

#7534 FARMER CHARLIE: PRECISION AGRICULTURE AT SMALLHOLDER FARMERS' SERVICE

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ABSTRACT

Preliminary research and an ongoing project in Nigeria showed that agriculture is a crucial activity in the country. It is mainly carried out in small, family-owned farms, suffering from the lack of agricultural data and weather forecast information easily available, that could play an essential role in improving cultivation strategies, the more so in consideration of the impact of climate change.

Farmer Charlie was conceived to provide farmers, especially smallholders ones, with connectivity and data to exploit weather information and to know their land conditions and features. The aim of the project is to eventually double their income, subsequently allowing farmers to access market opportunities. Vertically integrated, the service includes sensors, satellite and IoT technology. It is cost-effective and modifiable. Besides, it offers the advantage of permitting a sustainable use of resources (water, fertilisers, pesticides).

Farmer Charlie is currently being tested on cassava crops in Nigeria. A grant awarded from Innovate UK has allowed the identification of 20 farms in various regions of the country, where a bespoke technology will be installed. The project kicked off at the beginning of June 2020 and cassava seeds are currently being planted.

INTRODUCTION

Current technology development represents opportunities which can benefit a range of activities. In agriculture, technology has been deployed to inform farmers and support them in their daily tasks. Historically, and for economic reasons, most of the technology has been dedicated to large farmlands, and industrial-scale agriculture. An example is provided by The Netherlands, where government policy is being applied to greenhouses complexes of large area, 'some of them covering 175 acres'¹. However, this large-scale model cannot apply in the shorter term to smallholder farms in emerging countries, as the level of investment and the associated return of investment do not consider the eco-system in which farmers in emerging countries operate.

After reviewing the factors affecting farming in emerging countries, the study will review the development and implementation of Farmer Charlie, a smart agritech hub, specifically designed for smallholder farmers. The first lessons learned from the research will also be presented.

MATERIALS AND METHODS

On being awarded an honorary doctorate in January 2020, the President of the African Development Bank Akinwumi Adesina stressed the crucial role of agriculture in fostering food security and global development in Africa as well as worldwide. 'Agriculture is the most important profession and business in the world,' Adesina stated¹. Because 65 per cent of the arable land remaining to feed the world is in Africa, investment in agriculture should be an essential priority not only for the continent, but for people all over the world.

The 2019 Report by the Oxford Business Group highlighted, too, that ‘To date, agriculture is still one of the most important economic sectors in Africa, accounting for over 15% of the region GDP. Notably, family farming accounts for 90% of agricultural activities’ⁱⁱ.

More specifically, the Global Panel on Agriculture and Food System for Nutrition's *Foresight 2.0* report has pointed out that ‘Smallholder activities in agriculture still contribute an important share of food production in sub-Saharan Africa [...]. Initiatives aimed at shifting relative product prices, supporting technological innovations, investing in market infrastructure to reduce transactions costs, facilitating access to information and credit, [...] must all take the needs and constraints of smallholders into account’ⁱⁱⁱ.

The devastating impact of COVID-19, unfortunately, contributed to worsen the situation, increasing the need for ensuring farmers of emerging countries, the availability of nutritional and sustainable food, and reaffirming the importance of efficient food systems, which ‘do not provide only food but also jobs, income, infrastructure, skills (socio-economic outcomes) and ecological services (environmental outcomes)’^{iv}.

Nigeria is considered one of the countries where the need for food security is most felt. It is one of the largest African countries, with a population of 201M, rapidly increasing over the last five years because of a very rapid birth rate. Due to the availability of vast arable land and the involvement of 70 per cent of the population in agricultural activities, the Federal Government has been trying to intensify the expansion of the agricultural sector during the past few years. However, observers remark that this effort has lacked to address fundamental issues of mechanization, irrigation, seeds, extension service, insurance, research and development in the sector^v.

In Nigeria, 20% of the country GDP comes from agriculture and a conspicuous 88% smallholder farmers cultivate their own land, first for their own subsistence, secondly to sell part of their production to the market. Most of them own less than 0.5 ha, and yield is often low. Previous research on cassava and maize has shown that despite the huge potential for sustainable production, quality nutrition, waste recycling and export, opportunities are still unexploited. For instance, Nigeria is the highest producer of cassava in the world (59M tons - 20.4% world share in 2017), the second by consumption, but in 2017 it recorded a small total export value (USD 1.25M), outshone by Thailand USD1.19billion^{vi}. Nigeria’s average yield rate was 8.7 t/ha in 2017, while it is 23.07 t/ha in Thailand. Factors contributing to this gap include choice of stems and fields, improper usage of fertilizer, high postharvest losses, small-scale farming without possibility to commercialise the production, cyclical markets gluts, policy inconsistencies, low level credit available, high transaction costs.

Information and information sharing have been therefore identified as a pivotal necessity for smallholder farmers to achieve better quality and quantity production, to be aware of their own soil conditions, manage the impact of weather and climate change and sensibly use productivity tools (fertilisers, pesticides), in addition to dealing with distributors and agents—who are often perceived as harmful to the smallholders’ interests. However, in a land where around 40 million people have not had access to any form of telephony services^{vii} and the rural communities are still to enjoy the benefits of accessing 3G and 4G^{viii}, the challenge of providing information through connectivity and delivering useful data is huge.

RESULTS AND DISCUSSION

Farmer Charlie was conceived after researching and assessing the emerging countries need for an efficient and cost-effective agricultural management. Farmer Charlie is developing an economical, smart agriculture hub, providing farmers with broadband internet connectivity, information on weather and land conditions and an app store filled with apps relevant to farming. Farmer Charlie works in partnership with academic researchers and farmers to

conceive, test and implement intelligent and precise farming technology. Farmer Charlie aims to increase the yield's productivity and quality. Vertically integrated, the service includes sensors, satellite and IoT technologies. It is cost-effective and modifiable, which means that it could be adapted to the needs of different crops, soil and countries, but also expanded to include transaction services, insurance and market-linkage through a digital, vertically integrated, and cost-effective approach. Besides, it permits for a sustainable use of resources, which in turn creates an impact towards environment protection and decreased waste production.

Farmer Charlie leverages on advances in remote sensing, data and analytics and mobile phone technology to connect farmers and provide them with information about weather and their fields' conditions and features. The precise agronomy tips enable farmers to better manage resources (water, fertilizer, pesticides) and maximize their yield potential at a dramatically lower cost than current solutions. Farmer Charlie system is described in Figure 1 below.

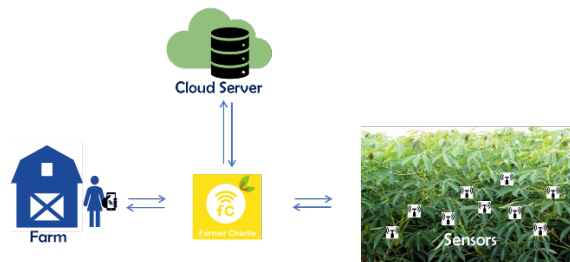


Figure 1. Farmer Charlie system

Farmer Charlie is currently in the concept development phase and it is being tested in the Nigeria thanks to the funding provided by the United Kingdom Research and Innovation (UKRI) organization, further to winning the Agri-tech Catalyst Round 9 call. Collaboration with the local partner Amolexis and with University College London produced a proposal inspired by the UN SDG criteria. The aims are multiple:

- improving the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers,
- providing inputs, knowledge, financial services, markets and opportunities for value addition
- bringing connectivity, gathering information on field, to be transmitted via a locally developed application.

Ultimately, Farmer Charlie is not only working towards improved food security and economic sustainability of cassava farmers, but also increasing the cassava yield. Last, but not least, the project involves an increase in the number of farmers using improved connectivity with smartphone applications.

Using the principles of Theory of Change, Farmer Charlie has been designed for creating an impact on food security. Key performance indicators of success are based on the sustainability of the solution and its adoption by the smallholder farmer community.

The project is on-going, and the first results are expected early 2021. However, some lessons are already being learned. When researching to create an impact, the use of technology by smallholder farmers must take into consideration the current ecosystem in which Farmer Charlie's hubs are deployed.

Farmer Charlie needs to be adapted to the users and situation of the local communities. Our strong links with the local partners is undoubtedly effective in considering features and pains affecting local farmers. However, our project includes a subsection on Human Centered Design, where market research and activities will be performed to properly assess the needs of local stakeholders, adapt the design to the existing infrastructure (for instance, the user interface

will be designed using a human-centered design technique to improve adoption), explain the integration of Farmer Charlie and possibly provide some training to allow smallholder farmers to make the most of the service.

Consideration must be given to infrastructure; this includes the road access, as well as the availability of power sources, irrigation and the availability of broadband internet. The road infrastructure is an important element which will affect the logistics and transport of the hub to the farms, as well as the maintenance of the equipment. Early on, Farmer Charlie was designed to be self-sustainable, and therefore is connected to batteries and solar panels, which make all the electronic equipment fully autonomous. In terms of irrigation, only one percent of Nigerian cropland is currently irrigated^{ix}. While Farmer Charlie is not yet including an independent irrigation system, the IoT sensors will measure soil humidity, and a weather station to inform farmers about weather conditions, which will then support the farmers' decision to adapt their practices according to the new information gathered. In terms of broadband internet connectivity, Farmer Charlie's hub will be available for uses beyond agriculture. Given the connection is available 24 hours, it is possible to use this connection for education, communication, and other needs.

CONCLUSIONS

While final research results will be available in summer 2021, the value of Farmer Charlie's smart hub has already been demonstrated. The challenges faced in the deployment of the solution are being solved.

The trial is providing useful insight on the benefits of the smart agritech hub, and at the same time, informs on logistics challenges. It is also an important opportunity to ensure the adoption of Farmer Charlie by farmers.

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