter five of the study detailed the mixed methods used for answering the five research questions of this case study. I described how I came to select the FAO project as

a case that is representative of the implementation of ICTs for agriculture in Senegal. The next section focused on the site of study, the region of Tambacounda which ranks among the most disadvantaged area of the country. After a geographical and historical presentation of the region, I described the social composition of the region and presented its economic resources. Along with raw materials with which the region abounds, agriculture and animal husbandry constitute the main drivers of the economy of Tambacounda. After describing the process used to select the case study and introducing the region of the case study, I then described the different methods employed to answer my research questions.

Scholars concur that case studies employ a wide range of methods to find answers about a current phenomenon. This dissertation is primarily based on in-depth interviews and in the first section of the chapter, I explained how my background as a TV journalist determined my inclination for using in-depth interviews. I realized that choosing in-depth interviews allowed me to understand the inception of the project, the different phases of the implementation, the constraints faced and the challenges that remained to be met. In the sampling of the participants, the FAO staff in Rome and Senegal were determinant in helping me find out the resource persons that could provide insights about the project. The participants in the one-to-one interviews included the managers of the project, the consultants/coordinators, the app developers, the farmers who were chosen as testers. I also included in the interviews government officials at the Ministries of Agriculture, Livestock, and Telecommunication, and the state focal points who participated in the FAO project. The other people I sat with for in-depth interviews included ICT specialists, start-up managers, state authorities and local agencies at the site of study. I used

purposeful sampling and recruited the interviewees based on their knowledge of the project under study (Lindoff & Taylor, 2011; Rubin & Rubin, 2015).

In addition to interviews, I included focus groups in my research methodology. The reason for combining the two methods derived from the greater depth of individual interviews and the greater breadth of focus group discussions (Morgan, 1996). I used convenience sampling and the participants in the focus groups were the farmers that took part in the different workshops organized by the FAO in Tambacounda. The members of the focus group discussions were also interviewed to gain more depth about their opinions. I segmented the participants based on gender and held two group discussions, one for men and one with women.

Besides these qualitative methods, I employed the survey method to produce a snapshot of the use of mobile phones in rural areas. The survey was distributed to 102 farmers in the districts of Koussanar, Missirah, and Tambacounda where farmers had been selected as testers for the FAO mobile app. An equal number of men (51) and women (51) responded to the questionnaire. The 102 questionnaires were later analyzed using the software SPSS.

To trace the history of the FAO project, I decided to used document analysis. As noted by Yanow (2007), documents contribute to gain insights into the background information related to the design and implementation of projects. They can help support or refute interview data. The study used primarily public documents which included the FAO website, reports written by the FAO, reports produced by official partners, news stories about the project published on the Internet, and policy documents on ICTs in Senegal. Chapter five ended with a description of the strategy I used to analyze the data.

The accounts related to the findings of the study started in chapter six. I started by describing the initiatives implemented for the development of ICTs in Senegal. The data which mainly came from ICT policy documents revealed that great strides were made since 2000 for the promotion of ICTs. The second part of chapter six described a series of initiatives launched by state entities for the promotion of ICT use by farmers and pastoralists. In the last part of chapter six, I reviewed a variety of start-ups developed by young Senegalese for the promotion of ICTs in rural areas.

Chapter Seven of the dissertation started with a presentation the major problems of the agricultural sector in Tambacounda. Land ownership is a crucial issue in Tambacounda and 62% of the respondents do not own land. Lack of land is mostly felt by women. A third of the women surveyed have no crop land. The issues facing farmers include access to equipment and inputs, deforestation, and climate change. In the second part of chapter seven, I analyzed the farmers' access and use of mobile phones. The survey and interview data showed a wide penetration of mobile phones even if most of the farmers owned basic or feature phones. Another key aspect of the data is that women have lower access to mobile phones compared to men. In the third part of the chapter, I described the farmers' sources of information. The data revealed that despite the wide penetration of mobile phones, radio remained the most used source of information. The other primary sources of information include family and friends, NGOs followed by mobile phones.

In the fourth part of chapter seven, I presented a comparison between men and women in terms of mobile phone usage. It appeared that, apart from the voice call functionality, which is equally used by all the participants, the other functionalities are

mostly used by men compared to women. These functionalities include SMS, Facebook, WhatsApp, and Instagram. Neither men nor women used YouTube frequently.

In the fifth part of the chapter, I stressed the constraints to mobile phone use in rural areas. It appeared that network coverage stood out as the major challenge followed by the lack of finances and electricity. Illiteracy represented another constraint as well as the lack of awareness and digital skills.

To end the chapter, I inquired whether farmers were willing to pay to access agricultural information on their mobile phones. As curious as it may seem, I found that the large majority of them responded positively even if the sum they were willing to pay was inferior to $2 a month.

In Chapter eight of the study, I revealed that the app project originated from the FAO headquarters in Rome and the UN agency pushed it into the African countries including Senegal. This approach contrasts with the FAO model of communication known as the Participatory Rural Appraisal Communication (PRCA) which is based on fluid communication between project managers and beneficiaries. It also appeared that the suggestions made by farmers could not change much to the design of the app which was conceived to be used by all African countries. The respondents unanimously agreed that the app could improve their living and working conditions and efficiently address their needs. The new tool could therefore grant farmers new freedoms that would allow them to make choices and live the lives they value (Sen, 1999). However, the interview data showed that the project came along with certain biases related to gender, languages, literacy, and access to mobile phones. Even if the project was conceived as gender - sensitive, the app did not contain information designed to target women's needs.

In chapter nine I offered an overview of the constraints that explain the transfer of the FAO app to ANCAR. It appeared that the lethargy that followed the end of the pilot phase resulted from management and administrative issues. The multiplicity of the focal points constituted a key hurdle in the implementation of the project. The remoteness of the site of the study was deplored by most of the respondents who suggested that, on account of the short duration of the pilot phase a site closer to the capital city would be preferable. Many respondents stressed the complexity of the region which is characterized by a rich linguistic diversity. Furthermore, data collection also was a huge conundrum for app developers. Not only many ministries did not produce the data, but others were reluctant to deliver the required information.

Even if the farmers were consulted before the implementation of the project, most of the participants deplored the top-down approach. The idea originated from the headquarters of the FAO in Rome before the decision was taken to reach out to the beneficiaries in Senegal and Rwanda. The ambition of the UN agency to have an app "branded FAO" explained the reluctance to collaborate with entities that were already offering the same services. Furthermore, the bureaucracy at FAO constituted another issue. Most respondents denounced the concentration of the authority in the hands of a small number of people in Rome. Such bureaucracy caused frustration and delay in the coordination of the activities. Despite this situation, the project was also marked by a deficit of leadership and commitment at the local level.

The short duration of the project combined with the remoteness of the pilot site, the lack of commitment and the lack of up-to-date information did allow to roll out the app and assess its impact on the living and working conditions of farmers. Another issue

that remained a big challenge was the sustainability of the project. In addition to the financial participation of the farmers which would allow covering the maintenance cost of the project, the FAO did not ensure the institutional sustainability of the initiative which would consist of having a local entity that takes over the enterprise when comes the time for the UN agency to stop its intervention.

Major Findings

In this section, I present the summary of the major findings that came up from the dissertation which was based on five research questions:

1) To what extent is the national context of Senegal favorable to the FAO project "Agricultural and Digital Inclusion in Africa?"
2) To what extent is the local context of Tambacounda favorable to the implementation of the FAO project?
3) To what extent has the FAO used a top-down approach versus a bottom-up approach in the rolling out of the mobile app?

   3a. To what extent have local farmers including women been involved in project planning?
4) To what extent does the project address farmers' local needs?

   4a. Are gender or other identity biases evident?
5) What social, cultural, political constraints explain the transfer of the project to ANCAR?

From the analysis of documents and the interview data, it emerged that Senegal has made great progress for the advent of information society and is therefore favorable to the

FAO project. With the reform of the telecommunication code and the liberalization of the sector, three major companies are intervening in the country although French multinational Orange represents the dominant player. The state IT Agency deployed great efforts for the advent of e-governance with the support of foreign donors; as for the regulation of the sector, it is under the onus of the Agency for Post and Telecommunication Regulation (ARPT). Large areas of the country have access to networks and Internet connection even if there is still much to be done in rural communities. Compared to other African countries, Senegal is well-equipped in terms of infrastructure and the cost of the Internet is considered affordable. According to the estimates, between 90 to 95% of the population and 80 to 90% of the territory are covered by telecommunications companies. Even at the level of the Agency for Post and Telecommunications Regulation (ARPT), the general opinion is that telecommunications companies abide by their terms of reference, many segments of the populations complain about the lack of coverage and network especially in rural areas.

In addition to the national strategies, sectorial initiatives are implemented by different ministries for the access of farmers, fishermen, and pastoralists to ICTs. Another particularity of the ICT sector in Senegal is the multiplicity of the actors. The government needs to determine a unique coordinator of its ICT policy. Along with the ADIE (which is the state IT agency), and the Ministry of Telecommunication, other entities such as the Trade Point and the ARPT constitute the key players in many ICT projects.

For Research Question 2, it emerged from the interviews and focus group data, that the local context in Tambacounda was not favorable to the FAO project. In this region which is seen as the most poverty-stricken in the country, farmers face structural

difficulties to access land, equipment, and inputs. Deforestation and climate change represent other crucial issues that cause the displacement of people to other areas. In terms of ICTs, it is worth mentioning the large penetration of mobile phones. From the survey, interviews, and focus group discussions, it appeared that mobile phones are well penetrated in the region and some farmers even have more than one mobile phones. Even if many mobile phones can be found in one household, the data also revealed that women have less access to mobile phones compared to men. Similarly, men have been having mobile phones for twice as long as women. A general feature is that farmers have more access to basic/feature phones than smartphones. Most farmers use their phones to connect with families and friends, get information, or reach out to extension workers. The other usages include marketing, money transfer and online payment. In terms of sources of information, radio represents the most used means for getting informed followed by family and friends, and NGOs. Mobile phones only come at a fourth rank followed by television. When it comes to an Internet connection, only a few farmers (2.9%) access the Internet through broadband connection compared to 22.5% who purchase Internet passes and 66.7% who get connections from other ways.

Men and women use equally use the voice call functionality of their mobile phones. However, on account of illiteracy and lack of financial means, more men than women use the other functionalities such as WhatsApp, Facebook, SMS, etc. Furthermore, the constraints to the access to mobile phones in rural areas include access to electricity, the deficit of network, lack of finances.

For Research Questions 3 and 3a , the data revealed that the FAO used an approach that could be characterized as participation by consultation. The project was conceived by

the authorities in Rome before field missions were organized to meet with the farmers. On account of illiteracy, the lack of network, Internet connection, the difficulty to have smartphones, a mobile app does not seem the best tool to communicate with farmers. Also, the top-down approach taken in the implementation explained the reluctance of the project managers to collaborate with start-ups that were already offering the same services. It also explained the bureaucracy and delay in the execution of the activities. Additionally, it was found that the farmers including women were involved in the design of the app. The project managers decided to consult with fifty farmers who were chosen as testers. They participated in different workshops and gave their opinions about the design of the app. However, the reality is that those suggestions could not bring a great change in the four contents of the app which was designed for all the African countries. On account of the top-down approach, aspects such as local languages and voice messages were not taken into consideration in the first design of the app. Even if women were conveyed to the workshops, their presence was inferior to that of men.

The study also addressed Research Question 4 which asked*:* To what extent does the project answer farmers' local needs? It appeared that the four contents were in adequation with the needs of the farmers. When it comes to finding markets, getting information about crop calendar and the weather, or information about how to feed the livestock or the nutritious food, the app could be of great importance. However, it came up from the data, that information about weather and crop calendar is more praised by farmers on account of the impact of climate change and the variations in the rainfalls. Information about nutritious food appeared to be of minor importance compared to other topical issues such as pest invasion. Therefore, there is a need to think about the priority

information contained in the app. Also, farmers seemed to face other structural issues that are more crucial and cannot be sold by the provision of an app. Access to land, equipment, and inputs are more crucial than the rolling out of apps. Moreover, even if farmers access to market information, they could not take advantage of it if they do not have good roads for conveying their products.

The data also revealed that there was a gender bias. Even if they were involved in the workshops, there was no specific content that targeted women's needs. Other assumptions made by the app managers were related to literacy, languages, and the availability of smartphones. The reality showed that using SMS , voice, or USSD services would be more beneficial for farmers who mostly lack financial means.

The study also unearthed the social, cultural, and political constraints that explained the failure of the project and its transfer to ANCAR. The top-down approach of the project, the multiplicity of the focal points, the lack of commitment, the lack of cooperation from part of telecommunication companies, cabinet reshuffles, a lack of leadership and institutional anchorage led to a failure of the project which was not taken over by a state entity at the end of the pilot phase.

Implications for theory

In this study, three theoretical frameworks were used to explore the implementation of an ICT4D project in Senegal. I employed the Modernization Theory, the Capability Approach as well as gender and development theories to discover the motivations behind the planning of the FAO project, the strategies taken for its implementation, and the constraints that hampered the execution. It appeared that the

three theories were suitable for answering the different research questions that undergirded this study. All three theories are guided by the same ideal of economic, social, and cultural emancipation of human beings, the attainment of better living conditions for the populations. The combination of the three theories helped debunk the discourses that surround the promotion of ICTs in developing countries. If the Modernization Theory offered an opportunity to understand the motivations of the project planners, the Capability framework and the theories of gender and development allowed to study the impact of ICTs on farmers' lives and to single out the factors that explain the unequal access for men and women.

The interviews with ICT promoters and specialists shed light on the objectives and goals of policy makers and the extent of the hopes placed on ICTs for changing the farmers' living and working conditions. The lived experiences of men and women who took part in the implementation of the project provided insights into the place that mobile phones have in their lives and activities. The accounts also informed about the constraints that continue to keep a large number of rural people out of the benefits of ICTs.

The combination of the three theories was necessary for analyzing the various experiences of the participants to the FAO initiative and address the complexity of the implementation of ICT4D projects in rural areas. The Modernization Theory, the Capability Approach, and gender and development theories offered lenses that allowed to capture the varieties of farmers experiences with ICTs and to narrate the intersectionality of categories of people such as rural women who are illiterate and poor.

The findings of the dissertation refute the tenets of the Modernization Theory which hold that underdevelopment is the result of traditions, illiteracy, the traditional

attitude of the population, agrarian structure, and the lack of infrastructure (Melkote & Steeves, 2015; Kutor, 2014). For the proponents of the Modernization Theory, it is necessary to break the chains of traditions and enter an era of modernity where science and technology provide individuals with the tools that help them control their social and physical environment. Scholars such as Daniel Lerner (1964, p. viii) considered modernity as a "state of mind – the expectation of progress, propensity to growth, readiness to adapt to change". Lerner also insisted on the importance of mass media in the development process. In the same way, Schramm (1964) praised the importance of the media for the transfer of ideas from Western countries to the developing world. Schramm (1964) also underscored the function of the media within developing countries where they operate as vehicles for information and knowledge from the urban areas to the rural zones.

The adherents to the Modernization Theory see social development as a process of Westernization that is based on a top-down, one-way approach to communication. Modernization Theory also places particular emphasis on economic growth through the creation of infrastructure and calls for an appropriation of Western science and technology.

The accounts made by ICT specialists illustrate how the development of telecommunications infrastructure is seen by local authorities as a way for fostering economic growth. The improvement of the access to the telecommunications network and Internet connectivity which underpins the Digital Senegal Strategy 2025 aims at the betterment of the living and working conditions of the citizens including the farmers. Technology has been central to development processes and digital inclusion has become

a major principle in the conception of projects and programs. It is generally expected that the creation of telecommunication infrastructure will impart the entrepreneurial spirit and give birth to various initiatives that generate income for people in urban and rural areas. The same belief is shared by international organizations such as the FAO which spearheads the implementation of ICTs for agriculture throughout the world and especially in developing countries. In such an approach, the traditions of local people which include agricultural practices inherited from the ancestors are considered obsolete and improper for an increase of production. This approach relegates to the backstage traditional methods such as interpersonal communication which continues to occupy a high rank in the communication habits of the farmers.

The narratives of the farmers confirmed the importance of mobile phones in their lives, but they also stressed the significance of radio in their household. The communitarian way of life, the prevalence of oral communication and the sense of sharing that prevail in these areas explain that most farmers still stick to radio communication. Even if most of them have mobile phones, they also make sure that radio sets are present in their households for information sharing . Therefore, I can argue that, even if Modernization Theory advocates for a break of the chain of traditions, technology has not yet succeeded in altering certain traditions such as information sharing, interpersonal communication. The individual attitudes prompted by mobile technology have not led to the emergence of individualistic societies where people are distanced from each other and count on themselves and their technological capabilities . Instead, tools such as WhatsApp are rather used for extending community relations with the creation of different groups where family, local, social, and even national issues are

discussed. There is an adaptation of the ICTs to the local contexts and the situational needs of the users.

Technologies such as mobile phones are well penetrated in rural areas and it is often frequent to see farmers with two or three mobile phones. As predicted by Schramm (1964) and Lerner (1964), technologies are exposing rural areas to new ideas and information from urban areas. However, the reality is that farmers have not renounced their cultural and traditional values. They rather appropriate the new technologies to share their ideas and opinions with others who either live in big cities or have migrated abroad. Also, the exposure to agricultural techniques from the North has not forced farmers to renounce their methods of production. Even if they may desire to acquire state-of-the-art equipment, the lack of financial means often prevents the producers to afford tractors or heavy machinery.

On another register, it came up that the content of the app that provides market information is based on the idea the traditional way of marketing agricultural products is no longer appropriate for farmers to get the best benefit of their labor. With the old way of marketing, intermediaries would take away a great part of the profit that farmers could derive from their activities. By allowing farmers to access the prices of agricultural products, the FAO app hoped to help them gain time and money. In fact, with the new app, the cost of touring different markets without finding affordable products is minimal. Also, farmers who know the prices of agricultural products in the marketplace can decide the amount to which they will sell their products. This implies an economic gain that contributes to the farmers' wellbeing. In the same way, the provision of weather information and a crop calendar is a denial of the farmers' traditional way of knowledge

related to rainfalls and weather forecasts. Scientific information obtained from the satellites and computer-based models stands as the reference for farmers if they want to avoid wasting seeds, fertilizers, and other inputs. Knowing in advance the weather will allow the farmers to be aware of the coming situation and to prepare themselves accordingly. Another aspect of the app that illustrates the tenets of the Modernization Theory is the content related to the system for feeding and curing the livestock. Such a section of the app appears as a rejection of farmers classic method for curing and feeding their livestock. Whatever may be said about that classical method, it has produced appreciable results for cattle-breeders and people who indulge in animal husbandry. The same comment can be made about the content of the app related to nutritious food. The objective of the project implementers is to bring change in the eating habits of people in rural areas.

When it comes to the Capability Approach and gender and development theories, they yielded another appropriate framework for exploring the experiences of farmers with mobile apps and the prospects for the adoption of the FAO mobile app. The Capability Approach was well reflected in the narratives of the farmers who elaborated on the impact of mobile phones on their living and working conditions. They also explained how the four different components of the FAO app could bring positive changes in their lives and activities.

The theory offered a valuable framework for grasping the place that mobile phones in general and mobile apps, in particular, have not only in their agricultural production but also in their social lives. Along with Sen (1999), it can be argued that mobile apps provide farmers with functionings and doings that represent signs of

progress. The content of the app related to market information offers possibilities to farmers to determine or adjust the prices of their products, decide to sell, or buy, and increase their revenue with the elimination of intermediaries. Knowing the right moment to proceed to seedings and pastoral work through adequate use of weather information enables farmers to make rational choices that could impact agricultural productivity. In the same way, by providing users with information about how to cure and feed the livestock, the app managers could contribute to boosting livestock management and production, which would imply revenue increases for animal husbandry practitioners. Furthermore, even if it can be seen by critiques as a negation of the eating habits of the farmers, the section of the FAO app that offers information on the nutritious elements of food could have a positive impact. When they are informed about the nutritious components of each category of food, farmers could have the ability to make choices and decide the kind of crop to grow for subsistence.

The tenets of gender and development theories are also reflected in the narratives of the participants of the study. In most African rural areas, there are great disparities between men and women when it comes to access to land, equipment, and inputs. Women are less likely than men to own properties. They are also more affected by illiteracy, poverty, and lack of access to technologies. Such phenomena equally impact married and unmarried women. Despite these gender inequalities, women do not see men as oppressors or enemies. They rather believe that the structural issues faced in rural areas can only be overcome with the support of men. They recognize that the roots of their current situation are complicated and closely related to the general cultural beliefs. Changes in the system cannot occur without the collaboration of men. In terms of

capabilities, despite their prevalence of high literacy rates among women, many of them who can neither read nor write, have acquired the ability to contribute to discussion groups on apps such as WhatsApp where audio files in local languages create synergy and foster engagement in debates between members of the community.

Implications and Policy Recommendations

This study related to the implementation of a mobile project in rural communities has various implications for policy makers, app developers, NGOs, and ICT project implementers. From the narratives of the farmers, it appears that mobile apps can empower farmers through the provision of relevant information and resources. The findings also reveal that mobile apps such as WhatsApp can operate as an arena for civic and community engagement. The narratives confirm that apps can play a big role in informing people about the issues at stake. The different WhatsApp groups that farmers are members of work as platforms for discussing social, economic, and community affairs. Except for politics, which is banned in many WhatsApp groups, the span of issues that people ponder over is quite large. When it comes to agricultural activities, the apps that farmers mostly used contribute to raise awareness and foster the exchange of goods and ideas.

The study also shows the necessity for Senegalese policy makers to reinforce telecommunication infrastructure and connectivity throughout the country, in particular in rural areas. The findings point out the necessity for the authorities to explore the potential of mobile apps for an expansion of education, health, financial services, and economic opportunities. The implementation of the Senegal Digital Strategies 2016-2025 should encompass the provision of specific digital information that targets rural areas. Such

information should be tailored for the specific public and include audio messages in local languages. These initiatives which serve the public interest could start as free before moving into low-cost apps. They could be complemented by radio programs and oral communication with services such as extension workers.

The findings of the study could help state authorities understand that despite the penetration of mobile phones, other technologies such as radio remain important in rural areas. Therefore, the programs or projects destined for rural communities should not only be focused on mobile phones but should rather include the most used means of communication such as radio and interpersonal communication.

For Senegalese authorities and governments in developing countries, the study proves that structural issues often thwart the promotion of ICTs in rural areas. Issues such as access to land, equipment, and inputs constitute development constraints that may relegate the promotion of ICTs to an inferior level. Furthermore, there is no need for farmers to have a mobile app that provides information about the prices of the products in the marketplace, if there are no roads and infrastructure that allow producers to reach the markets. In the same way, the benefit of the information on the weather forecast cannot be substantial if the farmers do not have electricity or Internet connectivity that help them access the content of the app.

On another level, the dissertation sheds light on the issues facing women in rural areas in Senegal. Even if great progress had been achieved since the adoption of the parity law of 2010, there is still much to be done for equal access of women to land, property, and technology. The situation is much more crucial for women in rural areas. The findings also call for better promotion of education in rural areas for both men and

women. The point is not just the construction of schools for formal education, but the reality is that most people in rural areas cannot read nor write in their mother tongue. This explains why oral communication is mostly preferred in these areas and the people still stick to the radio which often airs programs in national languages. The promotion of both formal and informal education would contribute to raise awareness about the issues at stake and allow farmers to be informed and critical citizens who can take advantage of the opportunities that ICTs offer.

Furthermore, it is imperative for the government through its IT agency to see to it that telecommunications companies abide truly by the terms of reference and ensure sufficient coverage of rural areas. In addition to the coverage of the areas and the population, it is also important to think about the way telecommunication companies would exert their corporate social responsibility by offering an affordable financial charge for accessing apps such as the FAO app.

The findings of the study could also be of great importance for the FAO and other international organizations that champion the promotion of ICTs in rural areas. The constraints faced in the implementation of the project in Senegal could serve as lessons in the perspective of extending the experience to other countries. The UN agency should make sure that the app is a real need in the countries where it intends to promote the project. Consequently, the content of the app should be adapted to the local realities in terms of language, information, and usability. Additionally, there is a need for ensuring the institutional and financial sustainability of the project.

On another level, all the participants stressed the importance of other ICTs (radio in particular) and the centrality of human relations. A mobile app indeed offers certain

advantages that radio cannot provide. The data in the mobile app may remain for a long time whereas the information given by radio is volatile. Once the radio program is over the listeners are unable to have it again unless there is a rebroadcast which is not the case for an app that can be accessed at any time. Also, mobile phones present more portability than radio and their reach is not negligible. However, the existence of various constraints to mobile phone usage calls for a combination of the FAO app with other ICTs such as radio.

In the same vein, on account of the high illiteracy rate, promoters of mobile apps for rural areas should consider more involvement of extension workers whose extensive experience working farmers can help anticipate their needs and demands.

In terms of sovereignty, the data collected in each country must remain stored in servers controlled by the country itself. Data about the farmers, their location, the size of their crop land, the number of the livestock may be sensitive. Therefore, ensuring that the confidentiality of the data is not breached is essential for each country.

As is the case with the project launched by ANCAR, the FAO should make sure to sign a Letter of Agreement with one single entity which would be responsible for the success or failure of the initiative in each African where the project will be implemented. For the FAO and other organizations that promote ICT4D projects, it is essential to bear in mind that initiatives such as the use of mobile apps for agriculture constitute innovative enterprises that require time and close collaboration with the potential beneficiaries. Therefore, the pilot phase necessitates longer duration compared to normal projects. Also, involving lead farmers and opinion leaders could foster a rapid adoption of the app.

Limitations

The major issue I faced was gathering information about a project whose pilot phased ended one year and a half ago and was not taken over by a national entity. It was also very difficult to get information about some of the project implementers because the project did not achieve the expected results. If the project were implemented, it would have been possible to assess the impact that the app has had on the working and living conditions of the farmers. Therefore, most of the prospects of economic benefits and social impact of the FAO app that the farmers describe could be considered as just expectations that could come true or not.

Another limitation of the study is related to the period of the fieldwork. I visited Senegal in late October 2019 for data collection. That period coincided with the dry season when most of the farmers were no longer in the fields. Their usage of mobile phones in agricultural activities would have been better tested and assessed if the study took place during the rainy season. In the same way, the impact of weather information provided by the National Agency for Civil Aviation and Meteorology on the activities of the farmers would also have been more obvious.

The duration of the fieldwork represented another limitation of the dissertation. I only spent six weeks in Senegal for the study, which was too short for carrying out the interview and focus groups, distributing and collecting the survey. On account of the limited time, I was obliged to do two to three interviews in a single day in the capital-city, Dakar. Also, the short duration explained that I could not meet the farmers in their villages and was obliged to convene them at the regional radio station of RTS in Tambacounda for the interviews and focus group discussions. Another consequence of

the limited time for the fieldwork was that I could not manage to carry out interviews with many high officials such as the Ministers of Agriculture, Livestock, and Digital Economy.

Gathering reports or documents related to the evaluation of the project by the main actors was not an easy task. Most of the documents analyzed for this study describe the genesis of the project and its objectives. The reports and evaluations carried by experts would have helped verify the statements made by the participants to the study. On account of the confidentiality attached to certain documents, I could not access the content and have an idea of the findings and recommendations made by the experts.

The language barrier also came up as a hurdle during the study. Apart from one producer who has a good level of French, all the farmers were interviewed in Wolof. However, during the focus group certain participants who were not able to express themselves in Wolof, preferred to talk in their mother tongue (Pular), and their ideas were translated by other participants. In the same way, it is worth mentioning the difficulties related to the transcription and translations of the interviews and focus groups. If all the interviews in French were directly transcribed in English , for the interviews in Wolof, I was first obliged to transcribe them first in French before being translated into English. As the Italian saying goes, “Traduttore, traditore” (which means “Translator, traitor”). In that sense, translating from one language to another can lead to a betrayal of the true meaning. This is all the more accurate as the languages that I used for collecting the data (Wolof and French) do not have the same structure as English. Furthermore, many words and phrases do not have their absolute equivalences in English. As a consequence, I was

obliged to refer to some similarities and commonalities to capture the ideas expressed by the interviewees.

Other limitations were related to the technical glitches that occurred in the process of data collection through phone interviews. I used WhatsApp for interviewing the FAO project coordinator in Rome and an ICT specialist in Rwanda. On account of recurrent connection issues parts of the phone calls were not clearly audible. If for the FAO project coordinator, the second interview allowed me to clarify many aspects, with the ICT specialist in Rwanda, I also carried a Zoom interview which helped bring more insights.

Suggestions for Future Research

The contribution of mobile technology to social and economic progress remained under-investigated. In Senegal, the narratives of ICT specialists and state authorities tell a lot about the expectations of the decision-makers about the potential of digital technologies. More studies could be carried out on the emerging sectors of e-commerce, financial services, online education, and e-governance. Further research that compares the use of technologies such as radio, television, computers, mobile phones could shed more light on the population's media consumption and attitudes towards new technologies. Such studies could also provide insights about the best tools for targeting the different segments when it comes to communication for development. Also, research on gender disparities in access to technologies could be expanded to include radio, television, radio, and computers. Such investigations would be more relevant if they involve more regions and a larger number of participants.

The use of local languages in new technologies constitutes another area to explore. As is the case for mainstream media, national language Wolof has become a major component of the digital services offered in the country. It would be interesting to carry out studies on the users' appropriation of the new services. Also, comparative studies of media consumption between rural and urban areas could be another area of exploration.

The findings of the study have significance for policy makers and media managers. The farmers' close relations with the radio medium could spur studies about the programs and shows that retain their interests and constitute their main focus. Such studies could help media managers improve their programming and better cater to the needs of the farmers. For policy makers, the results of the studies might provide relevant information about the programs and shows to be used to convey official messages to rural communities. Also, more research on the mobile use patterns especially mobile radio represents another issue of interest. The point for such research would be to determine to what extent farmers use their mobile technology for news and information as opposed to the traditional radio set.

Mobile apps have gained roots in many rural areas. Studies reveal that WhatsApp stands out as the most used app among farmers. In Senegal, the impact of the emergence of WhatsApp remains uninvestigated. The new app offers new opportunities to local people and migrants. WhatsApp now tends to replace the traditional Palaver Tree where Africans would discuss the issues of interest for the community. Further research on the dynamics of WhatsApp groups and their ability to educate and empower rural people would offer rich insights into the general trend. Also, such research would be interesting

on account of the high number of women who participate in these discussion groups. In the same way, the strategies implemented by WhatsApp groups administers to counter the spread of misinformation need to be explored.

This study could also be replicated for the mobile app project launched by ANCAR with the support of the FAO. The objective would be to assess the impact of the app on the living and working conditions of the farmers. Officially the app was supposed to be operational since December 2020. Researching the implementation of the project would contribute to informing about the feasibility and the sustainability of mobile app projects for rural areas. In the same way, evaluative research could be done in Rwanda to provide the real causes of success or failure. Such a study would be used by the FAO for replication or adjustment of its project in the other African countries.

Conclusion

When I decided to undertake this study, my objective was to contribute to the debates about the possibilities that ICTs offer to farmers and all the people living in far-flung areas beyond the possibility to participate in discussions in family WhatsApp groups. More specifically, I wanted to unearth the potential of mobile apps for empowering farmers. The findings of the research revealed that several ICT projects have been implemented by state entities and start-ups operators to allow farmers to get the great benefits of digital technologies. These projects are mostly based on SMS or USSD systems which make it easy for farmers to use their phone credit to access the services. Local entities such as the ANCAR or international organizations like the FAO should rather explore how to navigate between these processes for a real impact on the

lives and working conditions of the farmers. Such options would help overturn the issues of Internet connection and lack of financial means that characterize the rural areas.

Furthermore, the wide penetration of mobile phones could be leveraged by the state to create digital spheres for discussion, critical thinking, and problem-solving. On account of the low access to technologies such as television, mobile phones could represent a bridge that helps cater to the needs of people dwelling in remote areas. Another important finding was the place of interpersonal communication and radio in the lives of farmers which should not be overlooked in the strategies for agricultural extension and rural productivity.

On account of the prevalence of illiteracy in most rural communities, the use of local languages in addition to French constitutes a pivotal instrument for reaching out to the largest number of potential users. In this sense, the Wolof language appears as essential for bridging the divide between the happy few urban dwellers and the large portion of illiterate people who live in remote areas. As is the case in the mainstream media, namely radio and television networks, Wolof stands out as a *lingua franca* that connects diverse communities and groups. Conferring upon it a central place in the design of mobile apps for rural areas appears as a requisite for success.

It is also clear that mobile app services could also have tangible effects if the offerings include vocal systems that talk to the beneficiaries in their native languages. The reality is that most of the local language speakers cannot read nor write in those languages. Therefore, providing vocal services in the local languages contributes to the digital inclusion of segments of the population such as women who are mainly affected by illiteracy. In the same vein, it is also important to underscore the new freedoms that

women have started acquiring thanks to the promotion of ICTs. Apps such as WhatsApp have enabled the creation of fora where individuals including women contribute to share ideas and get information related to their lives and activities. One of the rare women farmers who used to have a smartphone praised the new freedoms associated with WhatsApp. She claimed to be a member of five WhatsApp groups and, even if she is illiterate, she revealed that she can send vocal messages, lead discussions, answer questions, and has acquired relevant knowledge from the messages or transfers made in the different groups. These new opportunities offered by the mobile apps could be used to enhance women's rights and foster better participation in decision-making processes.

Another important finding of the study is related to approaches to ICT4D projects. A participatory approach that is based on an assessment of the real needs and demands of the beneficiaries would ensure the ownership of any projects by the users. It would also help deconstruct the challenges related to the inadequacies of ICT4D projects and overcome the issue of sustainability.

The study also stressed that the promises of mobile technology promotion could be thwarted by the existence of structural and situational problems. The lack of infrastructure, the deficit in education, the difficulties to access land, equipment, and inputs could make difficult it for farmers to enjoy all the benefits associated with digital technologies.

APPENDIX A

LIST OF ACRONYMS

Acronym	Meaning
ACE	Africa Coast to Europe
ADIE	Agence de l'Informatique de l'Etat
ADSL	Asymmetric Digital Subscriber Line
ANACIM	Agence Nationale de l'Aviation Civile et de la Meteorologie
ANCAR	Agence Nationale de Conseil Agricole et Rural
ANSD	Agence Nationale de Statistique et de la Démographie
ARTP	Agence de Régulation des Télécommunications et des Postes
CDMA	Code Division Multiple Access
CFA	Communauté Financière Africaine
CIA	Central Intelligence Agency
CILSS	Comite Inter-Etat de lutte contre la Sècheresse au Sahel
CNAS	Compagnie Nationale d'Assurance Agricole du Sénégal
CNRA	Conseil National de Régulation de l'Audiovisuel
COMFISH	Collaborative Management for a Sustainable Fisheries Future
COMSAT	Communication Satellite
CSU	Consortium du Service Universel
CTIC	Incubateur de Croissance des Technologies de l'Information et de Communication
DAPSA	Direction de l'Analyse, de la Prévision, et des Statistiques Agricoles
DER	Direction à l'Entreprenariat Rapide des Femmes et des Jeunes

DICTAF	Domain of IT, Communication, Transport, Agriculture, and Finances
DIE	Direction de l'Informatique de l'Etat
DIRFEL	Direction Régionale des Femmes en Elevage
DRDR	Direction Régionale du Développement Rural
ENDA	Environnement et Développement en Afrique
EXCAF	Expo Carrefour
FAO	Food and Agriculture Organization
FBA	Field Budget Authorization
FICTIS	Fondation des Incubateurs du Sénégal
GAD	Gender and Development
GDI	Gender Development Index
GDP	Gross Domestic Product
GEM	Gender Equity Measure
GICC	Groupe Interinstitutionnel de Concertation et de Coordination en Géomatique
GIEWS	Global Information and Early Warning System
GPS	Global Positioning System
GOANA	Grande Offensive pour la Nourriture et l'Abondance
GTZ	German Agency for Technical Cooperation
HDI	Human Development Index
HPI	Human Poverty Index
ICTs	Information and Communication Technologies
ICT4D	Information and Communication Technologies for Development
ITU	International Telecommunications Union
LDC	Least Developed Countries
LITS	Livestock Identification and Traceability System
LTO	Lead Technical Officer

m-ARD	Mobile App for Agriculture and Rural Development
MDGs	Millennium Development Goals
MMDS	Multipoint Multichannel Distribution System
MVNO	Mobile Virtual Network Operator
NEPAD	Nouveau Partenariat pour le Développement de l'Afrique
NGO	Non-Governmental Organization
NPA	Nouvelle Politique Agricole
OCA	Office de Commercialisation Agricole
OCAS	Office de Commercialisation Agricole du Sénégal
OECD	Organization for Economic Cooperation and Development
ONCAD	Office National de Coopération et d'Assistance pour le Développement
OPTIC	Organisation des Professionnels des Technologies de l'Information et de la Communication
ORSTOM	Office de la Recherche Scientifique et Technique Outre-mer
ORTS	Office de Radiodiffusion Télévision du Sénégal
PASA	Programme d'Ajustement du Secteur Agricole
PISA	Programme d'Investissement du Secteur Agricole
PRACAS	Programme d'Accélération de la Cadence de l'Agriculture Sénégalaise
PRAPS	Programme Régional d'Appui au Pastoralisme au Sahel
REVA	Retour vers l'Agriculture
RIO	Réseau Intertropical d'Ordinateurs
RTS	Radiodiffusion Television Sénégalaise
SAPs	Structural Adjustment Programs
SAT – 3/WASC	South Atlantic 3/West Africa Submarine Cable
SENELEC	Société Nationale d'Electricité du Sénégal
SIGEL	Système d'information de Gestion de l'Elevage au Sénégal

SIM-Bétail	Système d'Information sur les marchés à Bétail
SMS	Short Message Service
SNEEG	Stratégie Nationale pour l'Equité et l'Egalité des Genres
SODEFITEX	Société Nationale de Développement des Fibres Textiles
SONACOS	Société Nationale de Commercialisation des Oléagineux du Sénégal
SONAGRAINES	Société Nationale des Graines
SONATEL	Société Nationale des Télécommunications du Sénégal
SPSS	Statistical Package for the Social Sciences
SyGEC	Système de Gestion Electronique du Courrier
UN	United Nations
UNDP	United Nations Development Program
UNESCO	The United Nations Educational, Scientific, and Cultural Organization
USSD	Unstructured Supplementary Service Data
WAD	Women and Development
WID	Women in Development
WMO	World Meteorological Organization
WSIS	World Summit on the Information Society

APPENDIX B

INTERVIEW GUIDE FOR FARMERS

Place of agriculture in their activities

1) How long have you been living in the community?
2) How long have you been practicing agriculture?
3) What brought you to the agricultural sector?
4) Who is the owner of the land that you work on?

Communication patterns

5) Tell me about your communication patterns
6) Who do you communicate with?
7) What are your main sources of information?
8) What are the benefits for using radio, television, computer, mobile phone, Internet, face-to-face communication?
9) What kinds of information are mostly looking for?
10) How long have you been using a mobile phone?

Position about the FAO project

11) Do you know about the project "Agricultural Services and Digital Inclusion in Africa?
12) To what extent are the mobile app easily accessible to you?
13) What are the perceptions of your community about the project called "Agricultural Services and Digital Inclusion in Africa"?

14) To what extent does the app reflect your needs?

15) Which content of the mobile app do you think is the most important?

16) How would you describe the potential impact of the project on you as an individual? What about the impact on the community as a whole?

Involvement in the FAO project

17) To what extent were your involved in the project?

18) Were you associated to the conception of the mobile apps?

19) Were you associated to the design of the apps?

20) In your opinion, how do women and men can use the information they access through the app? Are there differences?

21) What is the level of women and men's participation in the implementation of the project?

22) Do you think that women and men benefit equally from the project?

23) As a man or woman do you think that you have particular information needs that are not integrated in the mobile apps?

Cost of the project and challenges

24) What is the cost of using the mobile apps?

25) What are the challenges that can hinder your access to the mobile app?

26) In what ways do you think the project can empower you?

27) How do you explain the delay in the implementation of the project?

28) What do you think about the transfer of the project to ANCAR?

APPENDIX C

INTERVIEW GUIDE FOR ICT SPECIALISTS

1) How would you describe the current state of ICTs in Senegal?
2) Who are the stakeholders?
3) What are the current policies on the ICT sector?
4) How do you appreciate these policies in comparison with the policies implemented by the former regimes?
5) What are the priority areas of focus of ICT policy in Senegal?
6) What are the current projects being implemented?
7) What are the goals regarding ICTs in Senegal?
8) How would you rank Senegal in comparison with other African countries?
9) What are the sectors that benefit most from the ICT policies in Senegal?
10) What measures have been taken for the accessibility of ICTs?
11) What measures have been taking to ensure gender equality in ICT policy and implementation?
12) What measures have been taken to ensure regional equality in ICT policy and implementation?
13) What are the major challenges for ICT4D in Senegal?

APPENDIX D

FOCUS GROUP DISCUSSIONS GUIDE

OVERVIEW OF AGRICULTURE IN TAMBACOUNDA

1- What are the main challenges of agriculture in this area?

2- What actions have been taken by the Senegalese government to face these challenges?

ICTS AND AGRICULTURE

3- To what extent can new technologies help farmers in your area?

4- Which technologies provide more relevant to your work (radio, television, computer, mobile phones)

THE FAO PROJECT

5- What do you think about the project “Agricultural Services and Digital Inclusion in Africa” launched by the FAO?

6- What do you think about the app called “Cure and feed your livestock”?

7- What do you think about the app called “Whether and Crop Calendar”?

8- What do you think about the app called “AgriMarket Place”?

9- What do you think about the app called “e-Nutrifood”?

10- What do you think about the designs of the 4 apps?

11- To what extent do these apps reflect your needs?

12- Do you have needs that are not taken into consideration by the FAO mobile apps?

IMPLICATION IN THE PROJECT

13- How were you associated to the project? In what ways?

14- Where your opinions taken into consideration? Give examples

GENDER DIMENSION

15- To what extent have women been involved in this project?

16- To what extent can this project contribute to women's empowerment?

CHALLENGES FOR THE PROJECT

17- What are the main weaknesses of this project?

18- How do you explain the delay in the project?

19- What do you think about the transfer of the project to ANCAR?

20- What are the major challenges for the use of these apps?

APPENDIX E

SURVEY QUESTIONNAIRE FOR FARMERS

0) Are you a farmer?

   1- Yes
   2- No
   If you answer “no” to this question, you can stop answering the remaining questions

1) How long have you been farming?

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2) Do you own a crop land?

   1- Yes
   2- No

3) If you answer “no”, precise who is the owner of the crop land
   1- Husband/Spouse
   2- Family
   3- Organization
   4- Lead farmer
   5- Other (Precise)

4) What is the size of the crop land?
   1- Less than 1 hectare
   2- Between 1 hectare and 2 hectares
   3- Over 2 hectares

5) Do you have a mobile phone?
   1- Yes
   2- No
6) If no, why not?
   1- It is not useful for me
   2- My mobile phone has broken down
   3- I lost my mobile phone
   4- I don’t want to be reachable at any time
   5- I think it is very expensive

6- Other reason. Precise……..

7) If you have more than one, how many phones do you have? (Indicate the number)

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8) How long have you been having a mobile phone?

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9) What is the brand name(s) of the mobile phone(s)?
   1- iPhone
   2- Samsung
   3- Huawei
   4- Tecno
   5- Itel
   6- Others (Precise) ----------

10) If you have more than one mobile phone, indicate the brand that you most often use

---

11) Which category of mobile technology do you have?

   1- Basic cell phone
   2- Smartphone
   3- Others (Specify): ____

12) Does your mobile phone have a voice call functionality?
   1- Yes
   2- No
   3- I don't know

13) Can you mobile phone send text messages (SMS)

   1- Yes

2- No
3- I don’t know

14) Does your mobile phone have a multimedia player?
1- Yes
2- No
3- I don’t know

15) Does your mobile phone have Bluetooth?
1- Yes
2- No
3- I don’t know

16) Does your mobile phone have FM Radio?
1- Yes
2- No
3- I don’t know

17) Does your mobile phone have Wi-Fi functionality?
1- Yes
2- No
3- I don’t know

18) Does your mobile phone have a camera?
1- Yes
2- No
3- I don’t know

19) Does your mobile phone have a GPS?
1- Yes
2- No
3- I don’t know

20) Does your mobile have an expandable memory
1- Yes
2- No
3- I don’t know

21) Can you use your mobile phone to access Internet
1- Yes
2- No
3- I don’t know

22) Can you use your mobile phone to access Facebook
1- Yes

2- No
3- I don't know

23) Can you use your mobile phone to access WhatsApp?
1- Yes
2- No
3- I don't know

24) How often do you use the mobile phone's functionalities? (Check a column number with selected options from below)

Scoring Scale 1=never, I don't use 2=once per month 3=two to three times per month 4=once a week 5=two to three per week 6=once a day 7=two to three times per day 8=more than four times per day

Mobile functionalities	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1- Voice Call								
2- SMS text message								
3- Calculator								
4- WhatsApp								
5- Facebook								
6- YouTube								
7- Instagram								
8- Phone camera								
9- Notepad								
10- Calendar								
11- Voice Recorder								
12- Bluetooth								
13- GPS								
14- Internet browsing								

25) What is your primary usage of a mobile phone? (You can choose one or more answers)

1- I use my mobile phone to connect with my family and friends
2- I use my mobile phone to know what is happening around me
3- I use my mobile phones to take photos
4- I use my mobile phones to check the weather
5- I use my mobile phone to watch videos
6- I use my mobile phone for online payment
7- I use my mobile phone for money transfer

26) How do you connect to the Internet?

1- I have broadband connection at home
2- I buy Internet pass
3- Other ways (Precise)

27) How much do you spend each week for your Internet connection?

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28) How do you get information related to agriculture?

1- Extension agents
2- Lead-farmers
3- Family or friends
4- NGOs
5- Radio
6- Television
7- Mobile phone
8- Others (Specify): _____

29) Which one do you consider to be the three most significant challenge for using a mobile phone in rural areas? (Choose 3)

Options

1. Lack of electricity ……
2. Poor Network coverage ……
3. Lack of awareness ……
4. Financial resources ……
5. Digital skills ……
6. Language of the technology ……
7. Illiteracy …….
8. Up-to date information …….
9. Others (Specify): _____ _____ _____ _____ _____ ___

30) Do you know the project "Agricultural Services and Digital Inclusion" launched by the Food Agriculture Organization?
    1- Yes
    2- No

If yes, how did you get to know about the project

Precise----------

31) Are you willing to pay in order to access information on agriculture in your mobile phone?

    1- Yes
    2- No

If yes, how much are you willing to pay per month?

---

32) What is your level of education in French? Select only one

    1- None
    2- Primary School
    3- Secondary school
    4- Post-secondary
    5- Others (Specify):_____

33) What is your native language?

…….

34) Can you read in your native language?

1- Yes
2- No

35) Can you write in your native language?

1- Yes
2- No

36) What is your gender?

1- Male
2- Female

37) What is your marital status? Select one

1. Single
2. Married
3. Divorced
4. Widowed
5. Others (specify): …….

38) How old are you?

Less than 25 years
Between 25 and 35 years
Between 36 and 45 years
Between 46 and 55 years
Between 56 and 65 years
Over 66 years

39) In which of area of Tambacounda do you live?

1- Koussanar
2- Missirah
3- Tambacounda
4- Other (Precise) ----------

APPENDIX F

LIST OF INTERVIEWEES AND FOCUS GROUPS

FAO

- The Lead Technical Officer (two interviews)
- 2 consultants of the project in Senegal (I interviewed one of the consultants twice)
- 1 consultant of the project in Rwanda
- The senior app developer
- 1 of the two junior app developers
- The FAO CEP/GIPD Project Coordinator
- The FAO API Coordinator
- The FAO Subregional Office for West Africa IT Specialist
- The Coordinator of the ICT4AG at CTA The Netherlands

ICT SPECIALISTS

- The Director of Studies and Cooperation at the Ministry of Higher Education, Research, and Innovation/ assistant-professor of Communication Science
- An Assistant-Professor of Communication at the Center of Studies of Communication Sciences and Techniques (CESTI)
- The Director of CTIC-Dakar
- A former Knowledge Analyst with the ACACIA Program
- The ICT4D Regional Technical Advisor for Africa of Terre des Hommes Foundation
- The General Manager of Afrikinnovations

- The Host of the Radio Program *Disso*
- A producer of the Radio Program *Disso*

START-UP MANAGERS

- The Manager of *Soreetul* (who also worked as a consultant for the FAO project)
- The Manager of *Bayseddo*
- The Manager of M-*Louma*
- The Co-Manager of DICTAF Corporation
- The Manager of Geomatica
- The Coordinator of YeesalAgriHub

FARMERS' NATIONAL ASSOCIATION

- The Communication Officer/Spokesperson of the Farmers National Association
- The Chairman of the Tambacounda Farmers Regional Association
- The Land Focal Point of the Tambacounda Farmers Regional Association

GOVERNMENT

- The Governor of Tambacounda
- The Director of Telecommunications
- The Director of ICTs
- The Director of Livestock
- The IT Specialist at the Ministry of Livestock
- The Director of Horticulture
- The General Manager of ANCAR

- The Director of ISRA/UNIVAL
- The Communication Officer of ISRA/UNIVAL
- The Regional Director for Agricultural Development in Tambacounda
- The ICT Specialist at the Division for Agricultural Analyses, Forecasts, and Statistics (DAFSA)
- 2 extension workers

AGENCY FOR TELECOMMUNICATIONS AND POSTS REGULATION (ARPT)

- The Head of the Department for Resource Management
- The Head of the Department for Research and Market Analysis
- The Head of the Department in charge of Monitoring the Providers

THE STATE IT AGENCY (ADIE)

- The Coordinator of the Department for Projects
- The Coordinator of the National Geomatics Plan
- The Communication Officer

THE NATIONAL AGENCY FOR CIVIL AVIATION AND METEOROLOGY (ANACIM)

- The Head of the Department for Weather Information Systems
- The Head of the Department for Research and Development

FARMERS

5 women farmers

7 men farmers

FOCUS GROUPS

- One focus group with 5 men farmers
- One focus group with 5 women farmers

APPENDIX G

PROPOSAL FOR NEW ALLOCATION TO

FAO MULTI-PARTNER PROGRAMME SUPPORT MECHANISM (FMM)

CONCEPT NOTE

AGRICULTURAL SERVICES AND DIGITAL INCLUSION IN AFRICA

DATE: 30 SEPTEMBER 2016

DATE (REVISED VERSION): 16 NOVEMBER 2016

Strategic Objectives	**SO3, SO2, SO5, cross cutting Gender SO6 and IT FO 9**	
Country(ies)/Region(s) of implementation	Rwanda and Senegal	
Estimated total budget in USD	700,000 USD	
Start date	October 2016	**Estimated duration** 15 months

1. Background

1.1 Problems to be addressed and project objectives

- Poverty, unsustainable management of natural resources, distressed migration, food insecurity and conflict are all connected. About 75% of the world's poor live in rural areas and most of them depend – partly or entirely – on agriculture for their livelihood. 90% of the world's 570 million farms are owned by smallholders. However, these are often not considered as main players in the agricultural sector and investments in small-scale agriculture and technologies for the rural poor have been neglected. Their ability to benefit from the increasing demand in agricultural products is hampered by limited access to agricultural inputs, services, information, technologies, sometimes combined with poor infrastructure. They also tend to be more affected by crises and disasters, whether it is natural or man-made.

- Malnutrition went down from 20% to 17% of the global population, but has increased in absolute terms from 840 million to 925 million people between 1990 and 2010. almost half of those affected by malnutrition are children (Global Hunger Index, 2010). The highest levels are found in sub-Saharan Africa and South Asia. (IFPRI). From 3.5 to 5 million children under five years old die from malnutrition in developing countries each year (MSF).

- Internet and digital usage has increased rapidly in the last 15 years; the global internet population has grown to 3.4 billion7 (46% of the world population). More people now have mobile phones than electricity, clean water, or sanitation8, and millions are now better connected, increasing access to new or better products and services with a positive impact on their livelihoods and the economy. In 2015, 89% of the world urban population and 29% of the world rural population have 3G coverage. In Sub-Saharan Africa, it is estimated that the usage rates of 3G and above will reach 38% in 2020 (from 20% in 2015). However, the impact of these technologies are not all positive, increasing inequality between those who use them and those who can't, widening rewards for people with skills and access, while upping the penalties for those not having them[9]. These inequalities are reflected too between industrialized and agricultural economies, urban and rural areas and the digital divide affects women and youth even more[10]. ITU estimates that there are some 250 million fewer women online than men and the global Internet user gender gap grew from 11% in 2013 to 12% in 2016, and is as high as 31% in the world's Least Developed Countries.

- FAO and its partners are involved in the development and implementation of digital inclusion initiatives and the scaling up of innovative digital services. Bringing solutions closer to the needs of poor households in Africa and other regions is a direct contribution to poverty reduction and food security i.e. SDG1 and SDG2. ICTs help maximizing the impact of existing rural advisory services, financial services, social protection programmes. ICTs facilitate access to markets, information and entrepreneurship opportunities.

- Digital inclusion initiatives address the barriers to mobile internet adoption through infrastructure and policy, affordability, digital literacy and availability of local content[11]. This project focuses on the latter two. It will make useful data, information

[7] http://www.internetlivestats.com/internet-users
[8] Facts About Water & Sanitation
[9] http://www.worldbank.org/en/publication/wdr2016
[10] ICT Facts and Figures - ICT revolution and remaining gaps - ITU 2015
[11] GSMA - Digital inclusion

and statistics available and accessible as digital services[12] to the rural poor.
Four information and advisory services (mobile applications) will be developed.

- "Cure and Feed your livestock": An application providing real time information on animal diseases control and animal feeding strategies.
- "e-Nutrifood": An application providing information on production, conservation and consumption of nutritious foods.
- "Weather and Crop calendar": An application combining information on weather forecasts, crop calendars and alert systems.
- "AgriMarketplace": An application that will connect producers, traders and consumers to facilitate trade and access to inputs.

The applications will be developed initially for use in two countries in Sub-Saharan Africa: Senegal and Rwanda. The apps and services can then be adapted for use in other countries as well. A particular emphasis will be put on needs of young, self-employed entrepreneurs, female headed households, breaking down the barriers for access and use of information through digital technologies. This project is part of a broader CIO initiative that leverages the knowledge of FAO and its strategic partners in the mobile world, promoting digital inclusion for smallholders and family farmers.

1.2. Contribution to FAO Strategic Framework

SO 3 - REDUCE RURAL POVERTY	
The rural poor have enhanced and equitable access to productive resources, services, organizations and markets, and can manage their resources more sustainably.	3.1
Support to improve access of poor rural producers and household to appropriate technologies and knowledge, inputs and markets.	3.1.3
Support to innovations in rural services provision and infrastructure development accessible to the rural poor.	3.1.4
Regional Result *Africa's 2025 Zero Hunger Challenge*[13]	

[12] African Farmers in The Digital Age - Foreign Affairs
[13] http://www.fao.org/africa/perspectives/end-hunger/en/

SO 2 - INCREASE AND IMPROVE PROVISION OF GOODS AND SERVICES FROM AGRICULTURE, FORESTRY AND FISHERIES IN A SUSTAINABLE MANNER	
Producers and natural resource managers adopt practices that increase and improve the provision of goods and services in agricultural sector production systems in a sustainable manner.	2.1
Innovative practices for sustainable agricultural production (including traditional practices that improve sustainability, such as those listed as Globally Important Agricultural Heritage Systems) are identified, assessed and disseminated and their adoption by stakeholders is facilitated.	2.1.1
Regional Result *Sustainable production intensification and value chain development in Africa*[14]	

SO 5 - INCREASE THE RESILIENCE OF LIVELIHOODS TO THREATS AND CRISES	
Countries reduce risks and vulnerability at household and community level.	5.3
Improving capacities of countries, communities and key stakeholders to implement prevention and mitigation good practices to reduce the impacts of threats and crises.	5.3.1
Improving access of most vulnerable groups to services which reduce the impact of disasters and crises.	5.3.2
Regional Result *Building resilience in Africa's drylands*[15]	

STRATEGIC OBJECTIVE 6 - TECHNICAL QUALITY, KNOWLEDGE AND SERVICES	
Quality services and coherent approaches to work on gender equality and women's empowerment that result in strengthened country capacity to formulate, implement and monitor policies and programmes that provide equal opportunities for men and women.	**6.3**
Member countries are supported within the SOs by the Gender Unit to develop their capacities consistent with FAO's minimum standards for gender mainstreaming and targeted interventions.	6.3.1
Institutional mechanisms and staff capacities are established or strengthened to support countries' initiatives aimed at addressing gender equality.	6.3.2

[14] http://www.fao.org/africa/perspectives/agricultural-landscapes-africa/en/

[15] http://www.fao.org/africa/perspectives/resilience-in-drylands/en/

FUNCTIONAL OBJECTIVE 9 - INFORMATION TECHNOLOGY	
FAO business needs are addressed in timely manner in all geographical locations through timely, quality, effective and cost-efficient customer-oriented IT solutions and services.	**9.1**
A corporate data repository that offers a "single version of the truth" and a portfolio of business intelligence tools is developed and provided.	9.1.3
A comprehensive set of IT tools which satisfy the needs for collaboration and communication is provided.	9.1.4

1.3. Contribution to Country Programming Framework (CPF) for local activities

The four applications will be developed for use in Senegal and Rwanda, initially. Country selection criteria included: Existing demand for support in the development of ICTs by countries, FAO Regional initiative priorities, Priorities of the UN Joint Program on rural women's economic empowerment, FAO Strategic Program 3 focus countries and close observation countries, Internet access in rural areas.

1.3.1. Rwanda

- Rwanda has a large rural population (73% out of a total of 11.6 million of inhabitants). 43% of the population is under the age of fifteen (World Bank, 2013). 31% of the population is undernourished (SOFI, 2015).
- The Country Programming Framework (CPF) focuses on achieving resilience and sustainable food and nutrition security. The Government's goal is to eradicate pervasive chronic malnutrition and stunting among children under the age of two.[16]
- The CPF also aims at "improving food security and nutrition, agriculture and livestock productivity through sustainable use of natural resource management, adapted to climatic changes, value chain development and private sector investment as a basis for boosting commercialized agricultural development, institutional collaboration and knowledge sharing in addressing agricultural development, food security and poverty actions".
- Being a pilot country for "One UN", there is an opportunity for an integrated approach within the Nutrition Action Plan.
- FAO is focusing on the District of Rulindo as an ecosystem of innovation. Two projects to combat malnutrition among children in Nyamagabe and Rutsiro, two of the most affected districts, are implemented with the aim to promote local production and

[16] FAO CPF Rwanda

consumption of nutritious and safe food and build more resilient livelihoods. The projects are in synergy with the regional initiative "Sustainable production intensification and value chain development in Africa".

- Young people are very interested in ICT in Agriculture[17] and the Rwandan government engages young people in Agriculture by using ICT services. The Government supports the One Cow per Poor Family Program "GIRINKA" which provides an excellent entry point for the use of digital services for information on child nutrition, animal production and health, trade.
- Cell phone ownership in Rwanda is slightly below 50% (Gallup) [18]. The cost of internet for 500MB in Rwanda is 14% of GNI, which is higher than the 5% threshold. However, Tigo provides 3GB for 7.5% income (which is below the threshold) and Freebasics is provided by Airtel in partnership with Facebook.

1.3.2. Senegal

- Senegal has a rural population of 57% (out of a total population of 15.1 million). 43% of the population is under the age of fifteen (World bank). The unemployment rate is 10%, with youth unemployment as high as 14% and female youth unemployment rates at 19%. 10% of the population is undernourished (SOFI 2015).
- The focus of the FAO partnership with Senegal as described in the Country Programming Framework (CPF) is on building resilience and sustainable food and nutrition security[19] through support to production in agriculture, rural development, youth employment, resilience building and the development of social protection programmes. Senegal and FAO developed decent rural employment initiatives for vulnerable young people through micro-businesses and in the aquaculture sector. The Farmer Field School approach is used to promote Integrated Production and Pest Management (IPPM) in rice, onion and garden products and to build climate change resilient capacities.
- This FMM project will contribute to a range of ongoing projects: The third phase of an ongoing "*Purchase from Africans for Africa*" (PAA Africa) project aims at developing value chains for four commodities (rice, maize, cowpea and potato). The project *"Integration of climate resilience in agro-pastoral production for food security in vulnerable rural areas*" uses both the Farmer Field Schools approach and Dimitra Clubs. Dimitra clubs propose a gender-sensitive and participatory approach to development. Participants are able to access and share information, ideas and technologies and to bring about sustainable improvements in their community. There are more ongoing projects related to marketing of agricultural products and fish. Many

[17] As discussed with and confirmed by FAO Rwanda office.

[18] Disparities in Cellphone Ownership Pose Challenges in Africa

[19] FAO CPF Senegal

of them work with e-commerce to improve production and decrease the distance between producers and consumers.

- Cell phone ownership in Senegal is 63% (Gallup). Telecom operators already implement projects related to the development of rural areas, healthcare for women, youth education and employment and support to start-ups.

1.3.3 Review of the technical merits of the proposal with colleagues in Technical Divisions and Country Offices.

- The technical merits of the proposal have been discussed by CIO with colleagues in Technical Divisions (AGA, ESN, NRC, EST), with RAF and with FAO Country Offices in Rwanda and Senegal.
- The services (apps) proposed will be bidirectional/interactive. In many cases the role of beneficiaries will be decisive to report their experiences, and provide them with accurate and useful feedback. Using a user-generated content approach, FAO and partners will establish interaction with the beneficiaries building sustainable networks.
- CIO went for the "low hanging fruits" and identified digital services fro which data is mostly available at FAO and started the engagement with telecom operators, FAO country offices, national governments and NGOs and private companies. After choosing the complementary or related projects, the partners are invited to negotiate the details of the cooperation.
- CIO worked with Country Office in Senegal and Rwanda to develop the project, define in-house coordination mechanisms, and collect feedback on country plans and strategic partners to be involved in the projects in the selected countries.

2. Summary of proposed action

2.1. Expected results

- Rural communities in Rwanda and Senegal will have better access to tailored information related to agricultural production and marketing (Crop, Livestock, Fruits&Vegetables) and nutrition through availability of four applications designed for use by people with limited literacy.
  FAO and local partners will support the development of ICT applications, broadcasting content, and literacy to deliver quality information rural households in Rwanda and Senegal.

- In collaboration with the national governments, local and strategic partners, the main

idea of this initiative is to offer, in near real time, a portfolio of four initial mobile applications as presented in section below (2.2) providing services that support concrete daily needs of poor households in an easy, hassle free and customisable way. Based on the knowledge gathered by FAO and local policies, the package of software solutions will be delivered to ensure quality information and technical advisory services, using complementary and incremental approach between each one. The group of applications will be validated by the local communities and producers to receive suggestions for improvements of the portfolio.

- Youth and women will be empowered by the use of the mobile digital services, become more connected, save time and money, and get employment and education opportunities[20].

- Goals of this project have continued progression, having a global nature, bringing together a large multi-stakeholder community using digital communication tools and platforms. It aims at "doing business" in a different way, addressing global challenges and creating inclusive business models, leveraging the potential of digital innovations allowing for rapid enhancements. It's about finding new scalable solutions to global issues, harnessing multi-stakeholder participation of governments, UN agencies, the private sector and civil society using the power of the internet to share knowledge.[21]

- The proposed model and the strategy to implement these digital services ranging from basic information to more sophisticated services. They require intense consultation and articulation among the various partners starting with the national and regional governments to trained community leaders and extension workers supporting closer extension services for small farmers as well as professionals from private areas of telecommunications and internet.

- The project is in line and coordinated with national and priority programs in Rwanda and Senegal, FAO is addressing these challenges / problems with the coordination and support of local businesses of telecommunications and Internet access providers, launching digital services directly addressed for smallholder farmers, small scale agro-enterprises, subsistence farmers, and consumers groups in rural/Peri-urban areas. Communication through basic audiovisual aids (descriptive images, videos and audio in mobile formats) in local languages will reduce the communication time and gap between key players in the field.

[20] United Nations Secretary-General's Special Advocate for Inclusive Finance for Development (UNSGSA)

[21] Rethinking the United Nations for the Networked World - An Agenda for Strengthening the UN's Engagement through Global Solution Networks

2.2. Project Outputs

- Four information and advisory services (mobile applications) will be developed.
    - "Cure and Feed your livestock": An application providing real time information on animal diseases control and animal feeding strategies.
    - "e-Nutrifood": An application combining information on production, conservation and consumption of nutritious foods.
    - "Weather and Crop calendar": An application combining information on weather forecasts, crop calendars and alert systems.
    - "AgriMarketplace": An application to connect producers, traders and consumers to facilitate trade and access to inputs.

The apps can then be adapted for use in other countries as well.

Project activities can be divided in 3 categories:

A. Discover and organize the best content in open and accessible repositories using the best and most suitable technologies, ensuring these FAO resources are available, timely, consistent, accurate, scalable and interoperable.
    a. **Identify Content. High quality contents in FAO are available and have been identified**. In close collaboration with the technical departments AGA and ES, FAO country offices of Rwanda and Senegal, the FAO regional office in Africa and consultations with partner UN organisations ITU and WMO, freely available (and in some cases interoperable and standardised) contents have been identified and digital services have been described by our specialists in the technical departments. An important activity of the initiative will be to update and fine-tune the service descriptions based on the consultations of our team with the ministries and regulators, existing extension systems like Twigire Muhinzi containing the Farmer Field Schools and Farmer Promoters in Rwanda, farmer cooperatives, local telecom operators and private sector stakeholder like Smart Africa.
    b. **Select the most suitable delivery mechanisms** (Video, IVR, SMS) for each digital service, to make sure the services are useful, useable and used. The approach is updating the strategic focus of FAO delivery mechanisms in getting closer, and as close as possible, to rural farmers by using digital technologies. This will be measured with the indicators. Each app will have a Google Analytics profile measuring and monitoring the users and their usage (e.g. device, connectivity, interaction, duration, location, language, funnels).

c. **Coordinate with Farmer representatives, farm leaders and cooperatives**. These are key interlocutors for the initiative and well equipped to choose the most suitable delivery mechanisms for the digital services.
d. **Tap into active FAO projects** (13 in Rwanda and 6 in Senegal) that have a match with other services.

B. **Develop, implement and improve advisory and transactional services** in and for the field, delivering knowledge, training and support to the extension teams (the last mile agents) or directly to the family farmers.
e. **Strategic Partnerships**. A strategic partnership is discussed with Smart Africa, ITU, GSMA and FAO. This is very important to create a facilitating environment and strategic focus on the use of ICT in Agriculture. The work on the MoU with ITU and ongoing discussions Smart Africa are part of this strategic focus.
f. **Use Local Entrepreneurs**. Local Developers that are there, organised in Klab (Rwanda) and Jokkolabs (Senegal) with strong development capacities, good knowledge of local agriculture needs, already providing private services that are ongoing, in partnership with the government and national FAO offices.
g. **The long tail services.** Extension mechanisms like for example Twigire Muhinzi and Farmer Field Schools are effectively being deployed for input distribution and coordination of FAO projects. The initiative uses these extension systems to tap into existing projects and activities, assess the local farmers needs, capacity and existing project opportunities in the field, going the last mile. It is actively seeking the collaboration and commitment from local extension workers and local government people and private agents.
h. **Use local developers** that are able to contribute. Jokkolabs in Senegal and kLab in Rwanda are actively supported by the governments. We will work with 2 local start-ups that work with the ministries and youth associations to develop the app ideas.
i. Create collaboration models with local telecoms. Conduct meetings and negotiations with local telecom operators Tigo, MTN and Airtel in Rwanda and Orange, Tigo and Expresso in Senegal discussing feasible delivery mechanisms for our Digital Value Added Services, the best pricing model, network availability in rural areas and proposing them a collaboration model to commit to.
j. **Use a competition business model** linked to national policies and national support in terms of regulations, sharing networking etc. Ongoing discussions with telecom regulators in Rwanda and Senegal, to propose a good rural business model for mobile broadband connectivity, the best competition and collaboration between local telecom operators and link it to the national e-agriculture strategies.

k. **Strengthen the national value chain.** Assess the national value chain in the field and study and support with ICT elements that can make it sustainable and scalable.

C. **Outreach, disseminate and create engagement** for the services in each country, beneficiary and service, including development of online platforms and a media strategy but also tools able to engage farmers and extension agents in digital communities, in addition to promoting the mobile solutions in dissemination channels, like app stores.

l. **ICT in Agriculture Strategy.** The FAORAP/ITU e-agriculture strategy guide and ICT4RAGR strategy of Rwanda are guiding principles and form the basis of the implementation strategy of the initiative. The deep experience that was developed over the past 4 years with FAORAP, resulting in the e-agriculture strategy guide are provided as service by FAO and ITU to the initiative.

m. **Continuous validation**. The initiative discusses with assigned focal points of the national and local government and regulators, through the guidance of the FAO representatives in Rwanda and Senegal and integrate their priorities and existing local services, CPF, e-agriculture strategy and work to perfect the services with the local needs and value propositions. This is a crucial feedback mechanism to make sure that we are building "the right products."

n. **Create a national and FAO communication strategy**, through social media and engagement channels, collaborating with OCC and actively publicising the Services Portfolio in the App store and through FAO communication channels and fora.

o. **Build capacity and demonstrate champions**. Tap into the champions in the area and make them the drivers of innovation in the regions, like a digital showroom. Local governments are actively engaged to constantly assess opportunities to tap into and support regional champions and leverage existing capacities.

p. **Select high quality Over The Top service providers** (software houses) for scalability through an app competition, as reflected in the budget. This will increase the possibility to find useful, scalable and sustainable apps.

q. **Constantly monitor the outputs and activities on their impact**. The application usage (as demonstrated by UN Global Pulse), provide a wealth of information on behaviour and decision support for improving rural information. Usage can be monitored and evaluated. 2 Trainings and workshop will be conducted to trigger adoption and farmer promoters will be actively used to inform and engage farmers to use the digital services. Regional events in collaboration with the local government will be conducted.

2.2.1. Application "Cure and Feed your livestock" (advisory service - animal health and livestock production)

The application will provide real time information and advice to livestock owners. The app will help reducing losses in assets and optimize productivity using locally available resources. In the same application, it will be possible to create groups of farmers that exchange information and learn from the experience of others and good practices in animal feeding, hygiene and disease prevention.

Health component

- Livestock owners and their families without access to veterinary services and assistance lose their assets and source of livelihood due to diseases that could be prevented or easily treated. In some cases, these animal diseases can be transmitted to humans. Some of the important and high impact diseases in Senegal and Rwanda are: foot-and-mouth disease, peste des petits ruminants, African swine fever, Rift Valley fever, contagious bovine pleural pneumonia, Newcastle disease, brucellosis, sheep and goat pox, and anthrax. An outbreak of these diseases can kill the entire flock or herd or cripple production dramatically. Diseases of direct public health importance include: Rift Valley fever, brucellosis, Ebola, anthrax and the possibility of certain strains of avian influenza
- The app will allow livestock owners to enter information on clinical signs and syndromes (including pictures) and receive immediate information on diagnosis/differential diagnosis and cure and prevention measures. Syndromic surveillance, which relies on reporting general clinical signs seen in the flock, herd, or companion animal rather than focused and costly laboratory diagnostic information, can offer more timely identification of outbreaks, trigger an investigation by trained veterinary specialists in marginalized areas where traditional diagnostic medicine is weak. Further, the information provided can be sent to the local animal health worker or veterinarian, livestock officers, state veterinarian, and can provide a useful first step in diagnosis and provide information on parameters, such as number of affected animals, to better inform the type and quantity of medicine to bring along.
- The application also can be a good channel to alert farmers on diseases affecting nearby communities around them or provide advice on biosecurity.
- The existing EMA-i application provides an example of a successful similar application developed for public veterinary services. EMA stands for Event Mobile Application, and the "i" for information, intelligence, and intervention. "The use of EMA-i app in Uganda has demonstrated major improvements in disease reporting

and communication between districts and central level (i.e. from monthly to real-time) and increased the number of animal disease reports received from targeted districts. The "Cure and Feed your livestock" app will be tailored for use by livestock farmers, community animal health workers, or private veterinarians.

- Potential for evolution: The use of livestock ear tag sensors, can anticipate clinical signs including fever (an indicator of infection) sending notifications to the livestock owner. Similarly, a system can be developed whereby a farmer, animal health worker, or veterinarian can scan a barcode of a drug or vaccine label to assess the authenticity of the product and its expiration date.
- **Sources of data:**
    - EMPRES-i
    - Existing database of pictures of clinical conditions (AGA)

Feed component

- Feed is the key factor in animal production. Only when animals are fed a balanced ration will production level be satisfactory. Locally available feedstuffs will vary in quality and quantity according to the time of the year and the location.
- FAO (AGA) has developed a software for small scale dairy producers to prepare balanced rations for dairy cows using locally available resources. This is particularly important in emerging and developing countries where feed resources available locally are often under-utilized due to lack of information. Providing global knowledge on feed resources, including unconventional and lesser known ones, contributes to the development and use of innovative and appropriate feeding options and strategies.
- The software has been pilot tested in Myanmar and Sri Lanka and is used in TCP projects in these countries and in Thailand. The project will allow the development of an app, based on the existing software, and adapted to the needs of small scale producers involved in milk production in Rwanda and Senegal.

- **Source of data:**
    - The software uses data from **Feedipedia (www.feedipedia.org),** if local data on chemical composition and nutritional value are unavailable. Feedipedia is an open access information system on animal feed resources that provides information on nature, occurrence, chemical composition, nutritional value and safe use of nearly 1400 worldwide livestock feeds. It covers feeds mainly available in tropical, subtropical and Mediterranean regions but also includes common feeds used in temperate countries.
    - The development of Feedipedia is a joint project involving FAO, INRA (Institut National de la Recherche Agronomique, French National Institute

for Agricultural Research), CIRAD (Centre de Coopération Internationale en Recherche Agronomique pour le Développement, French Agricultural Research Center for International Development) and AFZ (Association Française de Zootechnie, French Association for Animal Production). The main objective of Feedipedia is to provide extension and development workers, planners, project formulators, livestock farmers, science managers, policy makers, students and researchers with the latest scientific information to help them identify, characterize and properly use feed resources to sustainably develop the livestock sector.

- The database is available and requires minimal maintenance (done by AFZ). Most of the information required is already available.

Partners:

CIO collaborates with AGA, FAORW and FAOSN, National livestock services to develop the app.

Links with *Project One Cow per Poor Family in Rwanda*. Involvement of state and district veterinarians/livestock officers, community animal health workers foreseen.

2.2.2. Application "e-Nutrifood"

An app combining information on production, conservation and consumption of nutritious foods (advisory service - nutrition)

- Adequate information concerning the quality and combination of essential nutritional values of food are vital in fighting malnutrition and food insecurity. Inhabitants of rural areas do not receive enough good quality information and technical orientation to produce and consume adequately nutritious food.
- Communication through basic audio-visual aids (descriptive images, videos and audio in mobile formats) in local languages will reduce the communication time and gap between key players in the field.
- A mobile platform is a sustainable solution to provide instant food and nutrition knowledge and information on best production and post-harvest practices (value chains) for a range of products/crops, including milk; to promote food security and better nutrition for rural development. The platform is meant for small holder farmers, small scale agro-enterprises, subsistence farmers, and consumers groups in rural/Peri-urban areas.
- Communication through basic audio-visual aids in local languages will reduce the communication time and gap between key players in the field. This will result in

higher yields, reduced food losses and waste, income generation and improvement of employment options; contributing to rural development. A major advantage of this technology is that it will benefit particularly women and children in remote locations where time and resources (service and utilities like electricity) are a huge constraint.

- Extension agents and community workers are the primary source through which food and nutrition knowledge and best production practices are disseminated to smallholder farmers, small enterprise agro-enterprises, subsistence farmers and consumers. These groups however have limited access to capacity development information available from extension workers due to the remoteness and lack of infrastructural capacities present in rural regions. Mobile platforms can now be used as a practical, affordable and scalable solution to improve the food and nutrition extension activities and operations in rural and remote areas with much less investment.
- A mobile app will provide day to day information about the subject that users register/select from a list of options available in the application. Nutrition information will be updated regularly through audio- visual aids. Farmers and consumers are linked to local markets to sell and buy nutritious foods.
- It will also aim to provide information on nutritious food combinations in connection with the food composition team, already available in the Nutrition and Food Systems Division (ESN). This will be tailored to the local context and based on what they have and what is available in the region, thus also serving to promote local recipes and strengthen local markets and policies. It also aims to provide information on how to adequately process, preserve and store produce; taking into account the region and resources available, to prevent nutrition losses. Furthermore, the app aims to empower women specifically in all of these cases.
- **Phase 1:** Text message for sending as mobile SMS
    - The ability to send short text messages of 125 characters, including spaces (approximately 12 – 130 byte) consisting of basic nutrition information, tailored to the country, using data from the INFOODS databases and INPhO technical - support framework .
- **Phase 2:** Upgrading to mobile app
    - Phase 2 is building on what has already been established in phase 1. This includes incorporating and upgrading to FAO mobile application that provide much more specific information with improved UX and UI to the user based on the product and the region within each country. Further development will also include the addition of the various other features. Phase 2 can be scaled up to and adapted for global audience.

Phase one can be implemented in 30 days, and phase two within 5 months, following further discussions involving all stakeholders.

- **Sources of data:**
    - The service will tap into and use data from FAO (INDDEX24), Health and Agriculture authorities, Farmers associations, myChild and BabyCenter & MAMA.
    - FAO Information on Post-Harvest Operations (FAO INPhO Technical Platform),
    - Since 1984, FAO hosts the International Network of Food Data Systems (INFOODS)22 a worldwide network of food composition experts aiming to improve the quality, availability, reliability and use of food composition data. Databases relevant to this app are all available through INFOODS.

Partners:

CIO collaborates with ESN, FAORW and FAOSN to develop the app.

3.2.3. Application "Weather and crop calendar" (information service – meteo, crop calendar, risk management)

- Rural families don't have access to periodical information about weather information to avoid crisis and mitigate risks. Many family farmers in Africa are affected by climate change, El-nino being just one dramatic example of how vulnerable rural communities are for ever more frequent extreme weather conditions. FAO is working to improve the resilience and mitigate the effects for the most vulnerable groups, helping the Sustainable Development Agenda to leave no one behind. Providing more crop per drop, deciding when to plant and when to harvest, based on accurate information is key for the livelihoods of millions of family farmers. These decisions are taken in many cases by women, bearing the burden of the high responsibility they have for the wellbeing of their families. Bottom line is they need to take the decisions, so having high quality timely and usable information is key to take informed decisions and empower women in rural areas.
- Access to basic weather forecast, including simple rainfall probability forecasts have proven to increase the income of small scale farmers in West Africa. This basic, easily scalable, daily SMS based service, can be complemented by more complex information at the pixel level from FAO in Crop production, Water, Soil and Vegetation. All this information at the pixel level (and hence at the farm level), can be provided in a user friendly, comprehensive service, directly to the farmers, based on the farmers GPS location, and can be tailored based on their personalised settings and farming needs.

[22] INFOODS

- The ever more accurate and detailed information provided by near real time satellite images and combined with the expertise of FAO and the ability to execute of our strategic partner Google Earth Outreach, provide a unique opportunity to deliver vital information closer to family farmers in rural areas, empowering women and young entrepreneurs.
- Furthermore, the FAO crop calendar can be added in due course to the information service, providing an even more complete advisory service to the family farmers. The Crop Calendar provides information for more than 130 crops, located in 283 agro-ecological zones of 44 countries, including Senegal.
- The mobile application provides early warning services to highlight potential risks and help increase resilience. It can harness big data to avoid crisis and mitigate risks. Climate Risk Management has proven to help farmers "make informed decisions, better manage risk, take advantage of favourable climate conditions, and adapt to change".

- **Sources of data:**

    - World AgroMeteorological Information Service (WAMIS) from WMO
    - Ignitia (ISKA)
    - FAO AG (Water Productivity and Crop Calendar)
    - FAO GIEWS (Global Earth Observations): GIEWS utilizes remote sensing data that can provide a valuable insight on water availability and vegetation health during cropping seasons. The information contains the Agricultural Stress Index, Mean Vegetation Health Index, NDVI Anomaly, Vegetation Condition Index, Vegetation Health Index, Estimated Precipitation, Precipitation Anomaly.
    - Also water productivity information, produced by the water productivity portal, can be added to the service to provide a set of useful decision support tools at the local level. Farmers can report back on the accuracy of the information, providing a participatory mechanism to improve the quality of the information and making it truly bi-directional.

Partners:

CIO collaborates with NRC, FAORW and FAOSN to develop the app.

2.2.4. Application "Business to farmer agriMarketplace"

An app that bring together producers, traders and consumers (transactional service - trade)

- In the Business Call to Action[23], private companies are challenged to develop inclusive business models. Inclusive business models can establish both commercial success and development impact. They unleash the potential of the poor by driving innovations, creating new markets and improving existing value chains.
- The digital economy empowers rural communities and global solutions networks play a key role in organising overarching partnerships between governments, business, civil society and citizens. Digital inclusion has become pivotal for sustainable rural development.
- Farmers often do not have good sources of information about who are - and where are - the best providers of supplies for raw material purchases neither know the best marketplaces to sell their products.

- The experience of the CASU project in Zambia demonstrates[24] how organising the logistics of mechanisation services with the use of e-vouchers can help improving agricultural development and food security and create truly inclusive value chains. Ongoing projects in the Tea sector in Rwanda and Dairy sector in Kenya in partnership with local mobile operators demonstrate how IVR services and mobile money improve farmers inclusion in the value chain.

- A mobile crowdsourcing application will be developed. Each farmer will be in a position to evaluate suppliers giving tips and hints for others about services and quality of the goods and offer their products to traders, markets and consumers. This facilitates a better integration in the value chain. It will benefit family farmers, suppliers, distributors and farmers associations, cooperatives, members of Farmer Field Schools (FFS) and Farmer Promoters (FP).
- The second "Data for Development" Challenge organised in Senegal in 2015, co-organised by UN Global Pulse, demonstrated how big data helps better understand rural livelihoods, agriculture events and social behaviour. This knowledge is key for better and more effective service delivery, most notably in rural areas.
- Mechanisation services can be requested through SMS and a mobile App by using e-vouchers, tapping into the CASU experience in Zambia.

- **Sources of data:**

    - Manobi / Sooretul / Aywajieune / MLouma
    - eSoko provides market price information in Rwanda as SMS service
    - GIEWS price tool (Price information for 11 markets in Senegal and 1

[23] Rethinking the United Nations for the Networked World - An Agenda for Strengthening the UN's Engagement through Global Solution Networks
[24] Zambia: Conservation Agriculture Scaling-Up Through ICTs Taking Root

market in Rwanda, Available through it's API. The information can be provided to farmers using SMS communication)

- AMIS market outlook
- EFMIS – Enhanced Fish Market Information Service
- Financial services of Local Mobile Operators (Orange, Tigo and Airtel)
- UN Global Pulse (now castings food prices).

Partners:

CIO collaborate with EST, FAORW and FAOSN to develop the app.

2.3. Logical Framework

Objectives	Indicators/Targets	Data sources	Assumptions
Impact goal Reduce rural poverty and malnutrition in Rwanda and Senegal. Provide the rural poor better and more equitable access to information, productive resources, services, and markets.	Contributes to SDG1, Target 1.4: Ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance	Reports on progress made on National poverty reduction strategies in Rwanda and Senegal.	
Outcome Reduce the "digital divide": Breaking down the barriers for use and access to information through digital technologies for socio-economic benefits and	The use of digital technologies and apps by the bottom 40 per cent of the population grows at a rate higher than the national average	Trade reports from agriculture local authorities and farmers associations Reports from health and	Digital inclusion promotes social inclusion reducing poverty and malnutrition

to accelerate poverty alleviation, gender equality, job creation, and nutrition security.		agriculture local authorities and telecom operators	
Outputs 1. Animal Production and Health (how to feed and cure your animals) e-Service application	40 000 households from both countries use at least one of the four mobile applications	Downloads in the app stores and usage statistics	There is connectivity to access the mobile applications
2. e-Nutrifood - Produce and consume nutritious food application	40 000 households both countries use at least one of the four mobile applications	Downloads in the apps stores and usage statistics	There is connectivity to access the mobile applications
3. FAO Meteo and Calendar	40 000 households both countries use at least one of the four mobile applications	Downloads in the apps stores and usage statistics	There is connectivity to access the mobile applications
4. Business to farmer agriMarketplace application	40 000 households both countries use at least one of the four mobile applications	Downloads in the apps stores and usage statistics	There is connectivity to access the mobile applications
Activities Improve existing data sources from open and accessible repositories using the best and most suitable technologies, ensuring these FAO resources are available, timely, consistent, accurate, scalable and interoperable.	Dataset mapped Repositories organised	CIO inventory list CIO inventory list	FAO divisions see use in the data availability Information Management improve quality of the advisory services

Develop, implement and improve advisory and transactional services in and for the field, delivering knowledge, training and support to the extension teams (the last mile agents) or directly to the family farmers.	Applications developed Digital platform concluded Capacity workshops realised	Project coordination CIO records Project coordination	
Outreach, disseminate and create engagement for the services in each country, beneficiary and service, including development of online platforms and a media strategy but also tools able to engage farmers and extension agents in digital communities, in addition to promoting the mobile solutions in dissemination channels, like app stores.	4 applications available in the apps stores Spots with information about the four services promoted in community radio stations Engagement in online interface of the digital platform	Downloads in the apps stores Programming of Dimitra Clubs radio stations OCC Internet and Internal Communications	

2.4. Addressing cross-cutting themes of FAO

- The application of ICTs in agriculture and rural development can have a significant impact on rural populations. For example, the provision of agriculture extension using ICT-based applications offers a promising approach for enhancing access to information for rural youth and women, as they can disseminate information widely for a relatively low cost, do not necessarily require users being literate, and can be tailored to local languages and cultures. Nevertheless, youth and women face many challenges in accessing ICTs: women have fewer resources and less income available to secure the use of ICTs; women and girls are less literate and lack access to education; women's time poverty restricts access; gender stereotyping and socialization and the perception of technology as men's prerogative in the household is an important factor; in typical rural communities, men control the

technology, thus excluding women from an awareness of how ICTs can contribute to improving livelihoods.

- The project will emphasise the gender perspective and specifically target the needs of women and female headed households.
- As well as with mobile devices possession, women have disadvantages in the connectivity. On average across the developing world, nearly 25% fewer women than men have access to the internet, and the gender gap soars to nearly 45% in sub-Saharan Africa. Rural women also have less access than men to productive resources, services and opportunities, such as land, livestock, financial services and education. In the telecommunications sector, women in low and middle-income markets are 13% less likely to own a mobile phone than men (202 million women). Innovative information and communication technologies (ICTs) will accelerate the progress to bridge the gender digital divide. Digital technologies overcome information problems that hinder market access for many small-scale farmers (mainly women), increase knowledge and information sharing through new ways of providing Digital Value Added Services (DVAS), and provide novel ways for improving rural livelihood conditions, fight poverty, increase resilience, food security, nutrition, market information and supply chain management.

2.5. Innovative aspects and contribution to cross-sectoral work

- There is a big opportunity for FAO and partners to scale up innovative digital services (provided by ICTs) and drastically increase their impact by bringing solutions closer to more farmers in Africa and other regions.
- FAO has the expertise and is in a unique position to tackle the challenges of the SDGs and digital divide with new and improved digital information, transactional and advisory services[25] to overcome the digital gap in the field. FAO has high quality data, information, knowledge, people and capacity to provide useful, usable and used services, know-how to engage farmers, women and youth that will improve their livelihoods and bridge the digital divide. More than this, FAO has the experience to scale up successful Digital Value Added Services together with our strategic partners and facilitate social entrepreneurship and relation with local governments.
- In the rural sector, different digital services are used with success all over the world.

[25] Digital Value Added Services types used by FAO:

- Information: data, images and other digital resources organized and available to predict, prevent, update and qualify the farmer activities in areas such as meteorology, market prices, natural disasters, etc.
- Transactional: ICT system or application able to facilitate an intermediary accomplishment between two operations in terms of finance, trade or management.
- Advisory: selected information and knowledge tailored to solve a problem under request, clarify a question or provide extension support using information and communication solutions.

The most common ones are financial services, price tools, and meteo information[26]. Currently, agricultural information, advisory and transactional services for meteo, trade, nutrition, animal health, pest control and early warning are being provided by FAO using delivery mechanisms that need to be easily scalable and engage more people directly the field. However, few of them are offered using mobile, affordable and user friendly formats and languages. The complexity of the services, developed focusing mainly on policy makers, academics and technical experts, hampers its use and adoption by the main beneficiaries of this FAO initiative.

- The digital value added services and mobile usage will be monitored by using google analytics and segment in combination with the delivery platform. This produces a wealth of information on devices, connectivity, interaction, duration, location, languages and funnels. The second "Data for Development" Challenge organised in Senegal in 2015, co-organised by UN Global Pulse, demonstrated how mobile data helps better understand agriculture events and social behaviour in rural areas. This contributes to better and more effective service delivery and to the definition of rural socio economic policies.
- This model, based on a set of Digital Value Added Services portfolio (DVAS) from FAO expertise and experience, will make the leap forward to provide high quality information services close to family farmers and extension workers like local veterinarians, Agricultural Extension Agents and nutrition experts using innovative and the most convenient digital technologies. The services will be designed observing special attention for the specific needs of women and youth.
- Initial selected portfolio includes services that will be enhanced and extended based on demand from the new countries and beneficiaries. FAO will work in the field using the Farmer Field Schools[27] and Dimitra Clubs[28] where possible, to map and capture the demand receiving inputs from local producers associations, extension workers and officers of agricultural development authorities. This demand-driven approach is key to identify the gaps and risks to enhance small scale agriculture in Rwanda and Senegal. More than mapping the demand, these consultations will be central to discover opportunities and adapt the services portfolio to the real needs from local farmers.

2.6. Participants and other stakeholders

- The project will focus on rural households, women, youth and self-employed entrepreneurs, working to break down the barriers of adoption and promoting digital inclusion that unlock new market opportunities and deliver significant socio-

[26] See http://www.agritools.org/ and http://www.ictworks.org/.
[27] FAO Farmer Field Schools
[28] Dimitra Project - Gender, rural women and development

economic benefits that transform their lives, to accelerate poverty alleviation, gender equality, job creation, and food security. Freely available and user friendly applications will facilitate reaching the target.

2.6.1. Rwanda

- 90% of the labour force is involved in agriculture (5.67 million people in agriculture) and an estimated half of rural households own livestock (the country counts 1.13 million heads of cattle, 3.5 million sheep and goats and 4.8 million chicken). Livestock is usually an important component of women livelihood`s portfolio. Providing they have a mobile phone and access to internet, the "Animal Health e-Service" app will be of use to over 2 million people working with livestock as owners or labourers.
- Providing they have a mobile phone and access to internet, all of the 2.4 million households in Rwanda will potentially have access to the "e-Nutrifood" and "FAO Meteo and Calendar" apps. This includes the 400,000 households living in urban areas.

The apps will be developed taking into account that 93% of the population speaks Kinyarwanda only and illiteracy rate is still 30%.

2.6.2. Senegal

- 77% of the labor force is involved in agriculture (5 million people in agriculture) and an estimated two thirds of rural households own livestock (the country counts 3.5 million heads of cattle, 11 million sheep and goats and 49 million chickens). Providing they have a mobile phone and access to internet, the "Animal Health and Feed" app will be of use to an estimated 3 million people working with livestock as owners or laborers.
- Providing they have a mobile phone and access to internet, all of the 1.5 million households in Senegal will potentially have access to the "e-Nutrifood" and "FAO Meteo and Calendar" apps. This includes the 800 000 households living in rural areas.

The app will be developed taking into account distribution of languages in the country (Wolof 38.7%, Pular 26.5%, Serer 15%, Mandinka 4.2%) and a national illiteracy rate which is still at 40%, and higher in poor rural communities.

2.7. Promote private public collaboration

- In the Business Call to Action[29] private companies are challenged to develop inclusive business models with mutual benefits for the poor and private companies. These concepts are equally valid for urban and rural areas. Inclusive business models can establish both commercial success and development impact. They unleash the potential of the poor by driving innovations, creating new markets and improving existing value chains. The digital economy empowers rural communities and global solutions networks play a key role in organising overarching partnerships between governments, business, civil society and citizens. Digital inclusion has become pivotal for sustainable rural development. Ever more investment agencies and donors request reporting on economic, social and environmental impact. Novel ways of establishing truly inclusive digital business models, empowering rural poor and women are capable of delivering on these demands.

2.8. Capacity development activities and corresponding milestones

- In collaboration with the national governments, local and strategic partners, the main idea of this initiative is to offer, in near real time, a portfolio of these initial four mobile applications, providing services that support concrete daily needs of the farmers in an easy, hassle free and customisable way. Based on the knowledge gathered by FAO and local policies, the package of solutions will be delivered to ensure quality information and technical advisory services, using complementary and incremental approach between each one.
- FAO, strategic and local partners will support the development of mobile devices and ICT applications, broadcasting content, and literacy to deliver quality information about food production, nutrition, health, natural disasters and financial services inclusion and access to commercialisation market and agricultural credit for women farmers from Rwanda and Senegal.
- The capacity development will organise at least two workshops, use local radio programs in community broadcasting stations and other ways to communicate, inform and engage farmers, extension workers and rural leaders highlighting the benefits of the services and promote the apps.
- As result, FAO expects that 40 000 rural households from both countries use at least one of the four mobile applications to improve the access to information and agriculture advisory support to reduce poverty and increase resilience in the field.

[29] Rethinking the United Nations for the Networked World - An Agenda for Strengthening the UN's Engagement through Global Solution Networks

3. Feasibility and sustainability of the proposal

3.1 Potential risks

The UN Broadband Commission for Digital Development has agreed on a threshold of 5% of average national income for 500MB of mobile data a month.[30] According to the Affordability Report 2015, Rwanda (14% of GNI) and Senegal (11% of GNI)[31] are both above this threshold. Mainly women and the poor are more likely excluded from the digital revolution.

Digital inclusion initiatives in both countries need to address the barriers to mobile internet adoption through infrastructure and policy, affordability, digital literacy and local content[32]. It will make useful data, information and statistics available and accessible as digital services[33]. As an incremental gain, mobile devices usage by farmers, with broadband connectivity, will allow more access to a range of health and educational services, communication tools and several new sources of information and entertainment.

The main political sensitivity risks of the initiative are that there may be: (a) limited political will to foster gender equality in politically sensitive thematic areas, such as access to land, wage and empowerment; (b) cultural barriers, such as religion and moral traditions. To avoid these elements, FAO and partners will work with local associations to organize activities that enable consultation and awareness of women and local communities to develop a common understanding, clarify concepts and approaches, and identify policy and programmatic openings for interventions targeting rural women. Capacities of rural women's groups will also be developed, based on context-specific assessments to ensure that trainings and other support are tailored to the specific capacities and needs of the target groups, while taking into account social and cultural realities in rural areas.

The project will specifically focus on women and youth, working to break down the barriers of adoption and promoting digital inclusion that unlock new market opportunities and deliver significant socio-economic benefits that transform their lives, to accelerate poverty alleviation, gender equality, job creation, and food security[34].

3.2 Sustainability of the proposal

By the end of the project, it is expected that community-based rural women's and men's groups in the selected countries will have improved their livelihoods using ICTs-based services to purchase goods, keep animals productive and healthy, monitor local markets, receive meteo information on real time, and access useful data to commercialise their

[30] The secret formula for bridging the digital divide? It's 1 for 2, claims study

[31] Affordability Report 2015

[32] GSMA - Digital inclusion

[33] African Farmers in The Digital Age - Foreign Affairs

[34] United Nations Secretary-General's Special Advocate for Inclusive Finance for Development (UNSGSA)

production. More than this, they will achieve the basic right to decide independently on their own destiny by working in the field without relying on a single source of information or systematic external support. The social dynamics created by the project will increase rural women's capacity to share experiences, provide peer-to-peer mentoring, participate in decision-making and take on leadership roles, which will continue after the end of the project.

The continuity of the work in the field shall be taken from the local and national-level institutions and stakeholders. By one hand, supported with resources from the countries, at highest level (national government), having public institutions as part of the team, providing facilities, HR capacity, training and grants. The private sector also will contribute giving access to new technologies, networks and ICT solutions for the women farmers groups, working with local companies and smallholders associations.

The initiative also will facilitate replication of the women's empowerment approach in other regions of the target countries and in other agricultural value chains and will reinforce the FAO's capacity at the country level by fostering knowledge sharing and strengthening partnerships with relevant national institutions, civil society organizations, private sector and other relevant stakeholders. This dissemination will contribute to establishing a cost-effective modality for further replication and expansion of the project activities.

The methodology used in the project and the focus on empowering people, women and youth in particular, will be crucial for ownership purposes and subsequent sustainability. Both country and citizens' ownership are important for effective development. Country- and local-driven solutions will need to be identified based on information, capacity development and good governance at different levels. Without ownership there is no sustainability. Empowerment, local adaptability, ownership, participation, value creation, scalability, decentralization and sustainability are key words in the process. At field level, FAO experiences with gender-responsive participatory methodologies have proved their usefulness. For examples, in Niger where many Dimitra Clubs have been existing since 2009, no support has been provided to these informal organisations after the initial period of three years. However, the clubs continued working well after the support had stopped, working to improve their livelihoods with income-generating activities in agriculture. To resolve the issue linked to the cost of the clubs' mobile phone, innovative solutions were found such as use of the phone as a public booth.

4. Synergies/Partnerships

Goals of this project have continued progression, having a global nature, bringing together a large multi-stakeholder community using digital communication tools and platforms. It tries to do business in a different way, addressing global challenges and creating social inclusive models, leveraging the potential of digital innovations allowing a quick and challenging enhancements. It's about finding new scalable solutions to global issues, harnessing multi-stakeholder participation of governments, UN agencies, the private sector

and civil society using the power of the internet to share knowledge.[35]

The proposed model and the strategy to implement these digital services ranging from basic information to more sophisticated services. They require intense consultation and articulation among the various partners starting with the national and regional governments to trained community leaders and extension workers supporting closer extension services for small farmers as well as professionals from private areas of telecommunications and internet.

The strategy considers an initial deployment of basic information services based on country level websites and focus groups surveys with dynamic information to different sectors, app development for local partners providing knowledge and final user apps to connect local partners and information. After the initial phase with the two applications delivered, new and sophisticated transactional and advisory services will be developed to add to FAO's portfolio based on the needs from different groups, where the final user could access information/knowledge/advisory services on demand.

Formal and informal working agreements and cooperation need to be carefully constructed, designing scenarios, managing risks and opportunities, calibrating expectations and necessities, creating a common environment for long-term cooperation, building mutual trust and mainly, creative and innovative solutions. The experiences of FAO with similar services are precious but need to be renegotiated in each partnership, each country and each service.

CIO identified potential digital services offered by FAO and started the engagement with telecom operators, national governments and NGOs and local private companies. After choosing the complementary or related projects, the partners are invited to negotiate the details of the cooperation.

Besides, HQ has worked with Local Country Office from Senegal and Rwanda to organise and share the project, defined in-house coordination mechanisms, and collect feedback on country plans and strategic partners to be involved in the projects in the selected countries.

4.1. Institutional collaboration

- GSMA (mAgri and Connected Women)
- SmartAfrica
- FAO and ITU (e-Agriculture)
- Rwanda Government - Ministry of Agriculture and Animal Resources (Minagri) and Ministry of Youth and ICT (MYICT)
- Senegal Government - Ministère de l'Agriculture du Sénégal, Ministère de l'élevage et des productions animales (MEPA) and Agence De l'Informatique de l'Estat (ADIE)

[35] Rethinking the United Nations for the Networked World - An Agenda for Strengthening the UN's Engagement through Global Solution Networks

- Local mobile telecom operators (Orange, Airtel, Tigo, Vodafone, MTN, Expresso)
- NGOs and small enterprises (MLouma, Manobi, IBLI, Ignitia, e-Soko, Sooretul, Aywajieune, mVAM)
- Farmers associations

5. Budget

Output	Budget Lines	2016	2017	Total	%
1	**Staff**				
	Temporary Assistance (Administration) (55 days x 203 USD)	3,045	8,120	11,165	2
	Consultants-International				
	1 project manager (209 days x 300 USD)	13,200	49,500	62,700	9
	1 project assistant (209 days x 150 USD)	6,600	24,750	31,350	4
	Consultants-National				
	2 Consultants (Rwanda and Senegal)	17,600	77,400	95,000	14
	Contracts				
	Development of 4 applications	50,000	50,000	100,000	14
	Contracts and Services with partners in Rwanda and Senegal (Public-Private Partnerships)	40,000	20,000	60,000	9
	Travel				
	Travel	71,200	8,885	80,085	11
	Training				
	Workshops (2 trainings on use of the apps for extension workers)	0	24,000	24,000	3
	Apps for Food Startups Awards	0	15,000	15.000	2

Output	Budget Lines	2016	2017	Total	%
	Communication				
	Communication (videos for the apps, radio messages promoting the use of the apps, digital content, translations)	0	45,000	45,000	7
	TSS				
	Technical Support Services (TSS)	29,700	55,000	84,700	12
Subtotal		231,345	377,655	609,000	87
	13% PSC Rate			91,000	13
Total				700,000	100

Percentage that will be allocated to:

Salary Professional: 0 %

Staff (short term hires and TSS reimbursements): 12 %

Consultants: 41%

Contracts: 9 %

Other (travel, GOE, etc.): 25 %

Responsible Units:

Budget Holder (BH): Samuel Varas (CIO)

Lead Technical Officer (LTO): Cezar Santos Alvarez (CIO)

APPENDIX H

FAO ANNUAL MEETING CONSULTATION

15th of June 2017

Agricultural Services and Digital Inclusion in Africa

FMM/GLO/116/MUL

1) How the new resources were catalytic to your areas and the Strategic Framework of FAO, mainly SP3.

STRATEGIC OBJECTIVE 3 - REDUCE RURAL POVERTY	
The rural poor have enhanced and equitable access to productive resources, services, organizations and markets, and can manage their resources more sustainably.	3.1
Support to improve access of poor rural producers and household to appropriate technologies and knowledge, inputs and markets.	3.1.3
Support to innovations in rural services provision and infrastructure development accessible to the rural poor.	3.1.4
Regional Result *Africa's 2025 Zero Hunger Challenge*[36]	

The new resources have been invested in the development of 4 mobile applications that will help the rural poor, in particular smallholders and family farmers, to access key reliable information that will improve substantially their life conditions. The applications are the following:

- "**Cure and Feed your livestock**": An application providing real time information on animal diseases control and animal feeding strategies.
- "**e-Nutrifood**": An application providing information on production, conservation and consumption of nutritious foods.
- "**Weather and Crop calendar**": An application combining information on weather forecasts, crop calendars and alert systems.

[36] http://www.fao.org/africa/perspectives/end-hunger/en/

- "**AgriMarketplace**": An application that will connect producers, traders and consumers to facilitate trade and access to inputs.

2) How these resources are being used

These resources are being used in order to implement project activities with some particularly innovative aspects such as the following:

- Use of local knowledge: the project applications are developed by a joint group of young developers, 6 of them will be hired in the project implementation countries, 1 senior 2 junior developers are hired in Rwanda and 1 senior and 2 junior developers are hired in Senegal. They work together as a joint team and cooperate also with a Data engineer and a Front End Developer based in FAO HQ, Rome. Three National consultants are working in Rwanda and Senegal on the relations with the National Governments and local strategic partners and are instrumental in the signing of Agreements with the National Ministries and Strategic Partners in the countries.
- Cross-sectoral work within FAO internal divisions: for each one of the developed apps, a specific division within FAO has been involved (AGA, ESN, NRC, EST), through the identification of a focal point but also through the joint work for defining the contents of the apps, the information to be spread out to the farmers (or extension workers), the data collection mechanisms and the forms that the data should have in order to be transformed into the apps. To ensure the coordination of the work carried out by the technical teams and the correspondence to the project's objectives, weekly meetings (TSS meetings) are being organized among them and the project management team. For the same purpose, a monthly meeting among all focal points of the technical teams (called *project task force*) is being organized.
- The services (apps) proposed will be bidirectional/interactive. In many cases, the role of beneficiaries will be decisive to report their experiences, and provide them with accurate and useful feedback. Using a user-generated content approach, FAO and partners will establish interaction with the beneficiaries building sustainable networks.

3) Mention some concrete results so far (if any). I know some of them but not all.

ACTIVITIES CARRIED OUT

1. Project framework set up:
    - Work-plan and general roadmap designed

- Staff hired and country offices organized; currently the project team is composed of
  - 1 Lead Technical Officer at FAO HQ,
  - 2 local consultants in Senegal,
  - 1 local consultant in Rwanda,
  - 2 technical international officers at FAO HQ,
  - 1 project manager at FAO HQ
- HQ TSS teams organized with Focal Points nominated in the relevant divisions – regular coordination meetings (weekly) carried out
- Project Task Force (PTF) set up and monthly coordination meetings carried out (this is to ensure the engagement of relevant divisions and the sharing of common objectives)
- Common virtual working space organized and shared for project activities' monitoring and facilitate coordination with country offices, among TSS teams and project staff

2. Launch workshops organized:
   - 19th – 24th March 2017 in Dakar, Senegal
   - 26th – 31st of March 2017 in Kigali, Rwanda
   - Common activities:
     - Meeting country representatives
     - Meeting Ministers
     - Work meeting FAO local staff
     - Work meeting project local consultants
     - Meeting appointed Focal Points
     - Launching official ceremony
     - Development workshop
     - Field visit to involved regions in both countries (Rulindo in Rwanda and Tambacounda in Senegal)
3. Communication:
   - Website page has been constructed and published on the FAO website (http://www.fao.org/in-action/africa-digital-services-portfolio) in English and French (French version under translation – Jun 2017)
   - Project brochure has been published in English and French. See http://www.fao.org/documents/card/en/c/1fa9dcb3-39ae-427e-9371-61845aa1b00e
4. Collaboration with local relevant stakeholders:
   - **Senegal** – Government: relevant ministries have been individuated, met and proposed a collaboration; Focal Points have been nominated and engaged in the project; the following have been involved:
     - Ministry of Agriculture
     - Ministry of Telecommunications
     - CSA – Commissariat à la securité alimentaire
     - Ministry of Livestock

        - SECNSA – Secretariat Executif du Conseil Nationale de Securité Alimentarie
        - ANACIM – Agence National de l'Aviation Civile et de la Metereologie
        - Local Government of Tambacounda
    - **Rwanda** – Government: relevant ministries have been individuated, met and proposed a collaboration; Focal Points have been nominated and engaged in the project; the following have been involved:
        - Ministry of Agriculture and Animal Resources
        - Ministry of Youth and ICT

With the above-mentioned governmental ministries or agencies, specific Letters of Agreement or Formal Letters of collaboration are under negotiation and will be signed by the end of June 2017.

- **Senegal** – Local strategic Partner:
    - **CTIC Dakar**: is the first incubator and accelerator for IT and mobile technology young entrepreneurs founded in West Africa.
- **Rwanda** – Local strategic Partner:
    - **ICT Chamber**: it is the youngest member of the Private Sector Federation (PSF), bringing together ICT Associations, businesses, groups and individuals into a community where they can share ideas on how to promote and develop Rwanda's ICT and ICT enabled Industries.

Also with CTIC and the ICT Chamber, a Letter of Agreement is under negotiation and is expected to be signed by the end of June 2017, which will make them officially strategic partners of the project that will support the local developers' team.

5. Contents definition: in order to prepare the field for the apps development, the following activities have been carried out or are in progress:
    - Identify content available in Rwanda and Senegal
    - Develop knowledge of FAO local programs/projects in the intervention areas
    - Discover non FAO content from other stakeholders
    - Creation of databases/lists of existing data/sources for each app
    - Assessment of the data sources in terms of maintainability
    - Description of the basket of goods (products/services) that have been chosen and why
    - Assessment of the intervention areas (Rulindo, Rwanda and Tambacounda, Senegal)
    - Investigation for choosing the most appropriate delivery/dissemination mechanism
    - Mapping of web services available for each app
    - Mapping of data availability, quality and attributes per each app

SHORT-TERM PLANNED ACTIVITIES

1. Hiring of local developers: currently the country offices are selecting 3 developers in Senegal (1 senior and 2 junior) and 3 developers in Rwanda (1 senior and 2 junior) with the support of local strategic partners;
2. Developers Workshop in Rome: the project team is currently organizing a workshop in Rome that will take place from the 31st of July to the 4th of August and will allow the following participants to work together on the development of the 4 apps:
    a. 3 developers from Rwanda (1 senior and 2 junior)
    b. 3 developers from Senegal (1 senior and 2 junior)
    c. 2 local consultants from Senegal
    d. 1 local consultant from Rwanda
    e. 1 focal point form CTIC Dakar
    f. 1 focal point from IT Chamber in Kigali
    g. Developers from CIO division will participate as well as the rest of the project staff at FAO HQ
3. Capacity Building workshops: 2 capacity building workshops are being organized in Senegal and Rwanda for local farmers and extension workers in order to make the best possible use of the four app; the workshops are planned to take place by the end of September;
4. Fund raising activities: currently funding proposals are being elaborated in order to support the consolidation phase of the actual project (Year 2) and the expansion phase (adaptation to new countries, more apps, further development of current apps..) to be presented to different donors (National governments, private foundations, governmental aid agencies..).

4) Some observations in terms of difficulties, challenges and lessons for the future.

The main challenges and difficulties recognized until now have been the following:

- Engagement of local governments: ministries and governmental agencies tend to perceive this project as a funding source for their activities while the intention is that they take it up as deep commitment to improve the lives of their rural poor. The creation of a sense of ownership towards the project is one of the main objectives of the current work carried out with institutional local interlocutors. This will serve in particular for the future sustainability of the project once the current financial support finishes, since the local ministries or governmental agencies will have to continue collecting, organizing and storing the necessary data to feed the apps;

- Definition of different layers of interlocutors: it is still to be properly defined what kind of information will be delivered to extension workers and which ones to farmers (tailored differently according to the kind of needs that they have, the device they are using, and the role they play in local communities).

Lessons learnt so far:

- The sincere involvement of local governments (through the designation of a dedicated focal point, who does possibly not change in the course of the project) is a key element for the success of the project and needs to be secured since the beginning
- Technical issues are not to be underestimated (delivery mechanisms, business model definition).
- Bureaucracy can slow down a lot the project implementation and should not be underestimated (especially in terms of hiring staff, signing of bilateral agreements).

REFERENCES CITED

Abraham, R. (2007). Mobile phones and economic development: Evidence from the fishing industry in India, *Information Technologies and International Development,* 4(*1*), pp. 5-17.

Abunyang, E. (2007). Mobile banking in developing countries: Secure framework for of SMS-banking services. Radboud University Nijemegen (Master thesis).

Adegoke, Y. (2017). The mobile phone is still changing the game in Africa. Retrieved from https://qz.com/africa/1127274/one-billion-people-in-sub-saharan-africa-will-have-mobile-phones-by-2023/

Africacheck.org (2019). Senegal: Le taux d'electrification rurale est-il situe entre 42 et 43% ? [Senegal : Is the rural electrification between 42 and 43% ?]. Africacheck.org. Retrieved from https://fr.africacheck.org/reports/senegal-le-taux-delectrification-rurale-est-il-situe-entre-42-et-43/

Africultures (2011). La radio et la télévision au service de l'éducation et du développement en Afrique. Analyse de l'action de l'UNESCO dans les années 1960-1970 [Radio and television in service of education and development in Africa. Analysis of the action of UNESCO in the 1960s-1970s]. Retrieved from http://africultures.com/la-radio-et-la-television-au-service-de-leducation-et-du-developpement-en-afrique-9977/

ADIE (2020). Une histoire d'innovation [A history of innovation]. Retrieved from https://www.adie.sn/agence/une-agence-tourn%C3%A9e-vers-l%E2%80%99avenir

Agar, M., & MacDonald, J. (1995). Focus groups and ethnography. *Human Organization,* 54, 78- 86.

Aker, J. C. (2011). Dial "A" for agriculture: A review of information and communication technologies for agricultural extension in developing countries, *International Association of Agricultural Economics*, 42, pp. 631-647.

Aker, J. C. & Fafchamps. M. (2014). Mobile phone coverage and producer markets: Evidence from West Africa, The World Bank Economic Review, 29(*2*), pp. 262-292.

Aker, J. C., Ghosh, I., & Burrell, J. (2016). The promise (and pitfalls) of ICT for agriculture initiatives, *Agricultural Economics*, 47, pp. 35-48.

Aker, J. C. & Mbiti, I. M. (2017). Mobile phones and economic development in Africa, *Journal of Economic Perspectives,* 24(*3*), pp. 207-232.

Alozie, N. & Akpan-Obong, P. (2017). The digital gender divide: Confronting obstacles to women's development in Africa. *Development Policy Review*, 35(*2*), pp. 137-160.

Alzouma G. (2005). Myths of digital technology in Africa leapfrogging development? *Global Media and Communication*, 1(*3*), 339-356.

Amin, S.(1976). Unequal development. Retrieved from https://maoistrebelnews.files.wordpress.com/2015/04/unequal-development.pdf

Anderson, J. R. & Feder, G. (2007). Handbook of agricultural economics. Agricultural extension. 3, pp. 2343-2378.

Angello, C. (2015). Exploring the use of ICTs in learning and disseminating livestock husbandry knowledge to urban and peri-urban communities in Tanzania, *International Journal of Education*, 11(*2)*, pp. 5-22.

ANSD (2019). Situation Economique et Sociale de la Region de Tambacounda [Economic and social situation of the Tambacounda region]. Dakar: ANSD. Retrieved from http://www.ansd.sn/ressources/ses/SES-Tamba-2016.pdf

ANSD (2019). Situation Economique et Sociale du Senegal en 2016 : Education, Formation. [Economic and social situation of Senegal : Education, training]. Dakar: ANSD. Retrieved from http://www.ansd.sn/ressources/publications/3-SES-2016_Education-formation.pdf

ANSD (2019). La population du Senegal en 2018 [The Senegalese population]. Dakar : ANSD. Retrieved from http://www.ansd.sn/ressources/rapports/Rapport_population_060219%20002%20RECsn%20.pdf

ANSD (2014). Recensement général de la population, de l'habitat, de l'agriculture, et de l'elevage [National Demographic and Statistics Agency (2014). General Census on Population, Habitat, Agriculture and Livestock]. Dakar: ASND. Retrieved from http://www.ansd.sn/ressources/rapports/Rapport_provisoire_RGPHAE_2013.pdf

ANSD (2015). Situation Economique et Sociale Régionale 2013 [Economic and social situation of the region in 2013]. Dakar: ANSD. Retrieved from http://www.ansd.sn/ressources/ses/chapitres/1-demographie-tamba2013.pdf

ANSD/SRSD (2013). Situation économique et sociale régionale 2013 [ANSD/SRSD (2013). Regional economic and social situation] Retrieved from http://www.ansd.sn/ressources/ses/chapitres/17-annexe-tamba2013.pdf

APANEWS (2018). Senegal : Production record pour la campagne agricole 2017-2018 (Officiel) [Senegal : Record production for the agricultural campaign 2017-2018]. Retrieved from https://apanews.net/index.php/news/senegal-production-record-pour-la-campagne-agricole-2017-2018-officiel

ARTP (2019). Rapport d'analyse sur le marché des télécommunications au Sénégal [Analysis report on the telecommunications market in Senegal]. Agency for Posts and Telecommunications Regulation.

ARTP (2020). Nos mission [Our missions]. Retrieved from https://www.artpsenegal.net/fr/lartp/nos-missions

Asongu, S. & Boateng, A. (2018). Introduction to special issue: Mobile technologies and inclusive development in Africa, *Journal of African Business*, 19(*3*), pp. 297-301.

Asongu, S. & Nwachukwu, J. C. (2017). Comparative human development thresholds for absolute and relative pro-poor mobile banking in developing countries, African Governance and Development Institute.

Au-Senegal.com (2020). Le Parc National de Niokolo-Koba [The Niokolo-Koba National Park]. Retrieved from https://www.au-senegal.com/le-parc-national-du-niokolo-koba,009.html

Austen, R. A. (2001). The slave trade as history and memory: Confrontations of slaving voyage documents and communal traditions. *The William and Mary Quarterly*, 58(*1)*, pp. 229-244.

Awunyo-Vitor, D. (2016). What drives mobile money services demand by farmers in Ghana? A study of maize farmers, *International Journal of Management Practice*, 9(*2*), pp. 173-191.

Ayee, E.S.A. (1993). A participatory communication approach to rural community development. D.Phil (dissertation). Potchefstroom: Potchefstroom University for Christian Higher Education.

Badji, A. M. (2019). Obtention d'un papier administratif : un véritable parcours du combattant [Obtaining an administrative document : a real obstacle course]. Retrieved from http://www.topnews.sn/obtention-dun-papier-administratif-un-veritable-parcours-du-combattant/

Badji, S. (2018). Le sud du Sénégal a l'heure de la culture irriguée de la banane : Innovations agricoles et dynamiques territoriales. [The South of Senegal in the age of irrigated banana production: agricultural innovations and territorial dynamics]. Saint-Louis: Gaston Berger University (Dissertation). Retrieved from file:///C:/Users/layir/Desktop/Banane.pdf

Banda, M.M. & Changala, M. (2019). The use of e-voucher as an input distribution system by small scale farmers in Chongwe district, Zambia: An adult education perspective, *Journal of Adult Education*, 1(*2*), pp. 15-27.

Barr, D. F. (1998). Integrated rural development through telecommunications. In *The First Mile of Connectivity*, edited by D. Richardson and L. Paisley, pp. 152-167. Rome: FAO.

Batista, C. & Vicente, P. (2019). Improving access to savings through mobile money: Experimental evidence from smallholder farmers in Mozambique, Working Paper no. 1705. Novafrica Working Paper Series. Retrieved from http://novafrica.org/wp-content/uploads/2017/08/1705.pdf

Bessette, G., ed. (2006). People, land and water: participatory development communication for natural resource management. S.l.: International Development Research Centre.

Best, M. L. & Kumar, R. (2008). Sustainability failures of rural telecenters: Challenges from the sustainable access in rural India (SARI) project, *Information Technologies, and International Development*, 4(*4*), pp. 31-45.

Bonnefond, P. & Couty, P. (1988). Senegal: Passe et avenir d'une crise agricole [Senegal : Past and future of an agricultural crisis]. *Tiers-Monde*, 29(*114*), pp. 319-340. Retrieved from: https://www.persee.fr/doc/tiers_0040-7356_1988_num_29_114_3542

Bowen, G. A. (2009). Document analysis as a qualitative research method, Qualitative Research Journal, 9(*2*), Gale Academic OneFile. Retrieved from https://link.gale.com/apps/doc/A218450363/AONE?u=euge94201&sid=AONE&xid=56281c00

Brugger, F. (2011). Mobile applications in agriculture. Retrieved from https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2011/12/Syngenta_Report_on_mAgriculture_abridged_web_version.pdf

Burrell, J. & Oreglia, E. (2015). The myth of market price information: mobile phones and the application of economic knowledge in ICTD, *Economy and Society*, 44(*2*), pp. 271-292.

Cambridge, V. C. (2019). Milestones in communication and national development. In *Global Communication: A multicultural perspective*, edited by Yahya R. Kamalpour. Rowman and Littlefield.

Caswell, N. (1984). Autopsie de l'ONCAD: La politique arachidiere du Senegal: 1966-1980 [Autopsy of ONCAD: The groundnut policy: 1966-1980]. *Presence Africaine,* pp. 39-74.

Central Intelligence Agency (2019).The world factbook: Senegal. Retrieved from https://www.cia.gov/library/publications/resources/the-world-factbook/geos/sg.html

Chakravartty, P. (2006). Who speaks for the governed? World Summit on Information Society, civil society, and the limits of 'multistakeholderism'. *Economic and Political Weekly*, 41(*3*), pp. 250-257.

Chapoto, A., Chisanga, B. & Kabisa, M. (2017). Zambia Agriculture Status Report, *African Journal of Agricultural and Resource Economics* 13 *(2*), pp. 193-197.

Chitnis, K. (2005). The Duality of Development: Recasting Participatory Communication for Development using structuration Theory. Investigacion Y Desarrolo Vol. 13, No 2 , 228-249.

Cisse, A. (2013). Richesse culturelle des Bassaris [Cultural richness of the Bassaris]. Retrieved from http://www.baobabafrique.com/index.php/reportage/item/246-richesse-culturelle-des- bassari

Cobridge, S. (2002). Development as freedom: The spaces of Amartya Sen. *Progress in Development Studies,* 2, pp. 183-217. https://doi.org/10.1191/1464993402ps037ra

Cooke, B. & Kothari, U. (2001). Participation: The New Tyranny? London and New York: Zed Books.

Costopoulou, C., Ntaliani, M., & Karetsos, S. (2016). Studying mobile apps for agriculture, *Journal of Mobile Computing & Application*, 3(*6*), pp. 44-99.

Couty, P. (1982). Les Mourides et l'arachide au Senegal [The Murids and the groundnut in Senegal]. Tiers-Monde, 23(*90*). Sociologie du development. pp. 311-314. Retrieved from https://www.persee.fr/doc/tiers_0040-7356_1982_num_23_90_4117

Creevey, L. (1996). Islam, women, and the role of the State in Senegal. *Journal of Religion in Africa,* 26(*3*), 268-307. https://doi.org/10.2307/1581646

Creswell, J. W. & Creswell, J. D. (2018). Research design. Qualitative, quantitative, and mixed methods approaches. SAGE Publishing.

Creswell, J. W. & Miller, D. (2000). Determining validity in qualitative inquiry, *Theory Into Practice*, 39(*3*), pp. 124-131. https://doi.org/10.1207/s15430421tip3903_2

CSE (2012). Tambacounda en chiffres et en images [Tambacounda in figures and pictures]. Dakar : Centre de Suivi Ecologique. Retrieved from https://www.cse.sn/index.php/publications/profils-environnementaux-regionaux/send/16-profils-gouvernementaux-regionaux/58-contribution-du-cse-au-conseil-interministeriel-re-gion-de-tambacounda

Daffe, G. (2011). Les disparites de genre dans l'acces et l'utilisation des TIC au Senegal [Gender disparities in ICT access and use in Senegal. Dakar : CRES.

Daral Technologies (2020). Home. Retrieved from https://daraltechnologies.com/index.html

Daymon, C. & Holloway, I. (2002). Interviews. pp 166-185. In *Qualitative research methods in public relations and marketing communications*. London: Routledge.

Decree no 2004-1038 of July 23, 2004. Retrieved from https://www.adie.sn/sites/default/files/lois/3-De%CC%81cret%20Portant%20Org%20et%20fonct%20ADIE%20-%20Copie.pdf

Deloitte (2017). Invest in Senegal. A competitive investment destination in West Africa.

Denovan, K. (2017). Anytime, anywhere: Mobile devices and services and their impact on agriculture and rural development, In *ICT in Agriculture: Connecting Smallholders to Knowledge, Networks, and Institutions*, World Bank Group.

De Silva, H. & Ratnadiwakar, D. (2008). Using ICT to reduce transaction costs in agriculture through better communication: A case-study from Sri Lanka', mimeo, 20. Retrieved from: https://pdfs.semanticscholar.org/e6c0/b9874dee0102ab3fc4d62f9b792010563c4d.pdf?_ga=2.151810111.705952477.1586471509-1559633981.1582582244

Denzin, N. K. & Lincoln, S. Y. (2005) Handbook of qualitative research, Thousand Oaks: Sage Publications.

Devereux, S. (2001). Sen's entitlement approach : Critiques and counter-critiques, *Oxford Development Studies*, 29, pp. 245-263 https://doi.org/10.1080/13600810120088859

Dewan, S. & Kraemer, K. (2002). Information technology and productivity: Evidence from country-level data. *Management Science,* 46(*4),* pp. 548-562.

Dey, I. (1993). Qualitative data analysis: A user-friendly guide for social scientists. New York: Routledge.

Dia, S. (1987). De la TSF a l'ORTS : Evolution de la place et du rôle de la radiodiffusion au Senegal 1911-1986 [From TSF to ORTS : Evolution of the place and role of radio broadcasting in Senegal]. University of Bordeaux III (Thesis).

Diagne, A. & Daffe, G. (2002). Le Senegal en quête d'une croissance durable [Senegal in search of sustainable growth]. CREA-Karthala.

Diamanka, F. (2013). Broadcasting change: Radio talk shows, education and women's empowerment in Senegal. The Patton College of Education of Ohio University (Dissertation).

Dictaf Corporation (2020). Accueil [Welcome]. Retrieved from http://www.dictafcorp.com/representation.html

Dieng, A. A. (1996). Le Senegal au-dela de l'ajustement structurel : Pour une strategie de developpement fondee sur des forces populaires [Senegal beyond structural adjustment *: For a development strategy based on popular forces]*. *Africa Development/Afrique et Développement*, 21(*2/3*), The African and Middle East Crisis: An Alternative Une alternative à la crise de l'Afrique et du Moyen Orient, pp. 43-65.

Dioh, T. (2009). Histoire de la télévision en Afrique noire francophone, des origines à nos jours. Paris : Karthala.

Diop, L. (2016). Television content control in a developing country: A case study of Senegal. Philadelphia: Drexel University (Master's thesis).

Diop, M. C. (1984). L'Etat, la confrerie mouride, et les paysans [The state, the Murid brotherhood, and the peasants]. Labour, *Capital, and Society/ Travail, Capital, and Société*, 17(*1*), pp. 44-64.

Diouf, M. (1992). La crise de l'ajustement [The adjustment crisis]. *Politique Africaine*, 45, pp. 62-85. Retrieved from: http://politique-africaine.com/numeros/pdf/045062.pdf

Donner, J. (2004). Microentrepreneurs and mobiles : an exploration of the uses of mobile phones by small business owners in Rwanda, *Information Technologies and International Development*, 2(*1*), pp. 1-21.

Dupon, J.-F. (1964). Tambacounda, capitale du Senegal Oriental [Tambacounda, capital of Eastern Senegal]. *Les Cahiers d'Outre-Mer*, pp. 175-214. Retrieved from https://www.persee.fr/doc/caoum_0373-5834_1964_num_17_66_2337

Durufle, G. (1995). Bilan de la Nouvelle Politique Agricole au Senegal [Assessment of the New Agricultural Policy in Senegal.

Dwazu, M. M. (2017). Mobile phones are replacing bank accounts in Africa. Retrieved from https://www.bloomberg.com/news/articles/2019-08-13/mobile-phones-are-replacing-bank-accounts-in-africa

Englander, M. (2012). The interview: Data collection in descriptive phenomenological human scientific research. *Journal of Phenomenological Psychology*, 43(1), pp. 13-35. https://doi.org/10.1163/156916212X632943

Esoko.com (2020). Who we are. Retrieved from https://esoko.com/who-we-are/

Etwire, P. M., Buah, S., Ouedraogo, M., Zougmore, R., Partey, S., Martey, E., Dayamba, S., Bayala, J. (2017). An assessment of mobile phone-based dissemination of weather and market information in the Upper West Region of Ghana, *Agriculture and Food Security*, 6(*8*), pp. 1-9.

Fakuda-Parr, S. (2003). The Human Development Paradigm. Operationalizing Sen's ideas on capabilities. *Feminist Economists*, 9(*2-3*), 301-307. DOI: 10.1080/1354570022000077980.

Fafchamps, M. & Hill, R. V. (2008). Price transmission and trader entry in domestic commodity markets, *Economic Development and Cultural Change*, 56(*4*), pp. 729-766.

Fall, A. (2019). Production de la banane au Sénégal. [Banana production in Senegal]. Retrieved from https://www.lequotidien.sn/production-de-banane-au-senegal-production-de-banane-au-senegal/

FAO (2007). Technical consultation on agricultural information and knowledge management. Retrieved from http://www.fao.org/fileadmin/user_upload/kce/Doc_for_Technical_Consult/E-AGRICULTURE_-_English.pdf

FAO (2016). Proposal for new allocation to FAO multi-partner program support mechanism (FMM). Concept note. Agricultural services and digital inclusion in Africa.

FAO (2017a). National e-agriculture strategy. Retrieved from https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/2017-faobrochure-national_eiagriculture_strategy.pdf

FAO (2017b). Information and communication technology (ICT) in agriculture. A report to the G20 agricultural deputies. Food and Agriculture Organization of the United Nations (FAO) with inputs from International Food Policy Research Institute (IFPRI) and Organization of Economic Cooperation and Development (OECD)

FAO (2018). Tackling poverty and hunger through digital innovation. Retrieved from http://www.fao.org/home/en/

FAO (2020). E-agriculture. Retrieved from http://www.fao.org/e-agriculture/

Fern, E. F (1982). The Use of focus groups for idea generation: the effects of group size, acquaintanceship, and moderator response quantity and quality, *Journal of Market Research* 19, pp. 1-13. https://doi.org/10.1177/002224378201900101

Fernandez-Portillo, A.; Almodovar-Gonzalez, M; Coca-Perez, J. L. & Jimenez-Naranjo, H.-V. (2019). Is sustainable economic development possible thank to the development of ICT? *Sustainability*, 11(*6307*), pp.1-15.

Fink, A. (2003). The survey handbook. SAGE.

Flor, A. G. & Cisneros, A. J. (2015). E-agriculture, The International Encyclopedia of Digital Communication and Society.

Folitse, B. Y., Manteaw, S. A., Dzandu, L. P., Obeng-Koranteng, G., & Bekoe, S. (2018). The determinants of mobile-phone usage among small-scale poultry farmers in Ghana, *Information Development* XX(*X*), pp. 1-11.

Forget, N. (1966). Rapport de fin de mission [End of mission report] UNESCO. Senegal : UNESCO.

Frank, A. G. (1967). Latin America: Underdevelopment or Revolution, USA: Monthly Review Press.

Franklyn, C. & Tukur, A. (2012). Problems and prospects of adopting ICT in agriculture: Some comments; *African Journal of Agricultural Research and Development*, 5(*3*), pp 39-47.

Fraser, C. & Restrepo-Estrada, S. (1998). Communicating for development: Human change for survival. I. B. Tauris.

Freire, P. (2000). Pedagogy of the Oppressed, 30th Anniversary Edition. New York: Continuum. Communication.

Frey, H. H. & Fontana, A. (1993). The group interview in social research. In Successful Focus Groups: Advancing the State of the Art, edited by David L. Morgan, pp. 20-35.

Gainde 2000 (2019). Senegal. La loi sur les start-ups adoptée. [Senegal : Adoption of the Start-up Act]. Retrieved from https://www.gainde2000.com/senegal-la-loi-sur-les-startupsadoptee/#:~:text=Les%20parlementaires%20s%C3%A9n%C3%A9galais%20ont%20adopt%C3%A9,la%20startup%20dans%20le%20pays.

Gellar, S. (2005). Democracy in Senegal-Tocquevillian analytics in Africa. New York: Palgrave MacMillan.

Ghosh, B.N. (2012). Beyond Gandhian economics: Towards a creative deconstruction. Sage Publications India.

Granqvist, M. (2005). Assessing ICT in development: A critical perspective, In Hermer, O. & Tufte, T (eds.), *Media and Global Change: Rethinking communication for development*, Goteborg: Norden, pp. 285-296.

Gruber, H. & Koutroumpis, P. (2011) Mobile telecommunications and the impact on economic development, *Economic Policy*, 26(*67*), pp. 387-426. DOI: 10.1111/j.1468-0327.2011.00266.x

Gurumurthy, A. (2017). A history of feminist engagement with development and digital technologies. Retrieved from https://www.academia.edu/36316444/A_history_of_feminist_engagement_with_development_and_digital_technologies

Hafkin, N. (2002). Gender issues in ICT policy in developing countries: An overview. UN Division for the Advancement of Women Expert Group Meeting on Information and Communication Technologies and Their Impact on and Use as an Instrument for the Advancement and Empowerment of Women, Seoul, Republic of Korea, pp. 11–14.

Hafkin, N. J. and Huyer, S. (2006). Cinderella or Cyberella? Empowering women in knowledge society. Sterling, VA: Kumarian Press.

Hargreaves, J. D; Camara, C.; Clark, A. (2019). Senegal. Retrieved from https://www.britannica.com/place/Senegal

Heeks, R. (1999). Information and communication technologies, poverty, and development. *Development Informatics*, Working Paper Series, no. 5. Manchester, UK: Institute for Development Policy and Management.

Heeks, R. (2002). Information systems and developing countries: Failure, success, and local Improvisations. *The Information Society*, 18, pp. 101-112. Retrieved from https://doi.org/10.1080/01972240290075039

Heeks, R. (2006). Theorizing ICT4D research. *Information Technologies and International Development*, 3 *(3*), pp. 1-4.

Heeks, R. (2008). ICT4D 2.0: The next phase of applying ICT for international development. *The IEEC Computer Society*. Retrieved from https://ieeexplore.ieee.org/document/4548169

Hellstrom, J. (2010). The Innovative Use of Mobile Applications in East Africa, Stockholm, Swedish International Development Cooperation Agency.

Hesseling, G. (1985). Histoire politique du Sénégal: Institutions, droit, et société. [Political history of Senegal : Institutions, law, and society]. Karthala.

Hilbert, M. (2011). Digital Gender Divide or Technologically Empowered Women in Developing Countries? A typical case of lies, damned lies, and statistics', *Women's Studies International Forum* 34(*6*), pp. 479–89. https://doi.org/10.1016/j.wsif.2011.07.001

Hildebrandt, N., Nyarko, Y., Romagnoli, G. & Soldani, E. (2014). Price information, inter-village networks, and bargaining spillovers: Experimental evidence from Ghana, Retrieved from https://esoko.com/wp-content/uploads/2019/07/NYU_Esoko_Case-Study.pdf

Huyer, S. & Sikoska, T. (2003). Understanding ICTs and their potential for the empowerment of women. INSTRAW Research Paper Series no 1.

ICLD (2019). Climate change is not the cause, migration is not the problem: Local representation and precarious young farmers leaving Senegal. Swedish International Center for Local Democracy: Research Report no 14. Retrieved from https://icld.se/app/uploads/files/forskningspublikationer/icld-researchreport-14-2019-web.pdf

IFC (2011). IFC mobile money study 2011. Summary report. International Finance Corporation in partnership with the Republic of Korea.

Independent Evaluation Group (2011). An evaluation of World Bank Group activities in Information and Communication Technologies. Capturing technology for development, The World Bank. Retrieved from http://ieg.worldbankgroup.org/sites/default/files/Data/reports/ict_evaluation.pdf

International Telecommunications Union (2005). Global Digital Solidarity Fund inaugurated. Retrieved from: https://www.itu.int/itunews/manager/display.asp?lang=en&year=2005&issue=03&ipage=global_digital&ext=html

International Telecommunication Union (2017). Measuring the information society report. Volume 1. Geneva, Switzerland: ITU.

International Telecommunication Union (2017). Measuring the information society report. Volume 2. ICT country profiles. Geneva, Switzerland: ITU.

Internet Society (2019). History of the Internet in Africa. Retrieved from https://www.internetsociety.org/internet/history-of-the-internet-in-africa/

Issahaku, H., Abu, B. M., & Nkegbe, P. K. (2018). Does the use of mobile phones by small maize farmers affect productivity in Ghana, *Journal of African Business*, 19, Mobile technology and Inclusive Development in Africa, pp. 302-322. https://doi.org/10.1080/15228916.2017.1416215

ITU (2018). Measuring the information society report. ITU Publications.

Jack, W. & Suri, T. (2011). Mobile money: The economics of M-Pesa. NBER Working Paper Series (National Bureau for Economic Research, Cambridge, MA). Retrieved from https://www.nber.org/papers/w16721.pdf

Jacobson, T. L. (2006). Amartya Sen's capabilities approach and communication for development and social change. *Journal of Communication,* 66, pp. 789-810. https://doi.org/10.1111/jcom.12252

Jensen, R. (2007). The digital provide: Information (technology), market performance, and welfare in the South Indian fisheries sector, *Quarterly Journal of Economics*, CXXII (*3*), pp. 879-924. https://doi.org/10.1162/qjec.122.3.879

Jeune Afrique (2012). Senegal. Adieu la GOANA [Senegal : Goodbye GOANA]. Retrieved from https://www.jeuneafrique.com/25572/economie/s-n-gal-adieu-la-goana/

Kabeer, N. (1999). Resources, agency, and achievements: Reflections on the measurement of women's empowerment. *Development and Change*, 30, pp. 435-464.

Kassem, H. S., Shabana, R. M. Ghoneim, Y. A. & Alotaibi, B. M. (2019). Farmers' perception of the quality of mobile-based extension services in Egypt: A comparison between public and private provision, *Information Development* XX(*X*), pp 1-19. https://doi.org/10.1177/0266666919832649

Katz, R. & Koutroumpis, P. (2012). The economic impact of telecommunications in Senegal, *Communications & Strategies*, 86 (*2*), pp. 1- 23.

Khan, F. & Ghadially, R. (2010). Empowerment through ICT education, access, and use: A gender analysis of Muslim youth in India, *Journal of International Development*, 22(*5*), pp. 659-673. https://doi.org/10.1002/jid.1718

Kiambi, D. (2018). The use of information, Communication, and Technology in advancement of African agriculture, *African Journal of Agricultural Research*, 13(*39*), pp. 2025-2036.

Kikulwe, E. M., Fischer, E., & Qaim, M. (2014). Mobile money, smallholder farmers, and household welfare in Kenya. DOI: 10.1371/journal.pone.0109804

Kisan, W. S.; Dadabhau, A. S. & Singh, K. (2013). Factors affecting the sustainability of ICT intervention for agricultural development – A review, *Agricultural Reviews*, 34(*3*), pp. 197-206.

Kivunike, F. N., Ekenberg, L., Danielson, M. & Tusubira, F.F. (2009). Investigating perception of the role of IT towards the quality of life of people in rural communities in Uganda, in *Assessing the Contribution of ICT to Development Goals*, E. Byrne, B. Nicholson & F. Salem (eds), Dubai School of Government, UAE, 143-160.

Kotler, P. & Zaltman, G. (1971). Social marketing: An approach to planned change. *Journal of Marketing*, pp. 3-12. https://doi.org/10.2307/1249783

Kpare, T. (2011). La contribution des collectivites locales a l'atteinte de l'OMD 1 (La reduction de la pauvreté et de la faim) au Senegal : Cas de Tambacounda. [Contribution of local communities to the achievement of MDG 1 (reduction of poverty and hunger) in Senegal: The case of Tambacounda]. Dakar: Cheikh Anta Diop University (Thesis).

Kuriyan, R., Ray, I. & Toyama, K. (2006). Integrating social development and financial sustainability: The challenges of rural kiosks in Kerala, in Proceedings of the 2006 International Conference on Information and Communications Technologies and Development, pp. 121-130. DOI: 10.1109/ICTD.2006.301849

Kutor, S. K. (2014). Development and underdevelopment of African continent: The blame game and the way forward. *Research on Humanities and Social Sciences*, 4 (*7*), 14-21.

Kwami, J. (2010). Information and communication technologies for development and gendered realities in the South: Case studies of policy and practice in Ghana. University of Oregon (Dissertation).

Latouche, S. (1990). La planete des naufrages: Essai sur l'apres development [The planet of the wretched: Essay on post-development]. Paris: La Decouverte.

Lericollais, A. (1981). Le bassin de l'arachide [The groundnut basin area], In *Atlas du Senegal*, Paul Pelissier et Georges Laclaviere (eds), pp. 50-53.

Lerner, D (1958). The passing of traditional society: Modernizing the Middle East. London: Collier-Macmillan.

Lerner, D (1972). Modernization: social aspects. In D. Sills (ed.) *International Encyclopedia of the Social Sciences*, 9. New York: Collier Macmillan.

Lindloff, T. & Taylor, B. (2011). Qualitative Communication Research Methods (3rd ed.). London: Sage Publications.

Lohento, K & Sotannde, M. (2019). Business models and key success drivers of AGTECH start-Ups: Techincal report. Wageningen: The Netherlands, Technical Center for Agricultural and Rural Cooperation ACP-EU (CTA).

Lohento, K. (2020, December 12). Senior ICT for agriculture coordinator at CTA (L. Diop, interviewer).

Macdonald. K., & Tipton, C. (1993). Using documents. In N Gilbert (Ed.*) Researching social life*. London: Sage.

Marcelle, G. (2000). Transforming information and communication technologies for gender equality. Gender and Development Monograph Series No 9. New York: UNDP.

McCracken, G. (1988). The long interview: Qualitative research methods. London: Sage Publications.

McLaughlin, F. (2008). Senegal: The emergence of a lingua franca. In *Language and National Identity in Africa*, edited by Andrew Simpson. Oxford, UK: Oxford University Press

McNamara, K., Belden, C., Kelly, T., Pehu, E., & Donovan, K. (2017). Introduction: ICT in agricultural development, in *ICT in Agriculture: Connecting Smallholders to Knowledge, Networks, and Institutions*, World Bank Group.

Melkote, S. & Steeves, L. (2015). Communication for development: Theory and Practice for empowerment and social justice. Sage Publications.

Ministre de l'Economie Numérique et des Télécommunications (2019). Le droit des femmes sur Internet. Bulletin d'évaluation [Ministry of Digital Economy and Telecommunications (2019). *Women's right on Internet*. An assessment report. Retrieved from http://www.numerique.gouv.sn/sites/default/files/Tableau%20de%20Bord%20du%20Senegal%20MCTPEN.pdf

Ministry of Posts and Telecommunications (2016). Senegal Digital Strategy 2016-2025. Dakar: MPT.

Mitra, S. & Sarkar, A. (2003). Relative profitability from production and trade: A study of selected potato markets in West Bengal, *Economic and Political Weekly*, 38(*44*), pp. 4694-4699.

Molla, A. & Al-Jaghoub, S. (2007). Evaluating digital inclusion projects: A livelihood approach, *International Journal of Knowledge and Learning*, 3(*6*), pp. 592-611.

Monnet, T. (2019). Telecoms : Tigo Senegal devient Free Senegal, Xavier Niel pose sa marque sur le continent [Telecoms : Tigo Senegal becomes Free Senegal, Xavier Niel makes his mark on the continent]. Retrieved from https://www.jeuneafrique.com/837174/economie/telecoms-tigo-senegal-devient-free-senegal-xavier-niel-pose-sa-marque-sur-le-continent/

Morgan, D. (1996). Focus groups, *Annual Review Sociology*, 22, pp. 129-52. https://doi.org/10.1146/annurev.soc.22.1.129

Moulton, J. M. (1977). Animation rurale : Education for rural development. Non-Formal Education, 7. Retrieved from htps://scholarworks.umass.edu/cie_nonformaleducation/7

Murendo, C. & Wollni, M. (2016). Mobile money and household food security in Uganda, Globalfood Discussion Papers, 76. Retrieved from https://www.econstor.eu/handle/10419/126092

Murugesan, S. (2013). Mobile apps in Africa, *IT Emerging Markets*, pp. 8-11. Retrieved from https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6627897

Must, B. & Ludewig, K. (2010). Mobile money: cell phone banking in developing countries, Policy Matters Journal. Retrieved from https://deepblue.lib.umich.edu/bitstream/handle/2027.42/102583/2010-policymatters-must_ludewig-mobilemoney.pdf?sequence=1&isAllowed=y

Mwango, K. (2013). Assessment of the feasibility of implementing the Farmer Input Support Programme (FISP). A research report submitted to Mulungushi University as partial fulfilment of the requirement of the master's degree.

Mwantimwa, K. (2019). Use of mobile phones among agro-pastoralist communities in Tanzania, *Information Development*, 35(*2*), pp. 230-244. https://doi.org/10.1177/0266666917739952

Nakasone, E. (2013). The role of price information in agricultural markets: Experimental evidence from rural Peru. International Food Policy Research Institute. Retrieved from: https://www.researchgate.net/publication/259043871_The_Role_of_Price_Information_in_Agricultural_Markets_Experimental_Evidence_from_Rural_Peru.

National Economic Council (2000). The Clinton/Gore administration: From global digital divide to digital opportunity. Retrieved from https://clintonwhitehouse4.archives.gov/WH/EOP/nec/html/G8DigDivTaskForce000722.html

Navarro, V. (2000). Development and quality of life: A critique of Amartya Sen's development as freedom. *International Journal of Health Services: Planning, Administration, Evaluation*, 30, pp. 661-674.

Ndiaye, M. (2006). E-gouvernance et démocratie en Afrique : Le Sénégal dans la mondialisation des pratiques [E-governance and democracy in Africa : Senegal in the globalization of practices]. Bordeaux : Université de Bordeaux 3 (Thesis).

Ndiaye, A. D. (2013). Les femmes et le développement local au Senegal : Le rôle des associations féminines dans le Bassin arachidier : L'exemple de Diourbel [Women and local development in Senegal : The rôle of women associations in the Groundnut Basin Area : The example of Diourbel]. Bordeaux : Michel de Montaigne Bordeaux 3 University (Dissertation).

Nhema, A. G. & Zinyama, T. (2016). Modernization, dependency, and structural adjustment development theories in Africa. A critical appraisal. *International Journal of Social Science Research*, 4(*1*), pp. 151-166.

Obong, R., Mugonola, B., & Philipps, D. P. (2018). Determinants of mobile phones usage in sweet potato vine business in Gulu district northern Uganda, *African Journal of Agricultural Research*, 13(*21*), 1071-1079. DOI: 10.5897/AJAR2017.12213

Olatokun, W. M. (2009). Analyzing socio-demographic differences in access and use of ICTs in Nigeria using the capability approach, *Issues in Informing Science and Information Technology*, 6, pp. 479-496. https://doi.org/10.28945/1075

Ono, T., Lida K., & Yamazaki, S. (2017). Achieving sustainable development goals (SDGs) through ICT services. Fujitsu, *Sci. Tech. J*. 53(*6*), pp. 17-22.

Ojo, T. (2004). Old paradigm and information and communication technologies for development agenda in Africa: Modernization as context. *Journal of Information Technology Impact*, 4(*3*), pp. 139-150.

Oxaal, Z. & Baden, S. (1997). Gender and Empowerment: definitions, approaches and implications for policy. Draft Report Num. 40. Bridge.

Oya, C. & Ba, C. O. (2013). Les politiques agricoles 2000-2012 : Entre volontarisme et incoherence [Agricultural policies 2000-2012 : Between volontarism and inconsistency]. In *Senegal 2000-2012 : Les institutions et politiques publiques à l'épreuve d'une gouvernance libérale*, edited by Momar Coumba Diop, Paris : Karthala.

Padovani, C. (2005). Debating communication imbalances from the MacBride Report to the World Summit on the Information Society: An analysis of a changing discourse. *Global Media and Communication*, 1(*3*), pp. 316-338. https://doi.org/10.1177/1742766505058127

Plan Senegal Emergent (2014) [Emerging Senegal Plan (2014)]. Retrieved from https://www.sec.gouv.sn/sites/default/files/Plan%20Senegal%20Emergent_0.pdf

Pohjola, M. (2002). The new economy in growth and development. *Oxford Review of Economic Policy*, 18(*3*), pp. 380-396. https://doi.org/10.1093/oxrep/18.3.380

Qiang, C. Z., Kuek, S. C., Daymond, A., & Esselaar, S. (2011). Mobile applications for agriculture and rural development. Washington, DC: The World Bank.

Quebral, N. C. (2006). Development Communication in the Agricultural Context (1971, with a new foreword) 1. *Asian Journal of Communication*, 16(*1*), pp. 100-107. https://doi.org/10.1080/01292980500467657

RAC (2018). Revue Annuelle Conjointe (RAC) 2018 du tourisme [2018 Joint Annual Review for Tourism]. Dakar : Ministry of Tourism.

Rao, M. (2005). The information society: Visions and realities in developing countries. In *Media and Global Change: Rethinking Communication for Development*, edited by O. Hemer and T. Tutfe, pp. 271-284. Goteborg, Sweden: Norden.

Rawlands, J. (1997). Questioning empowerment : Working with women in Honduras. Oxford England: Oxfam.

Richardson, D. (1998). The Internet and rural development. In *The First Mile of Connectivity*, edited by D. Richardson and I. Paisley, pp. 170-181. Rome: FAO.

Rist, G. (1996). Development: History of a Western belief. Paris: National Foundation of Political Science.

Rodney, W. (1972). How Europe underdeveloped Africa. Retrieved from http://abahlali.org/files/3295358-walter-rodney.pdf

Rogers, E. M. (2003). Diffusion of innovations (5th ed). Glencoe, IL: The Free Press

Rostow, W. W. (1960). The five stages of economic growth: A non-communist manifesto. Cambridge University Press.

Rubin, H. J. & Rubin, I. S. (1995). Qualitative interviewing: The art of hearing data. Thousand Oaks, London, New Delhi: Sage Publications.

Sachs, W. (1992). The development dictionary. New York: Zed Books Limited. Retrieved from http://shifter-magazine.com/wp-content/uploads/2015/09/wolfgang-sachs-the-development-dictionary-n-a-guide-to-knowledge-as-power-2nd-ed-2010-1.pdf

Sachs, J. (2005). Information and communication technologies for development. In *Harnessing the Potential of ICT for Education*, B. Bracie and T. Culver, New York: UNICT Task Force.

Sagna, O. (2008). Le Sénégal dans l'ère de l'information [Senegal in the information era]. *Networks and Communication Studies*, NETCOM, 22 & NETSUDS, 3, pp. 13-36. https://doi.org/10.4000/netcom.2058

Sagna, O. (2001). Les technologies de l'information et de la communication et le développement social au Sénégal : Un état des lieux [Information and communication technologies and social development in Senegal : An overview], Geneva: UNRISD. Retrieved from http://www.osiris.sn///IMG/pdf/doc-58.pdf

Saldana, J. (2009). The coding manual for qualitative researchers. London, California, New Delhi, Singapour: SAGE Publications.

Samb, D. (1997). Gorée et l'esclavage: Actes du séminaire sur « Gorée dans la Traite Atlantique : Mythes et réalités [Goree and the slave trade: Proceedings of the seminar on "Goree in the Atlantic Trade: Myths and realities] *Initiations et Etudes Africaines* no 8 ; Dakar : IFAN.

Sant'Ana, M. (2008) The evolution of the concept of development: from economic growth to human development. *Democratic Governance and Theory of Collective Action. Sub-Network on Foreign Direct Investment and Human Development*.

Savana, A. (2018). Il y'a 299 partis politiques au Senegal [There are 299 political parties in Senegal]. Retrieved from https://www.financialafrik.com/2018/04/06/le-senegal-compte-299-partis-politiques/

Schech, S. (2002). Wired for change: The links between ICTs and development discourses. *Journal of International Development*, 14, pp. 13-23.

Schramm, W. (1964). Mass Media and National Development. California: Stanford University Press.

Senegal7 (2020). ARTP. Orange refuse de baisser ses tarifs. [ARTP. Orange refuses to decrease its prices]. Retrieved from https://senegal7.com/artp-orange-refuse-de-baisser-ses-tarifs/

Seneweb (2017). Abdou Karim Sall, DG ARTP: « Nous avons attribué 457 fréquences radio et 31 chaines de tele » [Abdou Karim Sall, General Manager of ARTP: "We have allocated 457 radio frequencies and 31 TV channels]. Retrieved from https://www.seneweb.com/news/Politique/abdou-karim-sall-dg-artp-laquo-nous-avon_n_228774.html

Servaes, J., & Malikhao, P. (2005). Participatory communication: the new paradigm? In O. Hemer, & T. Thomas, *Media and Global Change*, pp. 91-103. Buenos Aires: Clacso Books.

Servaes, J. (1996). Introduction: Participatory communication and research in development settings. In Servaes, J., Jacobson, T., & White, S.A. (Eds.), *Participatory communication for social change*. Thousand Oaks: Sage.

Sidibe, P. D. (2015). La production de banane de Tambacounda chute de 30.000 à 17.000 tonnes. [Banana production drops from 30,000 to 17,000 tons]. Retrieved from https://www.seneplus.com/article/la-production-de-banane-de-tambacounda-chute-de-30000-%C3%A0-17000-tonnes

SIM-B Senegal (2020). Historique [History]. Retrieved from http://simbsenegal.cilss.int/index.php/historique/

Slim, H. (1995). What is development. *Development in Practice*, 5(*2*), 143-148. https://doi.org/10.1080/0961452951000157114

SNEEG (2015). Stratégie Nationale pour l'Egalité et l'Equite de Genre [National Strategy for Equality and Gender Equality]. Dakar : Ministry for Women, Family, and Social Development.

SODEFITEX (2020). L'entreprise [SODEFITEX (2020). The company]. Retrieved from https://www.sodefitex.sn/index.php/fr/lentreprise/presentation/historique

Sow, F. (2014). Women's community radio in Africa: The case study of the Gindiku FM in Senegal. University of Oregon (dissertation).

Stake, R. E. (1995). The art of case study research. Thousand Oaks, CA: Sage.

Stake, R. E. (2005). Qualitative case studies. In *The Sage Handbook of Qualitative Research* Third Edition, edited by Norman K. Denzin and Yvonna S. Lincoln, pp. 443-466.

Steeves, H. L. (2003). Development Communication as Marketing, Collective Resistance, and Spiritual Awakening: A feminist critique, In *International and Development Communication*, B. Mody (ed), pp. 227-244. Thousand Oaks, CA: Sage Publications.B.

Steeves, H. L. & Kwami, J. D. (2012). ICT4D, gender divides, and development: The case of Ghana. In *Development Communication in Directed Social Change: A Reappraisal of Theories and Approaches*, S. Melkote (ed.), pp. 199-217, Singapore: AMIC.

Steeves, L. & Kwami, J. (2017). Interrogating gender divides in technology for education and development: the case of the One Laptop Per Child Project in Ghana, *St Comp Int Dev*, 54, pp. 174-192. DOI 10.1007/s12116-017-9245-y

Stewart, D., Shamdasani, P., & Rook, D. (2007). Focus Groups: Theory and Practice. Sage Publications .

Subervie, J. (2011). Evaluation of the impact of a Ghanaian mobile-based MIS on the first few users using a quasi-experimental design. Retrieved from https://esoko.com/wp-content/uploads/2019/07/CIRAD_ESOKO_study.pdf

Survey Solutions (2020). About. Retrieved from https://mysurvey.solutions/

Sy, J. H. (1996). Telecommunication and dependency: The African saga (1850-1980). Dakar: Alternative Communication Inc.

Sylla, I. (2008). TIC et acces des ruraux a l'information : L'exemple du Xam Sa Marse de Manobi au Senegal [ICTs and access of rural people to information : Examples of Xam Sa Marse of Manobi in Senegal], *Netcom, Reseaux, Communications, et Territoires*, 22(*1/2*), & *Netsuds*, 3, pp. 87-108.

Swanson, B. E. & Rajalahti, R. (2010). Strengthening agricultural extension and advisory systems: Procedures for assessing, transforming, and evaluating extension systems. Agricultural and Rural Development. The World Bank.

Sylla, M. (2006). Television in pluralism in West Africa: A state of affairs. Dakar: Institut Panos.

Tambacounda.info (2017). Tambacounda: La production de coton en baisse en 2016 [Tambacounda: Decrease in cotton production in 2016]. Retrieved from https://www.tambacounda.info/2017/02/22/tambacounda-production-de-coton-baisse-2016/

Thapa, D. & Saebo, O. (2014). Exploring the link between ICT and development in the context of developing countries: A literature review. *The Electronic Journal of Information Systems in Developing Countries*, 64(*1*), pp. 1-15.

Thiam, El H. I. S. (2015). La politique economique du Senegal sous Macky Sall [Senegal's economic policy under Macky Sall]. Retrieved from https://d-nb.info/1058273736/34

Thomas, P. (1994). Participatory development communication: philosophical premises. In: White, S.A., Nair, K.S. and Ascroft, J. eds. *Participatory communication: working for change and development.* New Delhi: Sage: 49–59. Thusong Service

Thompson, H. G. Jr. & Garbacz, C. (2007). Mobile, fixed line and Internet service effects on global productive efficiency, *Information Economics and Policy*, 19(*2*), pp. 189-214. https://doi.org/10.1016/j.infoecopol.2007.03.002

Todaro, M. P. & Smith, S. C. (2012). Economic development (11 ed.). Boston: Pearson Publication.

Torero, M. & Braun, Von Braun, J. (2006). Information and communication technologies for development and poverty reduction: The potential of telecommunications. Baltimore: The John Hopkins University Press.

Tufte, T. & Mefalopulos, P. (2009). Participatory communication: A practical guide. World Bank working paper no. 170. Washington DC: The World Bank.

United Nations (2005). Gender equality and empowerment of women through ICT. New York: United Nations Division for the Advancement of Women.

USAID (2017). Gender analysis for the follow-on USAID/Senegal CDCS (2019-2024). Retrieved from https://msiworldwide.com/sites/default/files/additional-resources/2019-01/Senegald%20Gender%20Analysis%20for%20CDCS.pdf

Voix d'Afrique (n.d.). "L'or blanc » de l'Afrique : Le coton. [« The white gold » of Africa : Cotton]. Retrieved from http://peresblancs.org/or_blanc_coton.htm

Vu, K. M. (2011). ICT as a source of economic growth in the information age: Empirical evidence from the 1996-2005 period, Telecommunications Policy, 35, pp. 357-372. https://doi.org/10.1016/j.telpol.2011.02.008

Wallerstein, I. (1974). The Modern World System. New York: Academic Press.

White, S.A. (1994). Introduction. The concept of participation: transforming rhetoric to reality. In. White, S.A., Nair, K.S. and Ascroft, J. (eds). *Participatory communication: working for change and development.* New Delhi: Sage: 15–33.

White, S. C. (1996). Depoliticising development: The uses and abuses of participation. *Development in Practice*, 6(*6*)–15.

Wimmer, R. D., & Dominick, J. R. (2011). *Mass media research. An introduction, 8th edition.*

World Bank (1998). Knowledge for development. World Development Report 1998/1999. Oxford University Press.

World Bank (2019). Senegal. Overview. Retrieved from: https://www.worldbank.org/en/country/senegal/overview

Wright, R. (2005). A short history of progress. Melbourne: Text Publishing.

Yanow, D. (2007). Qualitative-interpretive methods in policy research. In F. Fischer, G. Miller & M. S. Sidney (Eds.), *Handbook of public policy analysis: theory, politics, and methods* (pp. 405-416). Boca Raton, FL: CRC/Taylor & Francis.

Yilkoski, P. & Zahle, J. (2019). Case study research in the social sciences, *Studies in History and Philosophy of Science*, 78, pp. 1-4.

Yin, R. K. (2012). Case study Methods. In H. Cooper, H., & American Psychological Association. *APA handbook of research methods in psychology* (1st ed; pp. 141-155)., APA handbooks in psychology). Washington, DC: American Psychological Association. Research methods in Psychology.

Yonazi, E., Kelly, T., Halewood, N. & Blackman, C. (2012). eTransform Africa: The transformational use of ICTs in Africa. The World Bank and The African Development Bank with the support of the African Union.