LAPPEENRANTA UNIVERSITY OF TECHNOLOGY

School of Energy Systems

Degree Programme in Sustainable Technology & Business

Ville Myllynpää

MOBILE APPLICATIONS,

SOLUTION FOR SUSTAINABLE AGRICULTURE?

- STUDY OF mAGRICULTURE SERVICES IN KENYA

Supervisor: Associate professor Mirja Mikkilä

Examiner: Professor Lassi Linnanen

Associate professor Mirja Mikkilä

ABSTRACT

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Mobile applications, solution for sustainable agriculture?

- **Study of mAgriculture services in Kenya**

Master's thesis, 2016

115 pages, 25 Figures, 13 Tables, 3 Appendix

Examiners: Professor Lassi Linnanen, Associate professor Mirja Mikkilä

Key words: mAgriculture, ICT4Ag, ICT4D, entrepreneurship, youth, Kenya

During the recent years, mobile services have spread to many different sectors, including education, health and agriculture, while changing the practices in those fields. Agriculture sector is under pressure to fill the ever-crowing food demand, while suffering from lack of agriculture resources (such as water and soil) and climate change, as well as figuring how to involve young people in the agriculture sector, in order to replace aging farmers. These issues create a need to bring new sustainable solutions to the agriculture sector. This is the demand, which mobile agriculture, mAgriculture, services are trying to answer.

This thesis will examine the mAgriculture services in the Kenyan market. The thesis will provide an overview of the currently available mAgriculture services, their outcome and issues with which they are struggling. The thesis will also present recommendations on how to improve currently existing services and processes behind them. Secondly, thesis will provide four ideas for new services, which would answer for the needs of the farmers. Suitable business models, regarding the new services, are also covered. The thesis focuses with the young farmers as a target group, but findings are also applicable with other potential target groups as well.

TIIVISTELMÄ

LAPPEENRANNAN TEKNILLINEN YLIOPISTO
School of Energy Systems
Sustainable Technology & Business Koulutusohjelma

Ville Myllynpää

Mobiilisovellukset, ratkaisu kestävään maatalouteen?

- **Katsaus Kenian mAgriculture applikaatio markkinoihin**

Diplomityö, 2016
115 sivua, 25 kuvaajaa, 13 taulukkoa, 3 liitettä
Tarkastajat: Professori Lassi Linnanen, Dosentti Mirja Mikkilä
Avainsanat: mAgriculture, ICT4Ag, ICT4D, yrittäjyys, nuoret, Kenia

Viimevuosien aikana mobiiliapplikaatiot ovat levinneet monille yhteiskunnan sektoreille, kuten opetus, terveydenhoito ja maatalous, muuttaen samalla näiden toimintatapoja. Maataloussektori on paineen alla, kun se pyrkii vastaamaan yhä kasvavaan ruuan kysyntään, kohdaten samalla haasteita resurssien, kuten veden saannin ja maaperän, heikentymisen sekä ilmastonmuutoksen vaikutuksien johdosta. Lisäksi on tarve houkutella nuoria maanviljelyn pariin, jotta ikääntyvät viljelijät voidaan korvata. Nämä seikat luovat tarpeen tuoda uusia kestäviä ratkaisua maataloussektorille. Juuri tähän tarpeeseen erilaiset maatalousalaan liittyvät mobiili, mAgriculture, palvelut pyrkivät vastaamaan.

Tämä diplomityö käsittelee mAgriculture applikaatioita Kenian markkinoilla. Työssä käydään lävitse esimerkkejä nykyisin markkinoilla olevista palveluista, näiden aikaansaamia tuloksia sekä asioita, joiden kanssa näitä kehittävät yritykset kamppailevat. Työssä esitellään myös ratkaisuja, joilla parantaa nykyisiä palveluita sekä prosesseja niiden taustalla. Toiseksi esitellään neljä ideaa uusiksi palveluiksi, jotka vastaisivat paikallisten viljelijöiden tarpeeseen. Näiden kohdalla käsitellään myös sopivia liiketoimintamalleja. Työn kohderyhmänä ovat nuoret maanviljelijät, tosin esitetyt havainnot sopivat suurelta osin myös muihin potentiaalisiin kohderyhmiin.

ACKNOWLEDGEMENTS

It has been a long process and I now that it comes to an end, I hope that it has been worth it and the findings of this thesis will somehow be a useful in increasing the popularity of mAgriculture services.

Victoria, thank you for all your support and assistance during this process, you're great.

I want to thank all of those, who have supported, inspired and helped me over the years; family, friends, classmates, teachers, co-workers, etc.

I would like to thank my supervisors and examiners Mirja Mikkilä and Lassi Linnanen for your feedback and advices during this thesis process.

Thanks all of you, who I had chance to interview and otherwise talk to about these topics. Your comments and knowledge were valuable for this thesis.

I would like to thank also AIESEC Saimaa, for providing me an office space where to work during this thesis process, and the members for keeping me a company.

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LIST OF ABBREVIATIONS

(A)MIS	(Agriculture) Market Information System
ACDI/VOCA	Agricultural Cooperative Development International / Volunteers in Overseas Cooperative Assistance
ACP	Africa, Caribbean and Pacific group of states
Agri VAS	Agriculture Value Added Service
ARPU	Average Revenue Per User
AYF	African Youth Foundation
BoP	Bottom of the Pyramid
CAADP	Comprehensive Africa Agriculture Development Programme
CGIAR	Consultative Group on International Agricultural Research
CRM	Customer Relationship Management
CSM	Climate Smart Agriculture
CTA	Technical Centre for Agricultural and Rural Cooperation ACP-EU
DFID	United Kingdom's Department for International Development
FAO	United Nations Food and Agricultural Organisation
GDP	Gross Domestic Product
GFAR	Global Forum on Agricultural Research
GIS	Geographic Information System
GSM	Global System for Mobile Communication
GSMA	GSM Association
GTZ	Gesellschaft fur Technische Zusammenarbeit
ICT	Information and Communication Technology
Ict4ag	ICT for Agriculture
ICT4D	ICT for Development
IFPRI	The International Food Policy Research Institute
IICD	International Institute for Communication and Development
ITC	International Trade Centre
IVR(S)	Interactive Voice Recognition (System)
KACE	Kenya Agriculture Community Exchange
KARI	Kenyan Agricultural Research Institute
MCC	Market Call Centre
MIP	Market Information Point
MNO	Mobile Network Operator
MPSP	Mobile Phone Service Provider
MRC	Market Resource Centre
MSME	Micro, Small and Medium-Size Enterprise
MVP	Minimum Viable Product
NGO	Non-Governmental Organisation
RECOTIS	Regional Commodity Trade and Information System
SMS	Short Message Service
UNDP	United Nations Development Programme
USSD	Unstructured Supplementary Service Data

1 INTRODUCTION

1.1 Justification

Idea of this type of mobile application has been on my mind since the beginning of the year 2013. It originated from a thought that since “everybody” own, or have access to, some kind of mobile phone even in the developing world, then how those phones could be used to help in the spreading of information and know-how about sustainable agriculture. Since that, idea has went through many different phases. First version was mostly about teaching Permaculture principles. However, after a planning phase, that idea seemed then to be too challenging to execute as a mobile application.

Later on idea gradually refined more towards an agroforestry system planning tool, which option was studied during summer of 2014. When this model didn’t seem to catch on and it witness some issues regarding business model and technical details, idea was put to backburner. Finally during this thesis process, which started at January 2015, the aim would be to find a suitable focus topics, which could then be transferred into an actual applications.

In the world, which is getting more and more connected and digitalised daily and where technology is available for a relatively cheap price almost everywhere in the world, it is small wonder that so far farming have not been witnessing that much of digitalisation, in a form of utilizing applications or other ICT solutions (Awuor et al. 2013), compared to sectors such as banking (M-Pesa) or communication (Skype, Facebook). However, this seems to be changing in the near future, as can be noticed, for instance, from the findings of this thesis. There are many projects around the globe, which are working on these issues, supported by organisations such as World Bank, GSMA and various countries Ministry of Foreign Affairs.

1.1.1 Market demand

Agriculture is the most important economy sector in the Africa; generating, on average, 32% of the Gross Domestic Product, GDP, 40% of the exports and employing 65% of the labour force (CTA 2014; Tenge and Wambaya 2014). Almost all of the farms in Africa are family farms, whose amount in globally is over 500 million and which are jointly producing 70% of the world's food supply (AYF and CTA 2014). These farmers are facing multiple issues, both under current conditions and especially when trying to answer to ever-growing food demand - caused by growing population, which is expected to reach 9 billion in 2050 and requiring 70% increase in the global food production (Plechowski 2014), while the availability of natural resources is simultaneously decreasing (Awuor et al. 2013).

Thought crop yields have been globally growing, this growth has not spread equally around the globe. Small hold farmers in developing markets has especially lacked behind this trend (Danes et al. 2014; Magesa et al. 2014). It could be even said, that agriculture has been in decline the past 40 years there. This has kept most of the farmers poor; 73% of them are living in rural area, with income of less than a dollar per day (Tenge and Wambaya 2014). Mainly farmers grow food for their own family use and possible surplus, and in some cases also cash crops, are sold to markets (Danes et al. 2014).

Small hold farmers operate in diverse environments, which differs in both physically, biologically, economically and culturally from each other (Danes et al. 2014). Poor quality soils, erosion, drought and high dependence of seasonal rains are all growing condition factors affecting farmer's productivity. Climate change also have a growing effect on those matters (Awuor et al. 2013). These differences in the farming conditions and issues faces by the farmers have a profound effect on the information needs of the individual farmers. Therefore, there is a profound lack of relevant and timely agriculture information, based on the farmers' geographical location and education level (AYF and CTA 2014).

Other group of problems is related to availability and quality of the agricultural inputs (Crandall and Kieti 2013). These inputs, such as seeds and fertilizers, are often poor in quality or farmers might not have money, or access to credit, needed to buy then (Danes et al. 2014). Therefore, farmers in the developing countries are unable to fully benefit from the latest technological advances in the agriculture sector (IICD 2014; Magesa et al. 2014).

In addition, other major factors being the lack of access to proper information regarding pest and disease treatment, new production methods, support services or information about market prices and demand (Awuor et al. 2013; IICD 2014).

Lack of market information has also generated so-called “middle mans”, which are traders who are equipped with up-to-date market prices and who might take advantage of the lack of market price knowledge among farmers, by offering lower prices for their crops. Often farmers also need to travel long distances to find better prices for their products from the larger markets. This is both time consuming and expensive, mainly due to poor road network. Also, some other issues in the agriculture value chain, such as the lack of proper storage facilities, support for marketing and opportunities for value addition to agriculture products, are affecting farmers in the post-harvesting time, when they are trying to sell their crops. The lack of proper support from government and trade policies side also have a affect to the agriculture sector development. (Magesa et al. 2014.)

All these factors together generates risks and uncertainties to the small hold farmers, who often sees limited incentives to produce more than they need for their own livelihood (IICD 2014). This lack of incentives can be seen as one of the key factors in the low overall productivity of the agriculture sector in the East Africa (Crandall and Kieti 2013). Also, since most of the farms globally are family farms, encouraging young to take over farming after their elderly parents, or other relatives, can be challenging under the current conditions. If the young are not interested to continue farming activities, since they don’t see that as viable career and choose to look for careers in the other sectors, it might cause a major negative effects to the global food system (AYF and CTA 2014).

As solution to these issues, farmers should be exposed to the much needed information about better production techniques (covering both pre- and post-harvest) and market oriented strategies, in order to help increase the supply of the agriculture products and generate sustainable income to farmers (Plechowski 2014). This is crucial, since nowadays the food security in the developing world is “dependent less on resource-intensive agriculture and more on knowledge intensity” (Awuor et al. 2013). Also, farmers should be educated and supported by taking more entrepreneurial attitude towards agriculture practices (Leenstra 2014). Figure 1 presents the different information demand categories in each of the phase in the agriculture value chain.

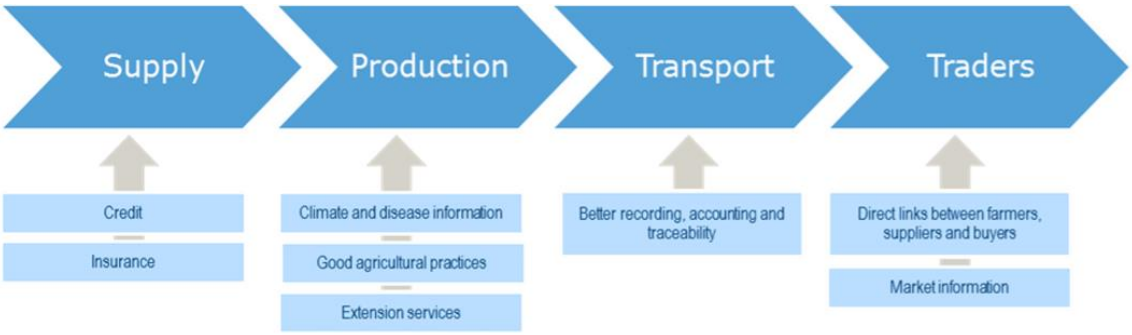


Figure 1. Information demand in each stage of Agriculture Value Chain (Danes et al. 2014)

1.1.2 Role of ICT and mobile technology

Rapid growth in the mobile phone penetration, during the last decade, in the developing countries has generated a significant opportunity to use mobile technology as a tool of spreading localized and timely agriculture information to farmers. Terms mAgriculture or m-Agri are commonly used to describe various mobile based solutions, such as Short Message Service, SMS, Unstructured Supplementary Service Data, USSD, call centre and mobile application services, which are aimed to farmers. These technologies have the potential to increase the productivity, profitability and sustainability of the agriculture activities, by providing needed information and act as a tool for exchanging knowledge between farmers (Awuor et al. 2013).

These mobile based services have impact on farming in two ways. On one hand, they provide locally specific information about crops management, input supply, transport options and market prices, enhancing farmer's decision making on what crops to grow based on market demand, resources available and local conditions (Awuor et al. 2013). On the other hand, they improve the integration and efficiency of the whole agriculture value chain (Danes et al. 2014).

These factors also have been noted in the researches, made by World Bank, Vodafone and Accenture. Both of them had similar outcomes: mobile services have potential to help farmers, by providing better access to market, information and financial services, improving data visibility in the supply chain and enhancing the link between different stakeholders in the agriculture markets (Omwansa et al. 2013).

Ultimately improved agriculture productively leads to economic growth, which reduce poverty and improve livelihoods in the developing countries (Magesa et al. 2014). Farming should be in the core focus of the actions, since it is backbone of the economic growth and employment generation in most developing countries (Awuor et al. 2013; Magesa et al. 2014). This strong link between agriculture productivity and economic growth has been emphasized in the research (Crandall and Kieti 2013).

However, mobile technology solutions needs to be tailored to suits the needs of the local farmers and they should be used in right way and for right purposes, meaning providing cheap and efficient tool for exchanging information, ideas and knowledge(Awuor et al. 2013). There should also be coordination between different stakeholders, such as farmers, private sector, research institutes, donors and governments, in order to archive sustainable results (Batchelor et al. 2014). In the best case, these actions can lead to the situation where "smallholders can be at the forefront of a transformation in the world's agricultural systems" (IICD 2014).

As Michael Hailu, the director of the Technical Centre for Agricultural and Rural Cooperation ACP-EU, CTA, put it in his opening address of the ICT4Ag: the Digital Springboard for Inclusive Agriculture Conference; "I believe this is one of the great opportunities of our times" (CTA 2014).

1.2 Objective

First parts of this thesis covers the Kenyan agriculture sector, with a focus in youth, identifies the current mAgriculture services in the Kenyan market and the issues, with which these services and companies are struggling. Focus was mainly with services related to crop agriculture and access to market information, although some financial services were also covered. Later parts of the thesis provides ideas on how to improve these currently existing mAgriculture services and covers possible topics for new mAgriculture applications, which there could be demand on among the local farmers. Also examples of suitable business models for them are developed. Those new mAgriculture service ideas, which are formed as an outcome this work, are meant to be mobile applications, which can be used with smart phones or tablets. Their target group is mainly those farmers, who have entrepreneurial and

business mind-set towards agriculture and have growth minded attitude towards improving their farming operations. Focus points of these application ideas will be formed based on the literary review and outcome of the expert's interviews, so that they would be more relevant and filling the needs of target audience. After the thesis, this project would hopefully continue as application development project, leading to bringing the actually applications to market as a sustainable business.

1.3 Research design

This chapter covers the research process explanation, used research questions and background theory of the case study methodology and qualitative analysis.

1.3.1 Process

The thesis process consisted of two phases. First phase was a series of interviews and discussion with representatives of various organisations, which are working in the agriculture related fields in the developing markets. The aim of these interviews was to identify topics affecting life´s of small hold farmers and how utilization of mobile technology could help on solving those issues.

Second phase was a literature review of the studies and research previously made about usage of mobile services in the agriculture sector, as well as other successful applications in the development markets. Also, the aim was to see which functions there is demand for among farmers and which of those functions are missing from the current solutions. As a result of these two phases conclusions, on how to improve current services and which new services could be provided, are formed, as can be noted from the Figure 2.

Figure 2. The thesis process flow

1.3.2 Research questions

Following research questions will be answered in this thesis. They are based on the assumption that there is a need both to improve current services and to develop new services, which better answer to farmer's need and future demands. In order to better understand the current situation, the existing services are studied. Also, in order to understand the needs of the - mainly young - farmers, their situation, and agriculture in Kenya in general, are studied using a literature review method.

1. What types of mAgriculture services there are currently in operation in Kenya, what type of information they provide to farmers and what can be learnt from their example?

2. Which tools and tactics could be used to improve both the currently existing services and services, which are going to be developed later on?

3. Which type of new sustainability focused mAgriculture services could be helpful for the local farmers?

1.3.3 Case study methodology and qualitative data analysis

In this thesis, the Case study methodology was used. This methodology aims to deeper understanding of the social phenome under study. It has been defined by Robson (2002), Yin (2003) and Benbasat at al. (1987) as "empirical method aimed at investigating contemporary phenomena in their context". Therefore, it is well suited for this thesis, since the aim is to understand the mAgriculture phenome, mainly in the context of Kenya. Key characteristics of Case study are; 1. It is coping with the complex and dynamic characteristics of real world phenome, 2. It´s conclusions are based on the clear chain of evidence, collected from multiple sources, 3. It´s adds to existing knowledge. (Runeson and Höst 2008).

According to Robeson's (2002) classification, in this case the research methodology have an Improving objective, meaning it is trying to improve certain aspect of the studied phenomenon. (Runeson and Höst 2008). Since one of the aims of this thesis is to find out how to improve existing mAgriculture services, as well as find out new services, improving classification is well suited for this thesis.

Data, which was collected for this thesis, is qualitative, meaning it involves words, descriptions and figures, which are then analysed by using sorting and categorising. Also, data Triangulation, which means taking different angle towards the studied object, was utilized, since the data was collected from various sources (Runeson and Höst 2008), including University's National Internet Electronic Library Interface (NELLI), Google Scholar and Google search. Due the huge technology development in the mobile sector over the last few years, only material, which was published after 2012, were used in this thesis. All the available relevant scientific articles and other material were studied. However, there is not that much previous research in this mAgriculture topic, which limited the availability of source material. Outcomes and results, presented in the source materials, were rather consistent through, without much of animosity between them.

In addition to literary sources, also interviews and discussions were used as source of data. Interviews consist of two one hour long sessions, first with three forestry professors and second with an independent consultant. Interview questions can be found in the Appendix 1. In addition of those interviews, there was three 5-10 minutes long discussion session, during different conferences, with various agriculture sector related professionals. Title of the discussion partners, the topics of the discussion and the outcomes are listed in the Table 2 in the section 2.1. Interviews.

In this case the research process was also Flexible, since the key parameters changed during the process (Runeson and Höst 2008), when the focus of this thesis moved, from the agroforestry application case, to study multiple other agriculture related functions as well. Outline of the whole methodology can be found in the Table 1.

Table 1 Outline of the thesis process methodology

Methodology	Primary objective	Primary Data	Design
Case study	Improving	Qualitative	Flexible

2 MARKET INTRODUCTION

Aim of this chapter is twofold; firstly it provides a general overview of the situation and needs of the farmers in the development markets, in a form of outcomes from the expert interviews and discussion. Secondly, this chapter introduces Kenyan market, in the terms of country's profile, agriculture sector overview, currently available agriculture information services and mobile environment. Also, as a part of the later section, young are introduced as potential target group, in terms of their role in the farming sector, their role ass information providers and potential for their status increase, caused by the utilization of ICT tools.

2.1 Interviews

It became clear during the interview with forestry professors, that the farmers need firstly better access to markets with better price and demand knowledge and only secondary more information about different tree and crop species. Farmers also don't usually separately agroforestry and normal farming, as both are parts of the traditional farming system there. Therefore, the applications should also provide information regarding the most commonly grown crops. Some possible application service ideas in the forestry sector, which did rise up during the interview, were charcoal trading between consumers and manufacturers, tree seedlings availability registry system between nursery and farmers and edible gum trading between producers and buyers.

During the interview with the independent consultant, a lack of agronomy information among farmers was highlighted. Other key points were the importance of farmer to farmer co-operation and knowledge sharing. Best way to strengthen this progress would be supporting the formation of farmer cooperatives. Also, farmers have different roles in the communities, some are naturally more entrepreneurial minded; seeing possibilities instead of risks, while some are not. Model, where more entrepreneurial minded persons in the community would do trade on behalf of others, in exchange of adequate compensation, could provide solution for this issue. Services should also be practical, localized and emphasize areas which value is already recognised among the locals. Also, youth's role in acquiring and spreading new agriculture information was emphasised.

Table 2 below describe the three shorter discussions, which were conducted during the thesis process, containing title of the interlocutor, the topics of the discussion and the main outcomes.

Table 2. Descriptions of the shorter discussions

Interlocutors title	Topics of the discussion	Outcome
Development organisations country manager in Kenya	• Agriculture and youth in Kenya • Availability of smartphones	• Youth don't see agriculture as viable career, but ends up doing it anyhow • Cheap smartphones are gaining popularity • Gamification has been used by start-up called Afroes, in making mobile learning applications for African market • Importance of county level decision making • Organisations; AGRA, USAID, One Acre Fund
Agriculture entrepreneurial training organisation representative from Zambia	• Entrepreneurship in agriculture • Youth role • Use of ICT tools in training	• ICT could bring young to farming • Strong need for the up-to-date information • Kenya is a leading country in this sector
Agriculture and agroforestry training organisation representative from Malawi	• Agroforestry training • Entrepreneurship training in agriculture • Youth role	• Focus on Agribusiness -> it will be the driving force in Africa • Youth have switched from seeking governmental work to being self-employed • Make youth seen agriculture as money! • We need to switch viewpoint from the food security to prosperity

2.2 Kenya

Kenya was selected as a focus country on the base of three reasons. Firstly, it is a birthplace of the most successful mobile service in the developing markets, M-Pesa. Secondly, it is a relatively developed country, with good mobile infrastructure and large number of mobile phone subscriptions. Thirdly, the majority of people are farmers and their position is a relatively good compared to many other African countries. Majority of them also have a basic education, meaning they know how to read and write.

Kenya is located in an eastern part of Africa, bordering Indian Ocean and neighbouring countries of Tanzania, Uganda, South Sudan, Ethiopia and Somalia, as can be noted from the map of Kenya (see Figure 3). Climate is tropical among the coast and when moving towards inland it changes to arid. There is low terrain in the cost and highlands in the central Kenya. Major environmental issues are related to water issues as waterway pollution, and to soils in the form of erosion and desertification. (CIA 2015.)

Figure 3. Map of Kenya (Worldtravels 2015)

Table 3 contains basic information of Kenya, covering both social and economic sectors. This information will be helpful in understanding the country as a suitable target market for mAgriculture applications. Information is from the year 2015, except where mentioned differently.

Table 3. Basic information of Kenya (CIA 2015)

Topic	Results
Land area:	580 367 sq. km
Population:	45,925 million
Major cities:	• Nairobi (3,915 million inhabitants) • Mombasa (1,104 million inhabitants)
People living in rural areas:	74,4% of the population
Median age:	19,3 years
Annual population growth:	1,93%
Age structure:	• 0 – 14; 41,56% • 15 – 24; 18,66% • 25 – 54; 33,17% • 55 – 64; 3,76% • 65 <; 2,85%
Main languages:	English and Swahili + many indigenous languages
Literacy rate:	• Overall; 78% • Men; 81,1%
GDP per capita:	3 100$
Annual GDP growth rate:	5,3%
GDP divination between economic sectors:	• Agriculture; 29,3% • Industry; 17,7% • Services; 53%
Labour force:	17,7 million
Labour force between sectors:	• Agriculture: 75% • Industry and Services: 25%
Unemployment rate:	40% (2013)
Population below poverty line:	43,4% (2010)
Inflation rate:	6,9%
Bank rate:	Central bank discount rate; 7% (2010) Commercial bank prime lending rate: 16,5%
Total value of exports:	6,271 billion
Main export products:	• Tea • Horticultural products • Coffee • Petroleum products • Fish • Beans
Main export partners:	• Uganda (share of exports 11,8%) • US (7,7%) • Netherlands (7,5%) • Tanzania (7,4%) • Zambia (5,7%)

2.3 Farming in Kenya

Farming in Kenya, as in many other developing countries as well, is dominated by the smallholder farmers growing diversity group of crops, in a relative small quantities and with variety of quality (Mukhebi and Kundu 2014). One estimation is that there is 7 million small hold farms in Kenya (Ally 2015) and average age of the farmer is 60 years (UNDP in Kenya 2015). Generally speaking, agriculture in sub-Saharan Africa is known from cultivation of small land area (usually less than 1 ha, in areas with high population density) and limited use of chemical agriculture inputs. For example, in Tanzania only 13% of small hold farmers use chemical fertilizers and 14% uses insecticides and fungicides (Batchelor et al. 2014). Different agricultural activities are located in the different parts of the Kenya. For example; Trans Nzoia County, in the western Kenya, is named as country´s "bread basket", since most of country´s wheat and maize are grown there (Namisiko and Aballo 2013).

Main agriculture products in Kenya are tea, coffee, corn, wheat, sugarcane, maize, rice and other fruit and vegetables. In the side of animal products, beef, pork and eggs are the main products. Agriculture land is in total 48,1% of the land area: 9,8% is arable land, 0,9% permanent crops and 37,4% permanent pasture. Forest covers 6,1% of the land. (CIA 2015).

One example group of Kenyan farmers can be withdrawn from the IICD research, which was conducted in June 2013. This survey covered total of 1100 farmers, out of which 80% were male. Results can be read from the Table 4. (IICD 2013.)

Table 4. Example profile of Kenyan farmer (IICD 2013)

Topic	Results
Age range:	24 – 38 years
Education:	• 15% had college / university education • 60% had secondary education
Average land size:	1 hectare
Land ownership:	70% owned their land
Main crops:	• Potatoes • Tomatoes • Maize • Cabbages • Onions • Beans
Usage of ICT in the farms:	90% were using some type of ICT service in their farms

During most of the 1900´s, agriculture markets have been strongly under government control and farmers having little to no influence on where and in which price to sell their crops. This changed during the 1980-90´s, when agriculture sector underwent various market liberalization policies. This change allowed farmers to participate to markets better and have better access to inputs. However, the majority of small hold farmers still keep missing this opportunity. (Tenge and Wambaya 2014). This is the case also in Kenya.

From those times dates also the clash between Green Revolution and Food Sovereignty paradigms. These two have become the main focus themes in the discussion of how farming in the Africa should be developed. Green Revolution aims to generate a large increase in the crop production by utilizing artificial fertilizers, pesticides and high level crop varieties. Principles in the Food sovereignty moment, in the other hand, are related to lowering market dependency, focusing on the ecological farming methods, usage of local seeds, support for the small holders and better access to land. However, both of these movements have their own issues. Green revolution have issues regarding wrong crop varieties and fertilizers, which have not been well suited for the local conditions. Also, its large-scale monoculture focus has been connected to environmental damage. Food Sovereignty movement has not succeed to support small holders enough, so that they would become more self-sustainable. Therefore, it seems that either of these are not able to solve the profound issues in the African agriculture by oneself. (Leenstra 2014.)

During the recent years, small hold farming has been recognised as an essential part of the agriculture value chain, mainly because of the work done by various value-chain development initiatives, in transformation and strengthening various agricultural processes and activities. This situation, together with a various targeted programmes, offers opportunities to farmers to develop their farming activities. This has already created a base for farming-as-business and increased young participation and interest towards farming. These factors have made the access to the reliable and relevant information about the markets and improved farming technologies even more relevant and crucial to development world farmers. (Plechowski 2014.)

Maputo Declaration Target - part of the Comprehensive Africa Agriculture Development Programme, CAADP, agreed on in the 2003 African summit - is declaration, where African governments agreed to spend at least 10% of their national budgets to agriculture. However, this declaration has not been that successful, since in 2012 - almost 10 years after the original

agreement - only 13 governments have met this target during one or multiple years. Kenya was not among those 13 countries. (IFPRI 2013.)

Development of agriculture is also one of the main pillars in the Vision 2030, which is Kenyan governmental development plan, covering period from 2008 to 2030, with an aim to transfer Kenya into industrialized middle-income country. In the plan, the focus topics under the agricultural sector are: increasing efficient utilization of land, utilization of key agricultural institutions in promotion of agriculture growth, increasing production in crops and livestock, and improving market access of small hold farmer's thought better marketing However, developing the usage of mobile technologies in the farming sector, as such, is not mentioned in the plan, although ICT have important role in the other pillars of the Vision 2030 plan. (Government of the Republic of Kenya 2007.)

2.3.1 Family farming

The majority of farms in globally are family farms, out of which 95% are under 5 hectares in size and are generally associated with poverty, since 70% of the poorest in the world are family farmers (AYF and CTA 2014). In the East Africa, 75% of the total agricultural outputs are produced by the small hold farmers, who's average farm size is 2,5 hectares. These family farmers mainly produce for at-home consumption, by using traditional technologies. They find difficulties when wanting to increase their productivity, because of lack of coordination along agriculture value chain and a lack of access to inputs and credit. Together these things factor to small hold farmers being less productive and profitable, than they could be (Crandall and Kieti 2013). Family farming has also been described as "a reflection of lifestyle, based on beliefs and traditions about life and work", so in many cases it is more than just an occupation (AYF and CTA 2014).

Family farms also have their positive sides, such as their ability to select varieties and breeds of plants, which are more adapted to the local diversity of the agro-ecological conditions, as in to the climate and soil combination. This factor plays an important role in the creating and conservation of the biodiversity and allows transformation of this knowledge to the next generation. Family farms also provide source of income in the areas, where employment in other sectors is often scarce. This is a valid point especially regarding the youth, who could

this way become self-employed, allowing them to contribute to the food and nutrition security and provide them a way to be integrated to the farming activities in the future as well. (AYF and CTA 2014.)

However, in many cases family-farmers practice income diversification, where they work in other sectors besides farming, such as tradesmen, taxi drivers or construction workers. This is closely related to the fact that farmers want to minimize their risks. Therefore, if their agriculture yields would decline, they still have some other sources of income as well. Though, it is also common that farmers invest the money acquired from the outside jobs to their farming operations. However, many invest their farm income to housing, education or to small business, causing a lack of investment to actual farming operations. (Batchelor et al. 2014; Leenstra 2014.)

In the family farms, decisions - regarding, for example, what to grow and how to manage the farm - are usually done by the oldest man of the family. To ensure continuity, family farms management transition, from elders to youth, should be emphasised. Thought, in many cases after the heritage, the land would be split into so many small pieces, - among all the children - that producing a sufficient livelihood in a sustainable way is a real challenge. (AYF and CTA 2014; Leenstra 2014.)

Overall, in the conditions where acquiring the farm land is difficult and expensive - and having a loan, in order to get the needed finance to buy the land, is challenging especially to youth - family farming could make the entry in the agriculture sector easier. However, family farming should be develop with a strong focus onto business and commercialisation aspects, so that farming would be attractive career for unemployed young in the developing countries. (AYF and CTA 2014; Leenstra 2014.)

2.3.2 Telephone farmers

This term refers to people, who are living in the cities, but are still actively involved with the agriculture in their home villages or other distance locations. Overall amount of them in Kenya is unclear, but one estimation is that they represent around 15 - 20% of all the farmers, so there could be around 1 - 1,4 million Telephone farmers in Kenya. Telephone farmer, as well as synonyms “Suitcase farmer” or “Weekend farmer” are terms originating from the

1970-80`s and means people who concentrate on more profitability activities, while farming "on the weekends and by telephone". They are the ones, which were generally able to benefit more from the development in the agriculture practices and inputs. Telephone farmers can be divided into two main categories; to those who inherited their land and use relatives or casual caretakers to manage the land and to those, who purchased the land as an investment and who are aiming to collect interest from the agriculture to compensate the purchase. (Leenstra 2014.)

However, traditionally telephone farmer's role has been someway overlooked in the development work. However, recently their role has been better recognised, since their entrepreneurial potential could help in growing agriculture sector productivity in Africa. Although they have access to land and to modest investment capital, they are witnessing issues in the farm management side, mainly a lack of communication and trust between them and the caretakers, who often have poor practical farm management skills also. Telephone farmers themselves seems also to a lack of business approach to agriculture and lack of willingness to invest in developing their agriculture activities. To overcome those issues, they need better access to business coaching and to technical and marketing advises. (Leenstra 2014.)

2.4 Youth as a target audience for the mAgriculture services

The young are selected as target audience group for mAgriculture services in this thesis, as was outlined also in the research questions. Reasons for this decision are many; for instance, the fact that average age of farmers in Kenya is 60 years, generates a need to attract young to the agriculture sector, to ensure continuity in the farms. Also, youth represent estimated 64% of the unemployed people in Kenya (UNDP in Kenya 2015), which generates a huge need for potential income sources. In this topic, agriculture sector can provide many possibilities, especially through utilization of mAgriculture services. Result from interviews and discussions also support this claim to focus on the young as target group for mAgriculture services. However, most of the topics and ideas covered in this thesis are also suitable for services which are focused on different target groups.

2.4.1 Their experience in the farming sector

Young people have various roles in the farming community. They could be contributing to variety of farm tasks, such as weeding or harvesting, or if they are not directly involved, they could provide various services, such as work as an input (seeds, fertilizers) suppliers or provide technical advices to other family members, who work as farmers. These smaller task works as a stepping stones for the youth, in their path for eventually taking over the farm management from their elderly parents or relatives. However, they are often not paid as employees and in cases where they are generating income outside the farm, they often invest that money back to the farm. In the case of youth moving in to urban areas, some of them continue growing crops even on their backyards or in roof gardens. Some eventually return back to their villages, with an aim to scale up their family business, while utilizing knowledge and skills learned while studying or working in the cities. It could be said that **"**there are a lot of untapped potentials in agriculture and family farming that youth should take advantage of". (AYF and CTA 2014; Leenstra 2014.)

2.4.2 Their role as an information providers in the agriculture sector

Youth's role as information provider's is crucial, since they tend to bring technology and innovation from the outside of the farm, by socializing more and picking up new and improved technologies faster than the older generations. Combination of this ability and the traditional farming knowledge and skills, - which youth acquire from their parents - will enhance agriculture productivity. (AYF and CTA 2014.)

This is especially clear in the ICT side, which youth are known to be more conversant with, making it possible for them to provide various ICT services, such as market information or mobile finance, for the family farms (AYF and CTA 2014). This role also seems be supported by the social norms in the farming communities, where parents and community leaders - acquainted with ICT - encourage young to participate in the ICT related activities. Also external conditions, such as access to ICT and general market situation, appears to be favourable towards young farmers applying ICT solution to their farming activities

(Plechowski 2014). Therefore, youth's role as an information brokers cannot be overlooked (AYF and CTA 2014).

However, there is a lack of capacity to fully utilize ICT among the youth in the developing countries. Therefore, this capacity building should be strengthened. This development would benefit not only the young, but also the whole family farm (AYF and CTA 2014). Thought ICT being common topic among the youth, it can remain as a vague concept. All in all, "digital world" is something that youth in the developing countries want to be part of, as one young said it: "If you do not belong to it, you feel as if you are missing an important means of improving your situation and achieving a dream for a better world" (Plechowski 2014).

Overall, ICT also extends opportunities, motivation and capabilities of the young people in the farming. This is especially important under the circumstances, where poor job prospects cause many young to leave the rural areas and head to cities to look for other job opportunities. In this case, ICT could enable them to stay in farms, since utilization of the access to market information and new production methods would generate improved income from the farming. (Plechowski 2014.)

2.4.3 Potential for their status increase

It has been noted, that you young, who applies ICT tools in their farms, not only increase their yields and income, but also increases their social status among other community members, as well as with the extension workers and private sector people (Plechowski 2014). These young are considered to be more entrepreneurial and eager to adopt new farming technologies, compared to the older generations. This has led to situations where extension workers start to consider youth as a main entry point for introducing new modern extension practices and ideas, instead of continuing working with the older farmers, who are more hesitant towards adoption of new technologies. As Johnah Rono, Crop Development Officer in Eldoret, Kenya said it: "I foresee the youth being the main farmers in five years' time." (IICD 2013.)

This status increase has been mentioned as a motivating factor for youth to continue applying the ICT tools to the farming. Increased status has led to situation, where young farmers are more tightly connected to their communities and where they are respected as technically resourceful persons by the other farmers. Good example of this progress is 18-year old farmer Esther Chebus, from Kakamega, Kenya, who said that "The people in my village now look up to me as the source of the latest farming information. This makes me feel important and it gives me a sense of responsibility in my community. They come to me whenever they want to know the latest prices of tomatoes or just new farming technologies." (Plechowski 2014.)

Also, important point is that the use of ICTs is generating more favourable picture of farming in general, leading to positive and supporting environment for youth commitment towards farming (IICD 2014). Therefore, examples of young farmers, who are involved in the business-oriented family farms and making adequate livelihoods, should be used as a role models, in the promotion of agriculture as a profession, for youth (AYF and CTA 2014). There has been cases in the Kisamo County, Kenya, where more young persons have shown interest towards farming, after various ICT application were introduced there (IICD 2013).

As a conclusion, use of mAgriculture services is like "A very cool field – ICTs – has been married to a not- so-cool field, agriculture", as Agnes Kalibata, Rwanda's Minister of Agriculture has said. (CTA 2014). Figure 4 sums up claims for youth as a suitable target group for the mAgriculture services.

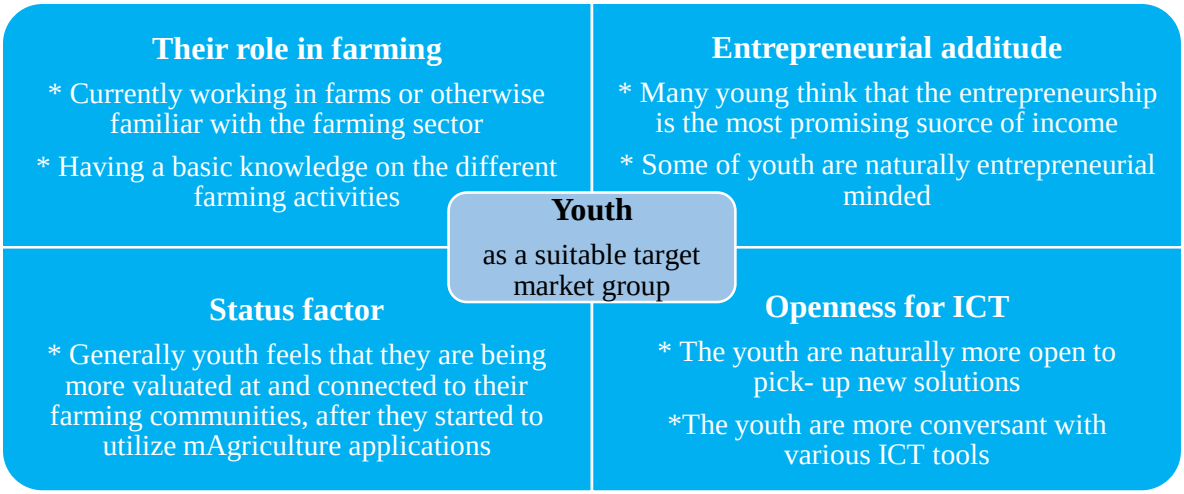


Figure 4. Conclusion of youth as a target market group for the mAgriculture services

2.5 Agriculture information services currently in Kenya

Traditional sources of the agriculture information for farmers in Kenya can be divided into three different groups; other farmers, extension workers and media. Farmers generally relies on the fellow farmers for getting advices on how to grow certain crops or to get the latest market information, such as crop prices. This can happen both by face-to-face or through phone calls. (Batchelor et al. 2014.)

Kenya has around 5 500 farming extension workers, whose task is to educate farmers in the rural areas, by visiting their farms or meeting them in the market places. They are trained agriculture experts and are employed mostly by the Kenyan government or local counties. In the case of media, radio and TV have important role in agriculture knowledge spreading. One example of this is Mediae´s Shamba Shape-Up, which is famous farm turnover television program (Batchelor et al. 2014). However, there could be even more room for media industry's involvement in the spreading of agricultural information to farmers. (Danes et al. 2014.)

However, in Kenya - despite these information channels - has still a clear lack of availability of, for instance, market information, causing farmers to fail to sale their products to markets. Therefore, various ICT tools should be made available to them, since that way they would have a fast access to relevant information (Namisiko and Aballo 2013). This could also happen by adding ICT elements into the current systems, for example to the tradition extension work. This is already in process in Kenya, with a project called "e-extension". This project aims to educate all the extension workers with ICT skills and provide them with laptop and smartphone. Ultimate aim of this is to transform extension programmes into more demand driven and decentralized by providing farmers localized and customized information (Odera 2014).

2.6 Mobile environment in Kenya

According to the latest available statistics (March - June 2015), Kenya had 36,1 million mobile connection subscribers, having penetration rate of 83,9% from the total population. The majority of those subscribers were pre-paid (35,1 million). On average, each user made calls for 84,1 minutes per month. Kenya has currently four Mobile Network Operators, MNOs: Safaricom (market share 67%), Airtel (19,4%), Orange (Telkom Kenya) (11,2%) and Equitel (Finserve Africa Limited) (2,4%). (Communications Authority of Kenya 2015.)

In the terms of the smartphone ownership, one estimation from the end of 2013 concluded that there was 4,3 million smartphones in use in Kenya (David 2013). Nowadays this figure has probably grown close to a 8 - 10 million units, since already in the first half of this year there were 1,8 million smartphones sold in Kenya, having growth rate of 112% compared to previous year and representing 58% of the whole mobile phone market. Average smart phone selling price, in one of the biggest Kenyan retailers, was 10 000 KES (100€), while in last year it was 15 000 KES (150€) (Jumia Kenya 2015). This trend is expected to continue and one future projection is that by the end of 2017, there will be 19 million smartphones in use in Kenya (Jorgic 2014). Also, Africa, in generally, also have a significant second-hand phone market, since around 45% of the phones in use there are second-hand (Batchelor et al. 2014).

99% of Kenyan internet subscriber's access web through mobile connections. Number of the mobile internet subscriptions was 19,8 million in the end of June 2015 and it grow 42% compared to a quarter year ago (March-June 2014). Total amount of the internet users is estimated to be around 29,6 million, having increase of 32,9% compared to a quarter year ago. Therefore, internet penetration rate was 57,1% from the total population. Safaricom is also the largest mobile internet provider with 12,59 million customers, followed by Airtel (3,66 million), Orange (2,69 million) and Equitel (0,87 million). Mobile internet broadband subscription amount was 5,32 million in June 2015, having increase of 82,8% compared to a quarter year ago. (Communications Authority of Kenya 2015.)

However, these mobile user figures should be taken with a certain uncertainty. According to one estimate, there is actually only 24,5 to 26 million unique mobile phone subscribers, since

many people are using multiple sim-cards from different MNOs simultaneously and therefore one user is counted for many times to the statistics (Hinkkanen 2015).

In any case, the development has been astonishingly fast, since in 1999 only 3% of Kenyans had a mobile phone (Namisiko and Aballo 2013). Compared to figures from 2012, which shows that even among the people in the Bottom of Pyramid, BoP, market, 60,5% owned a phone, out of which 20,5 % were capable to browse internet (Omwansa et al. 2013). This trend is expected to grow even more in the future; for instance Safaricom, largest MNO in Kenya, estimated that 90% of its revenues will come from the data by 2016 (Batchelor et al. 2014).

Traditional source for acquiring air time is a small kiosk, where it is sold as pre-determent priced scratch cards. These cards includes a code, which is send by SMS to the MNO, which then updates users account with the same amount of airtime. One research revealed that lack of credit has affected participant's ability to use the phone, especially mobile internet. That research also revealed that average air time, which users had on their phone, was 21 KES (0,21 €), ranging from 0 to 112 KES (0 – 1,12 €) (Wyche et al. 2013). However, according to another study, one fifth of BoP market has sacrificed food, clothing or transportation, in order to acquire air time (Omwansa et al. 2013). This shows that air time is emphasized over other needs in the BoP market.

Uptake of mobile applications among the poor Kenyans has been traditionally low. One survey - with total of 795 participants – found out that only 5% of participants know about commodity price services and 90% of those who know, were actually using those services. This might be because users think that internet based mobile applications are expensive to acquire and use, claim supported by a finding that only 1% participants were aware of data-bundles. These data-bundles could lower the cost of internet use significantly, compared to minute based billing. However, there was one mobile service, which 98% of the participants were aware of, that being the mobile payment system M-PESA. (Omwansa et al. 2013).

2.6.1 M-PESA

M-Pesa is an originally Kenyan based service for mobile money transfer, run by the MNO Safaricom. With M-Pesa people can transfer, deposit and withdraw money by their phones. In practise, people visit mobile money agents (usually airtime sellers or other shops), where they can deposit cash in to their digital accounts. They can then transfer it digitally or withdraw it later. Service fee, ranging from 0,14 - 0,66 % when transferring money or <1% when withdrawing the money, is collected per transaction. Currently it is the most successful mobile service, which has been launched in the developing markets. (The Economist 2013.)

History of M-Pesa dates back to the early years of 2000, when researchers from the Gamos and Commonwealth Telecommunications Organisations, CTO, noticed that people in Uganda, Botswana and Ghana were using mobile phone airtime as an unit of money, by exchanging it between relatives and friends, who could then resell it or use it by themselves (McKemey 2004). In 2003, in the World Summit for Sustainable Development, representatives of the United Kingdom's Department for International Development, DFID, proposed to Vodafone (major owner of Safaricom) to start number of public-private partnership projects related to poverty alleviation, which DFID would then support by giving significant financial support. Original idea was to use the service in repaying the micro-loans; service would have lower operation costs compared to previous non-digital model, leading eventually to lower interest rates. Vodafone partnered with the microfinance organisation called Faulu Kenya. Piloting started in October 2005, in eight points at Nairobi area. However, during the piloting phase, they noticed that users were utilizing the service also to pay for other services, to transfer money to different points and to buy airtime. Therefore, service was modified to include also airtime purchase with reduced price. (Buku and Meredith 2013.)

After six months of piloting, in May 2006, the outcome was that the micro finance repayment was not been used as widely as was originally expected. Faulus operation witnessed also various issues, so the microfinance option was decided to leave out from the full commercial launch. Also, it was noted that the customer training was the biggest challenge, leading to various improvements in the customer communication. Safaricom also invested in growing the agent network and had 750 agents in March 2007. At that time M-Pesa expanded to cover the entire Kenya, with a help of massive advertisement campaign. Service become successful

in a short time, having over two million registered users in May 2008, 10 million in March 2010 and finally in the end of 2011 15,2 million (Buku and Meredith 2013). Nowadays service has also got competitors inside the Kenya, thought M-Pesa is still the leading money transfer service there, with 21,34 million transfer subscribers in June 2015. Competitors had in total 6,36 million users (Communications Authority of Kenya 2015). M-Pesa generated revenues worth of 27 billion Kenyan shillings ($300 million) in the financial year of 2014 (Jorgic 2014).

Nowadays M-Pesa service has also been launched in various other countries, some case under different name. In September 2015, M-PESA system was available in Tanzania (launched at April 2008), Fiji (June 2010), South Africa (August 2010), Democratic Republic of Congo (November 2012), India (April 2013), Mozambique (May 2013), Egypt (June 2013), Lesotho (July 2013) and Romania (March 2014). (Vodafone 2015).

Viable learning point, which can be derived from the M-Pesa case, is that the service went through two user led transformations, when users self-innovated new uses for the original service. Therefore, it should be made possible for users to have active role in the application development and leave room for their own ways of using the service. Also, it should be noted that Kenyan Central Bank, KCB, let M-Pesa operate as an experiment, under low regulatory, which clearly affected positively on the spread of the service. Other reasons for high usage rates are Safaricoms position as the leading MNO in Kenya (Buku and Meredith 2013), successful marketing campaigns and high cost and risk related to the traditional ways to transfer money. Service has also become a platform for various other services. M-Pesa has had a major effect both to the Kenyan economy and society. It is estimated, that 25% of country's GDP flows through the service. Also, in one study it was noticed that after adopting the M-Pesa, income of the rural households increased between 5 - 30% (The Economist 2013).

2.6.2 Use of social media

Amount of Facebook users has grown rabidly also in the Kenya over the last five years. In 2011, estimated amount of Facebook users was 1 million, which doubled to 2 million in 2012 (Wyche et al. 2013). Recent estimation is close to a 5 million users (Hinkkanen 2015). Also, among the BoP market, Facebook is a commonly used; a few years old estimation was that 14,8% phone users in the BoP market use Facebook or other social media (Omwansa et al. 2013). Other commonly used social media platform in Africa is South-African based MXit, which claimed to have 45 million users in 2014 (Batchelor et al. 2014).

When looking at user's reasons for using the Facebook, a study made in the autumn of 2011 in Kenya reveals some insight. It interviewed 24 people, in multiple Internet cafes, all of which were aware of Facebook and half of them were using it actively. Those that were not members yet, wanted to be, but financial constrains prevented them to become members at the moment. Most of the people interviewed were farmers. Users named two main reason for the usage; to keep up with the world and chat with friends. (Wyche et al. 2013.)

Real time chatting in Facebook was preferred over the use of email, when communication with friends, and use of Facebook was also cheaper than over-seas phone calls. One user concluded well the "keeping up with the outside world" category; "You see, when you don't have technology it's like you are in your own world and people are in their other world". (Wyche et al. 2013.)

Use of social media generates benefits in teaching and learning as well; it, for example, enhances peer to peer communication, which is crucial to the co-creation of knowledge (Batchelor et al. 2014). This peer-peer communication and learning could play an important role in improving agriculture productivity and is something that mAgriculture applications could tap into. Social media can also play a major role in improving awareness among the youth, about the importance of seeing farming as an enterprise (CTA 2014). Therefore, Facebook and other social media sites should be a focus channel for advertising the mAgriculture applications.

Reasons, which limits the usage of Facebook are related to the infrastructure constrain, such as limitations in electricity and internet connectivity, and user's financials limitations. Typical cost of using Facebook in Internet cafes for 30 minutes is around 50-60 KES (0,5 –

0,6€), which could be one third of persons daily income in the rural areas. Also, limitations in the internet connection causes the Facebook page loading time to be a few minutes, rather than a few seconds. However, people have develop various strategies to use Facebook as efficient as possible. (Wyche et al. 2013.)

Overall, it seems that willingness to connect is overshadowing the obstacles and keeps people to come back to the service. Also, people see social and economic benefits of using the Facebook. Use of Facebook was also regarded as a status symbol, a "luxury" thing, which users would invest once other expenses were covered. This status matter could be one expletory matter in participant's strong desire to belong in the Facebook user community (Wyche et al. 2013). These factors provides a good example for the mAgriculture applications, about the importance of providing a useful content and to design services so that they create a strong willingness for usage.

2.6.3 Conclusion table of the mobile sector chapter

Figure 5 sums up the mobile sector related information, which were mentioned in the previous 2.6 - 2.6.2 chapters and concludes it as suitable market place for mAgriculture services.

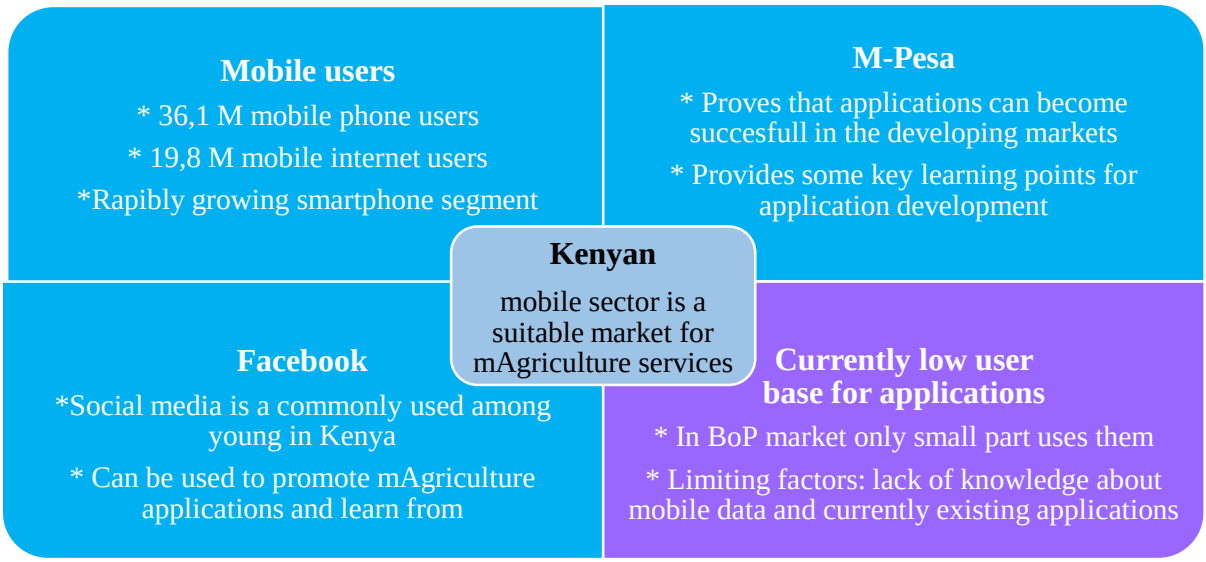


Figure 5. Conclusion of the Kenyan mobile sector

2.7 Conclusions; Kenyan youth as suitable target group

Figure 6 aims to conclude the Kenyan youth as suitable target market for mAgriculture services. It combines the results from the expert interviews and discussions together with the literary result from chapters 2.2 - 2.6, on how Kenya, as a country, can be seen as suitable target market for the mAgriculture services and how youth can be seen as target audience for mAgriculture services in this work.

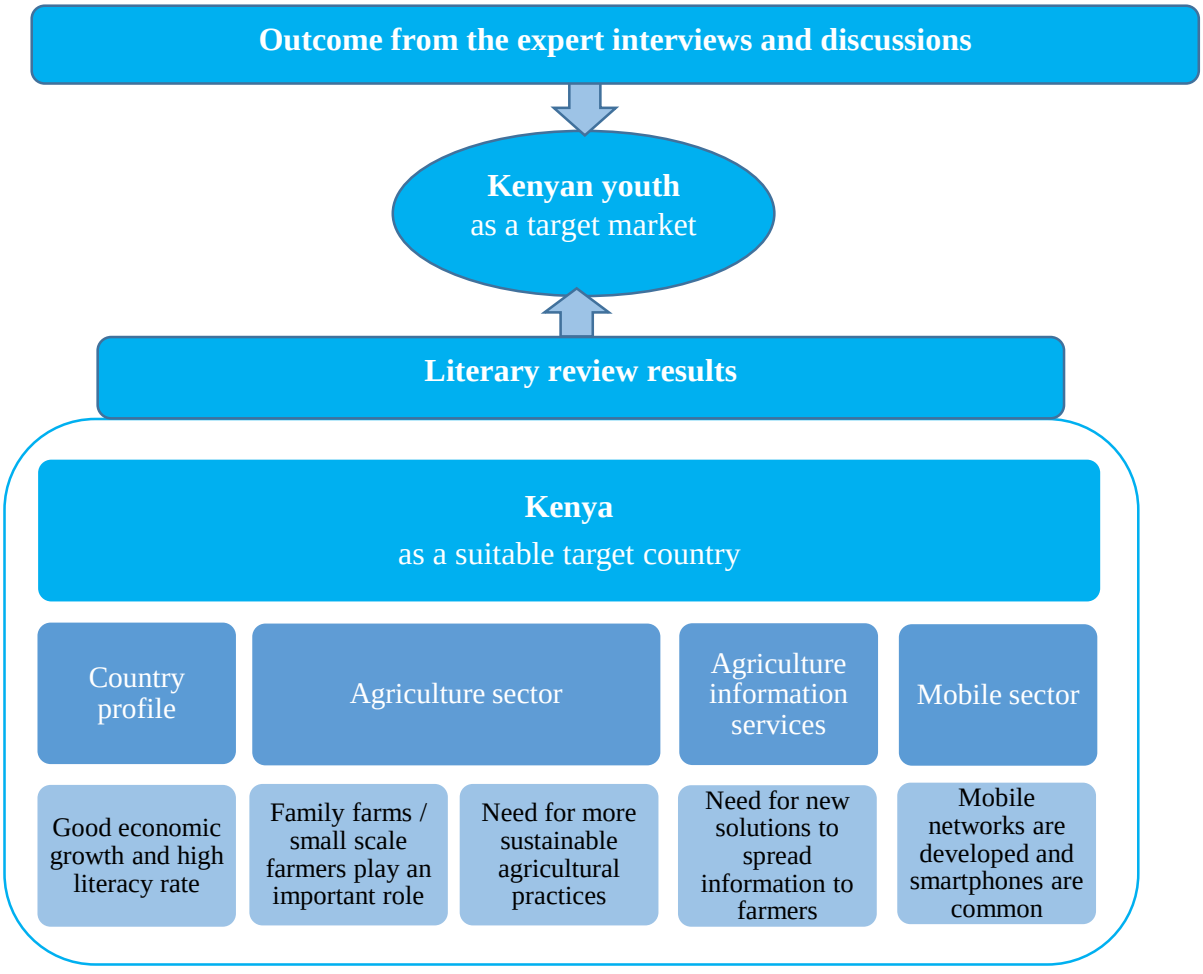


Figure 6. Conclusions for Kenyan youth as a suitable target market for mAgriculture services

3 CONCEPTS

This chapter present the most important concepts and their relevancy for the mAgriculture services, starting from the various agricultural and market information categories and continuing to explanation and background of the e-agriculture and mAgriculture terms. Understanding these concepts and their relevancy is important when going through the later parts of this thesis and when trying to comprehend the whole mAgriculture scene.

3.1 Agronomy information categories

In Table 5, the reader can see the different categories of the farmer's information needs in each phase of the farming cycle, from planning to selling. Crop related information consist of weather forecast, planting, growing, pest and disease treatment, harvesting and soil management sub-categories. Farmers also needs information regarding the market conditions, such as prices, demand forecast, right selling times and access to transport. Farmers would also need various financial services, such as access to loans, insurances and savings account.

Table 5. Various information need categories during the whole crop cycle (OXFAM 2013)

	Planning	**Planting and growing**	**Harvesting, post harvesting and selling**
Information services and networks for knowledge exchange	- Long-term weather forecast - Implication of local agro-environment - Crop and seed selection - Seeds/fertiliser availability, prices and location - Land preparation	- Techniques to protect against and prevent disease and pest infestation - Pesticides - Diagnose and treat disease and pest infestation - Short-term weather forecast	- What is the best time and method of harvesting - Weather forecast and implication for storage - Availability, cost and location of storage services - Instruction for self-storage
Value chain linkages	- Expected crop demand - Potential price fluctuations - Cost and availability of transport of inputs - Market contacts		- Accurate and competitive market pricing - Potential price fluctuations - Cost and availability of transport to market - Marketing, sales or negotiation tips
Financial services	- Loans and insurance availability, rates and contacts	- Loan availability and rates for non-farming activities	- Savings account rates and availability

3.2 Market information and market linkages

Following chapters will cover the both Agriculture Value Chain and value added services, market information and digital market places. They are all important topics for the small hold farmers, who are looking for getting higher prices for their crops. All of those could be provided through use of mAgriculture services.

3.2.1 Agriculture Value Chain and value added services

Agriculture Value Chain is a commonly used term for describing the process of bringing agriculture products from farmer to consumers, through various intermediates, such as wholesalers, food industry plants, markets and grocery stores. Various initiatives have been created to protect small hold farmer's interest in this chain, for example IICDs Inclusive Agriculture Value Chain (IICD 2014). Another initiative is Value Chain Development, VDC, which is business focused approach aiming to bring best value from all of the value chain stages to the final consumer. It aims to do that by balancing asymmetric information flows, improving technologies, improving access to various services (such as finance) and creating a better policy and legislation environment. All these actions would empower small hold farmers as well (Tenge and Wambaya 2014). Term Agriculture Value Added Service (VAS) means the various information and financial services, which are meant to address farmer's need along the crop cycle (OXFAM 2013).

3.2.2 Market information

Main element in this topic are so called Market Information Systems, MIS, which aims to provide prices and other relevant market information to farmers. They gather, analyse and distribute this information from the various parties in the agricultural network, such as farmers and trades (OXFAM 2013). Availability of this market information will allow farmers to get the better deals, by selecting the right buyers and selling times, and helping them to plan their production and marketing strategies for different crops. Availability of

this information would also help farmers to allocate their resources better (Tenge and Wambaya 2014; Magesa et al. 2014).

This is crucial, since the majority of African farmers are unaware of the prices and other market conditions even in their nearest town. This gives farmers a weak position when negotiating about deals with the traders or middlemen´s, who could exploit this lack of price knowledge. Also lacking is the knowledge that which type and quality of agricultural products there is demand of from the regional, national or international customers. This lack of market demand knowledge had effects both on the farmer's level, who could get higher income by choosing the right crops, or by producing higher quality, and in the national level, by failing to meet the planned export quantities. These types of market information services are standard in the developing markets, for example in the Europe there are few hundred webpages - in addition to special journals, government agencies and farmers unions - providing market information to farmers. (Tenge and Wambaya 2014.)

3.2.3 Digital market places

The most current development in this field are so called electronic marketplaces, e-marketplaces, which are either SMS, mobile application or web-page based systems. Their main function is to provide platforms, where buyers and sellers come together to discuss and agree on prices, quantities, delivery and payments of the various agricultural products (OXFAM 2013). They also provide market prices, which are collected from various physical market places, to help farmers to price their products right. Usually these platforms works so that the farmer post an offer to sell, or buyer post offer to buy, certain amount of a certain crop. Then these offers are matched together by the platform, by given suggestions on where to buy and to who to sell. That's way farmers can sell their crops directly to buyers, without using middlemen (Tenge and Wambaya 2014).

Platforms also provides legal and regulatory framework, which allows efficient function of the markets. Information attained from theses platforms will also help farmers in planning which crops to plant and when to harvest them, so that there will be actual demand for those crops. Also, prices, which farmers have get from their crops, have increased through the use of these market places. Platforms also have opened new markets to farmers, by linking them

to the traders, which they were not aware of before, leading to increased demand and higher prices for their crops. (Tenge and Wambaya 2014.)

3.3 e-Agriculture and mAgriculture

E-Agriculture has its roots in the wider ICT for development, ICT4D, movement, which has been developing solutions to problems, faced by the billions of people living in the developing countries, since the beginning of 1990´s (OXFAM 2013). As the name suggest, E-Agriculture aims to improve information and communication processes in the agriculture sector by utilizing various ICT technologies. The huge technology development, over the past 20 years, in the personal electronics, such as computers and mobile phones, as well as in data management technologies and networks, have made it possible to bring the information in to hands of the rural farmers through the mobile phones (Namisiko and Aballo 2013).

Major developing in this field happened in summer 2006, when FAO hosted the first e-agriculture workshop. There e-Agriculture Community of Practice Founding Group was formed. Members of this group includes: Consultative Group on International Agricultural Research (CGIAR), Technical Centre for Agriculture and Rural Development (CTA), UN Department of Economic and Social Affairs (DESA), FAO, Gesellschaft fur Technische Zusammenarbeit (GTZ), Global Forum on Agricultural Research (GFAR), Inter-American Institute for Cooperation on Agriculture (IICA), International Association of Agricultural Information Specialists (IAALD), International Centre for Communication for Development (IICD), International Fund for Agricultural Development (IFAD), International Telecommunications Union (ITU) and World Bank. (Namisiko and Aballo 2013.)

E-Agriculture has a huge potential in supplementing traditional delivery channels of information and communication in the agriculture, by using modern ICT technologies. This development can bring various benefits to farmers, such as improved access to information (about pre- and postharvest actions, prices, weather), empowering them to make informed decisions, simplifying processes and transactions, which leads to improved quality and value of agricultural products (Awuor et al. 2013).

Nowadays leading countries in this field are Côte d'Ivoire and Rwanda. They have pioneered in the development of national e-agriculture strategies, in order to support effective use of ICT in agriculture. In the case of these strategy developments, it has been showed that enthusiasm of leadings politicians towards the ICT can play a major role in the developing process. This was the case in Rwanda, where President Paul Kagames personal enthusiasm towards ICT has been a key factor in the development of e-agriculture strategy (CTA 2014).

mAgriculture, mobile agriculture, is the more resent term used to describe the various mobile technology based services, which are used in the agriculture sector. Term has evolved from the term e-agriculture, to specifically mean the mobile phone services developed in the past few decades. There were some mAgriculture pilots already in 1990´s, but the main development has been archived in the past five years, when the high increase in mobile phone ownership, among citizens in the developing countries, took place. This development has also evolved the methods used by these services from the traditional SMSs to utilization of pictures and videos, opening call centres and lately also to the usage of mobile applications (OXFAM 2013). Currently there are mAgriculture services in use in over 17 African countries (CTA 2014) and globally there are few hundred different services in use, developed by both the private companies and international organisations (OXFAM 2013).

These services can be categorised in to three main groups, as can be noted from the Table 6, according to type of service which they provide to the farmers; Value chain linkages, Information services and Financial services. Value chain linkage services covers the farm products selling and buying process, including forming connections to sellers and buyers and facilitation of the trade deals, by providing marketplace platforms. Information services category means the agronomy, weather or market price information, which is provided for the farmers through the mobile services. Financial services category includes such services as banking, money transfer and credit. This category also includes the mobile money and microfinance services, which have acquired a lot of visibility lately. (OXFAM 2013.)

Table 6. Description of m-Agriculture service categories (OXFAM 2013)

	Service offering	Benefits
Information Services	-Input information -Agronomic Information -Weather forecasts -Market information	-Better choice on inputs -Better sustainable agro practices -Improved productivity -Higher crop quality -Higher prices received - Reduced vulnerability of production to climate variability -Horizontal as well as vertical information flow
Value Chain Linkages	-Aggregation of farmers for purchase and sale -Connection with input providers and buyers	-Purchase inputs more cheaply -Access to larger buyers -Less product loss -Access to new products and markets
Financial Services	-Mobile banking (money transfers) -Micro-credit/saving -Micro-insurance	-Reduced risks and transaction costs - Increased investment in assets -Reduced vulnerability to risks and shocks

3.4 Conceptual framework

Figure 7 presents the conceptual framework, which was covered in more detailed during this chapter 3. Agronomy and Market frameworks helps the reader to understand better the services, what the mAgriculture initiatives, presented in the following chapter 4, are providing. Understanding the background of the terminology connects mAgriculture to the wider ICT4D scene and helps the reader to distinct it from the traditional e-Agriculture.

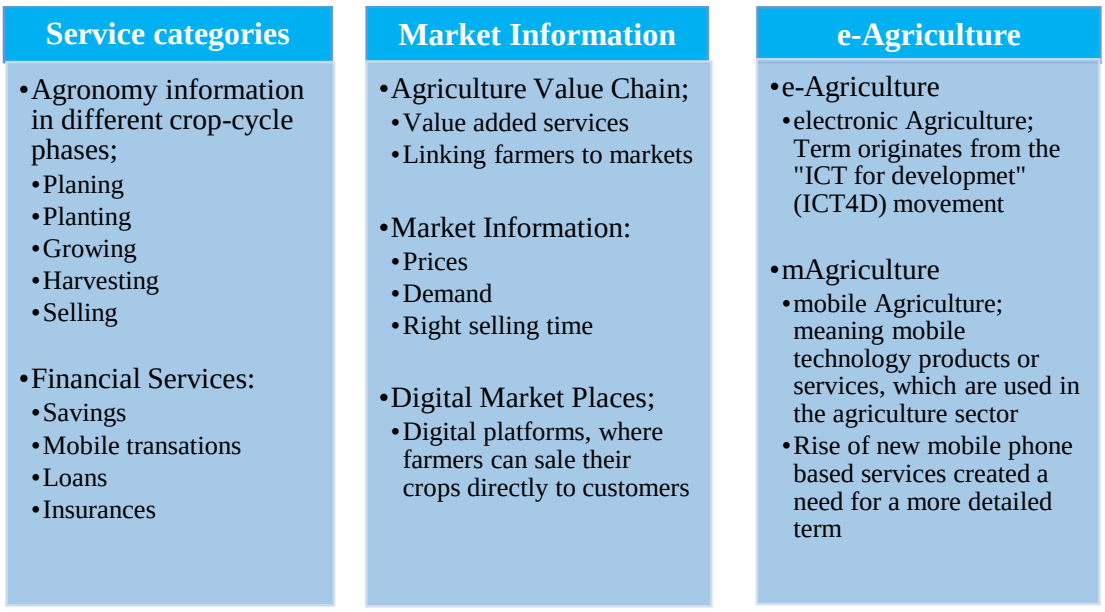


Figure 7. Conclusion of the different mAgriculture related concepts

4 mAGRICULTURE ORGANISATIONS AND SERVICES

In this part we take a detailed look on to the current services in the mAgriculture field in Kenyan markets. The aim is to get a view on what kind of services there are in the market currently, what kind of information they provide, which have been their learning points and other outputs. This chapter also introduces the organisations and projects, which are behind each selected service, to highlight their important role in the application development, as well as in the scaling phase.

4.1 International Trade Centre: Trade at Hand

This project is organised by the International Trade Centre, ITC, in cooperation with multiple local parties, such as MNOs, farming and development organisations. Project started in 2006 in Burkina Faso, with a SMS function used to receive a market place information from the local markets (mPrices). Program has this far spread to seven other countries as well: Fiji, Kenya, Liberia, The Maldives, Mali, Mozambique and Senegal. The set of functions available has also grown and currently there three other functions, besides the mPrices: mAlerts, Mobile Data Collection (mCollect) and Mobile Marketplace. (ITC 2014.)

As mentioned above, mPrices function allows Micro, Small and Medium-size Enterprises, MSMEs, as well as farmers to acquire simple and targeted product price information. System works with local trade support organisations, which selects the sources of market information. These systems are then connected to ITCs platform. Users then pay a competitive price per message, in order to cover the costs of the system. To date, over 100 sub-Saharan fruit and vegetable exporters are subscribing this service. (ITC 2014.)

Function of mAlert allows MSME companies, or other parties, to send bulk SMS messages to selected audience, for example about business opportunities, training events or market news. Service can be installed to any area, with a help of ITC and by selecting local partners and proper MNO, in order to reach as many of the local mobile phone users as possible. This service purchase the SMS messages in bulk, which leads to a low price of 0,03 $ per message. Currently more than 25 000 business receive mAlerts. (ITC 2014.)

mCollect, Mobile data collection, is a system designed to collect crop price information, from the various market places around the country, into one simply to use list. It complements the mPrices service. Once the information is collected, the system will send the information to a small business, who have subscribed the service. Information gathering works so, that the representatives of the local trade support institutions visits the local markets and sends their observations, using agreed-upon coding, by SMSs to the main archive, where information is then combined and send to the subscribers of the service. (ITC 2014.)

Mobile Marketplace allows farmers and small traders to post their product offerings (price and quantities) using their mobile phones, on to the online service. From there, exporters or supermarket buyers can see the offerings and negotiated deals based on those. Also transportation of the products can be arranged, through the service, on behalf of the buyers. (ITC 2014.)

4.2 Case: Kenya Agriculture Community Exchange, KACE

Aim of this project was to digitalize the market price function of KACE. KACE was originally launched in 1992 as a private family own initiative, founded by Dr. Adrian Mukhedi. Original business function was to help small hold farmers to access agriculture input and output markets. Operations started in their Nairobi headquarters in 1993, there they set up a trading floor, to where farmers could post their commodity offerings. Though they soon realized, that decentralized model would work better, so service redesigning was undertaken and firsts Market Information Points, MIP, were opened in 1996, in Machakos, Eldoret, Chwele and Bungoma. These places were equipped with computers, mobile phones and internet access, in order to collect the market information, send it back to the main office and to receive summary of market prices from the other MIPs. Each MIP would then share this price summary to the local farmers. There was also a trading floor in each of the MIP, where farmers could post their offerings by paying a fee of 1,18$ per offering. MIP Staff members would also work as a deal brokers, negotiating the deals on behalf of the farmer, in exchange of commission between 0,5% and 5% of the deal price. The problem with this model was that most farmers and traders were making their deals outside the MIPs trading

floors, thus causing a lack of income to MIP from the deal broking. (Mukhebi and Kundu 2014.)

During the early years of 2000 Kenya, as many other parts of the world also, witnessed wave of digitalisation, in a form of mobile handsets becoming widely used. With a funding from the Rockefeller Foundation and Agricultural Cooperative Development International / Volunteers in Overseas Cooperative Assistance, ACDI/VOCA, organisations, KACE developed an SMS and Interactive Voice Response System, IVRS, systems to spread the market price information directly to the farmers. Customer fee was 0,08$ per SMS and 0,35$ per minute in the IVRS. These systems were started as a revenue share basis, together with a local Mobile Phone Service Provider, MPSP. From the revenues, MPSP got 60% and KACE together with an ICT companies, who were providing technical support for the system, got the remaining 40%. The issue regarding this model was, that KACE didn't had direct access to records on how many users the service had and was forced relay to numbers provided by the ICT companies. During operation, SMS service had 30 000 users on average per month and even 50 000 during the harvesting times. In the other hand, IVRS service had only 1 500 users per month. (Mukhebi and Kundu 2014.)

In 2011, KACE launched national radio program, called Soko Hewani ("Supermarket on Air" in Swahili), to broadcast the market prices daily, from Monday to Saturday, in Kenyan Broadcasting Corporation station. To support this, they also opened a Market Call Centre, MCC, where farmers could call and post their offerings. MCC system witnessed various economical and technical issues and KACE decided to suspend it. However in August 2013, with a support from ITC, Ministry for Foreign Affairs of Finland and Safaricom, KACE redesigned the Soko Hewani system together with a SMS and IVRS systems. (Mukhebi and Kundu 2014) Redesigned service was launched in October 2013. Currently it works so, that farmers will post their offerings to the system, by using the IVRS with their mobile phones. These offerings are then collected - and some complied with others - by the Market Resource Centres, MRC´s, (previously known as MIPs) in five counties. They will also arrange transportation for the products. These offerings then become available to MRCs notice boards and in their web page, where buyers can see then and purchase those offerings either from the MRC, or straight from the farmer. Currently the service also uses mobile payments, such as M-Pesa, in transactions, allowing KACE to get adequate service fee. Service is

designed to be sustainable, so that it covers its own operation cost from the fees collected from the usage of the service. (ITC 2013.)

Currently, KACE also provides market information in their webpage and as an email list subscription service, both open for registered users. Service is called Regional Commodity Trade and Information System, RECOTIS. Service has daily updated market information of 42 different crop and livestock commodities. Fee of the service is 65$ for six months or 125$ for one year subscription. In spring 2014, these services had around 1 000 registered users. Though, around 70% of those subscribers were agricultural students, who are allowed to use the service for free (Mukhebi and Kundu 2014.)

Learning points from the KACE case are, that providing only market price information is not enough, since farmers need to actual sell their yields. To answer this demand, KACE provides the MRCs and renewed Soko Hewani service. By using those services, farmers can, besides getting the market information, also form linkages directly to the buyers. Farmers are also willing to pay for these kinds of linkage services. It was also noted that SMS and Internet services had become valuable tools for reaching the rural farmers. 75% of farmers and 60% of traders said that their income had grown after utilizing the market information system. (Mukhebi and Kundu 2014.)

4.3 GSMA; mAgri Programme

GSMA, GSM Association, has around 800 mobile operator members and around 250 other members - such as device makers and software companies - worldwide (GSMA 2015a). mAgriculture activities are part of the GSMAs Mobile for Development Programmes. In this programme, GSMA supports activities of mobile operators, application developers, farming organisations and other developing agencies. Currently they have six pilot projects running in Africa and Asia; in Tanzania, Kenya, Mali and India. In Kenya, project is called Airtel Kilimo, which is a joint project with the local MNO Airtel. (GSMA 2015c.)

4.4 Case: Airtel Kilimo in Kenya

This program is run by Kenyan mobile operator Airtel Kenya, which is a second largest mobile phone operator in the country (with 16,5 % market share), having total of 5,4 million customers. Service was launched in April 2013. System provides various agronomy information services, such as weather forecast and market price information, for the user. It is available both in Swahili and English. In the beginning of 2015, service provided information on maize, amaranth, banana, beans, cabbage coffee, mango, rice, passion fruit, and tomato. Service will be updated with information of other crops, as well as livestock related info, in the near future (GSMA 2015b). From the Figure 7, the registration process for receiving information from the Kilimo service can be seen.

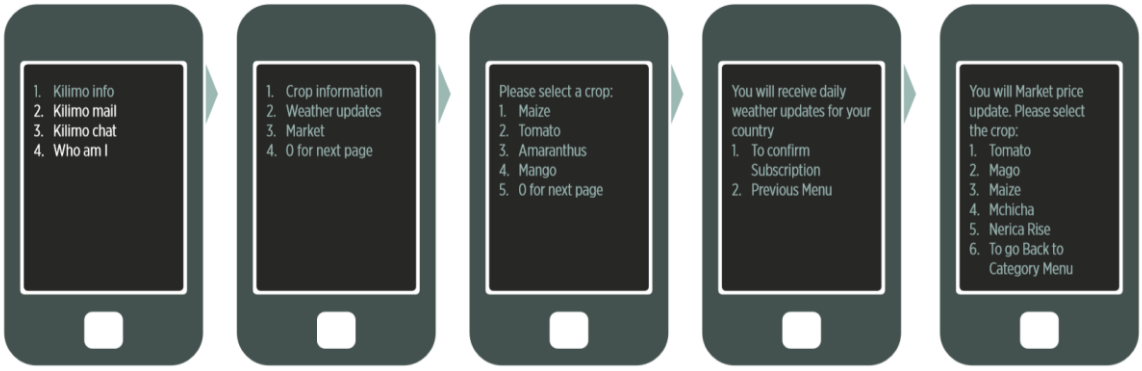


Figure 7. Registration steps for Airtel Kilimo as a USSD menu in December 2014 (GSMA 2015)

Service was originally based on the SMS and IVRS services. Users would get three messages about each selected crop, market prices two times a week and daily weather message, meaning in total minimum of 12 messages per week with a total weekly price of 36 KES (0,36 €). In IVR, it was free of charge to browse in menus, but receiving content cost 3 KES (0,03 €) per minute. (Palmer 2014) However, Kilimo underwent a major remodelling in November 2014, when it moved from SMS and IVRS to use only USSD. During the same time, they started a partnership with company called AGIN, which become their technology provider. Simultaneous they also changed their pricing model to be fixed weekly fee of 20 KES (0,2 €). AGIN also runs a Customer Relationship Management, CRM, system, which produces daily customer uptake and usage reports (GSMA 2015b).

Crop information is attained as a factsheet from the "Direct to Farm" database, managed by GABI. Kenyan Agricultural Research Institute, KARI, validates this information before it is send out to farmers and also translates it to Kiswahili. Most popular crop has been banana (44 % of all users have subscribed it) and planting has been the most popular information category. Available categories can be seen from the Table 7. Other service partners includes Kenyan Ministry of Agriculture, for market prices, and Kenya Meteorological Department, for weather forecast (GSMA 2015b). Market information is collected from six main market points; Eldoret, Kitale, Machakos, Mombasa, Nairobi and Nakuru. (Palmer 2014.)

Table 7. Information categories in Airtel Kilimo service, in April 2013 (GSMA 2015)

Year launched	April 2013
Soil management:	Soil requirements, Soil testing
Pre-planting	Seed information, Seed varieties, Inter-cropping
Planting:	Spacing, Water management, Pest and Diseases
Growing:	Plant nutrition, Pest and Diseases, Mulching
Pre-harvest:	Pest and Diseases
Harvest:	Pruning, Maturity indicators
Post-harvest:	Storage, Pest and Diseases

Study, covering December 2014, find out that the service had total of 22 438 users, out of which 6 438 users (28,7%) had received messages during that month. Average Revenue per User, ARPU, was 0,42 $ in a month (GSMA 2015b). Service had tripled its amount of user's, compared to May 2014, when service had around 7000 user, out of which only 28% had actually received information through the system (Palmer 2014). However, Airtel original expectation was to reach 200 000 users by the July 2014. Their estimation for the total addressable market in Kenya was 5,15 million (GSMA 2015b).

Farmers, who have been using the service, have benefitted from it in various ways; including increased yields, higher income and increase in confidence. Service witnessed some difficulties related to their multistate registration and subscription process. To market the service, Airtel formed a partnership with Kenya Livestock Producers Association and sponsored their agricultural trade shows around Kenya. They also used regional teams to promote the service in the rural areas for a short period of time. Kilimo also had two week period, when users could try the service for free. GSMA funded the program with 400 000$ matched grant, together with technical support for 24 months (GSMA 2015b).

4.5 InfoDev

Founded in 1995, this World Bank originating program aims to support growth oriented entrepreneurs in the developing markets. They provide early state funding and mentoring. InfoDev also have specific programs in various areas, such as agribusiness, mobile and climate (infoDev 2013a). Program is supported by Ministry for Foreign Affairs of Finland, among other countries, such as Brazil, Canada and Sweden. Also, private sector partners have important role. (infoDev 2013b).

4.6 Case; M-Farm

This company was founded by Jamila Abass, together with two other women in 2010, when they joined to IT hub in Kenya, called Akirachix. Later on they won a 10 000 € investment prize from IPO48 competition with the M-Farm idea. (M-Farm 2015). After this, they received a half grand, half loan funding of 100 000$ from the TechforTrade, for developing the service further (Tran 2013). Since then they have been supported by the InfoDev program (infoDev 2013b).

M-Farm service provides market information, by SMS´s, of 47 different crops, from five different market places all around Kenya, to farmers (Pasquier 2014). Besides providing market information, they also provide commodity trading service, were they utilize network of 18 agents, which will negotiate a best deal between farmers and buyers. In order to make major buyers interested, they group crops form many farmers - usually between 20 to 120 farmers - together, in order to have higher amounts of each commodity available. M-Farm charges service fee of 10-15% from the transaction sum. Farmers join this service by listing which crops they are selling and in how large quantities, into M-Farm system (see Figure 8). This information becomes available also to their website (Tran 2013). Researchers have also been interested on this collected price data (Crandall and Kieti 2013). M-Farm is also connected to the M-Pesa service, allowing farmers to manage their revenues easily (Pasquier 2014).

Figure 8. Ordering and receiving crop price information by SMS from MFarm service (Pasquier 2014)

One example of the farmers income development, after they started to use this service, is a snow pea farmers, who currently gets 0,90 £ (1,16 €) per kilo, which is double on what they used to get. In May 2013, M-Farm had total of 7000 users, out of which 5 000 uses also its commodity trading function. Limiting factor in this business case is that they don't have enough buyers involved, so they need to turn down farmers, which are wanting to join to their service. To overcome this, they are negotiating a deal with a British supermarket chains, such as Tesco (Tran 2013).

M-Farm business model has undergone a transition, from relying only to revenue from the premium SMSs, to the current situation where their revenue is coming from diversified sources of transaction commissions and data vending. Reason for this transition was that farmers were not willing to pay their original SMS prices. Current business model might be the right one for the path of having scalable business model. However, they are still in the need of further funding, which would be used to increase their marketing and user training. They also needed to deal with the credibility challenge. This was done by utilizing their own trusted data collection agents. Also, their data query technology, which is based on user's demand-driven queries, has help them to solve the data relevancy challenge (Crandall and Kieti 2013).

4.7 IICD; Economic Development Programme

International Institute for Communication and Development, IICD, has almost 20 years' experience on bringing ICT technology to the development sector. The base of these actions is "Social Innovation Progress", which is integrating capacity building approach consisting of eight steps. It starts from analysing the local information need - regarding the Agriculture

Value Chain - among the farming organisations, moving to linking those organisations to local ICT service providers and finally helping farmer organisations to scale up their ICT solutions. Their experience shows that using latest ICT solutions have a positive effect to engaging small hold farmers into Agriculture Value Chain. However, this process needs to be supported by building capacity of all the stakeholders and business logic needs also be applied to the Value Chain. (IICD 2014.)

IICD has also developed a special system for evaluating the ICT4D work, which they have integrated to their own work. This integration increases the impact and efficiency of those actions and verifies that farmers feedback will affect to design and implementation of those projects. IICDs actions are focusing on the four different topics; Improving management and administration of farmer organisations, Improving production through access to quality extension services, agricultural inputs and Geo-data, Improving access to markets and information on market prices and demand and Improving access to finance and financial information. (IICD 2014.)

Improving management and administration of farmer organisations; this segment includes ICT tools, which help farmer organisations in their various activities, such as in the financial and institutional management. These systems would also be able to collect and analyse socio-economic data, regarding their small hold farmer members. They would also keep track on their transactions. Globally 601 farmers organisation were advised on the use of ICT in 2013. (IICD 2014.)

Improving production through access to quality extension services, agricultural inputs and Geo-data; these include ICT solutions, which will help governments, NGOs or farmers organisations to improve quality of their extension services, which they are providing to the farmers. Geography data will help farmers, by providing a relevant information, based on their location, about agricultural practices, such as soil information and weather forecast. Globally 135 000 small hold farmers use IICDs ICT services to access information about production and markets. (IICD 2014.)

Improving access to markets and information on market prices and demand; these ICT systems allow collection and processing of market price data, which is gathered from various sources. It also gives farmers a real time access to this collected data. Also, these services support farmers in the marketing and in the negotiation with the buyers. Certification

services are also part of this topic. ICT technology, together with geo-referencing, enables tracking of the products history and their whole life span. This data is needed for certification of small hold farmers and their products. (IICD 2014.)

Improving access to finance and financial information; these ICT system improve small hold farmer's access to finance and financial information. These include mobile payment systems, which allow transactions between agriculture value chain, as well as micro-insurance and micro-lending services, which are tailored to the agriculture purposes. These services increases farmer's financial management capacities and improve rural entrepreneur's integration to the financial systems. In 2013, 43 000 rural entrepreneurs where using these mobile finance services. (IICD 2014.)

4.8 Case; farmerICT hubs

In Kenya, IICD has currently three projects in the western part of the country (in Kisumu, Kakamega and Eldored). In those areas, IICD has set up five farmerICT hubs, which exist near frequently visited by the farmers. Hubs are open for all and used to bring internet access, training and various other information services to the local farmers. These centres have dramatically increased the accessibility of ICTs in those communities. (Plechowski 2014.)

Focus point of those operations has evolved during the time. In the beginning, it was video production - about relevant farming practices of the popular value chain crops, such as tomatoes, potatoes and sweet potatoes - together with the farmers. Those videos would then be played, for example, at the collection points, in order to facilitate peer learning. However, frequent request about general ICT trainings, mainly from the young people, led centres to provide training about using Office programs and the Internet. These centres have also become frequent meeting points of the young community members, where to exchange information and experiences. (Plechowski 2014.)

The outcome form these programs seems really promising; potato farmer's yields have increased by 450%, after improving production techniques and better access to inputs, in the ADS-NR project. Also, amount of potato buying clients have increased, even in such way, that farmer organisations are actually looking potatoes to sell, in order to fill the increased demand. In a single farmer level, one sweet potato farmer has doubled its yields, in the ADS-

Nyanza Sweet Potatoes Marketing Cooperative. This happened after adopting new growing techniques, which he learnt from the video screenings. Also, 26 farmer organisations, which have participated to IICD´s program, have increased their annual turnover by 21% from 2011 to 2012. (IICD 2014.)

General benefits have been better access to the market information and direct link to buyers. This have helped farmers to know the current prices and there how being able to negotiate deals, without needing to use middlemen's. Like Hillary Kiplagat, potato farmer from the Nyara County said "We no longer entirely rely on the services of the exploitative middlemen and because of this we have more money for the same products we have been farming at a seemingly low price because we believed the prices the brokers quoted to us". Farmers have also utilized the computer and Internet use training, to learn about record keeping and making production plans. (IICD 2014.)

4.9 Conclusion table of the mAgriculture organisations and services

Figure 9 provides a roundup of the mAgriculture services presented in the previous chapter. It covers the types of the services provided, their learning points and supporting organisations.

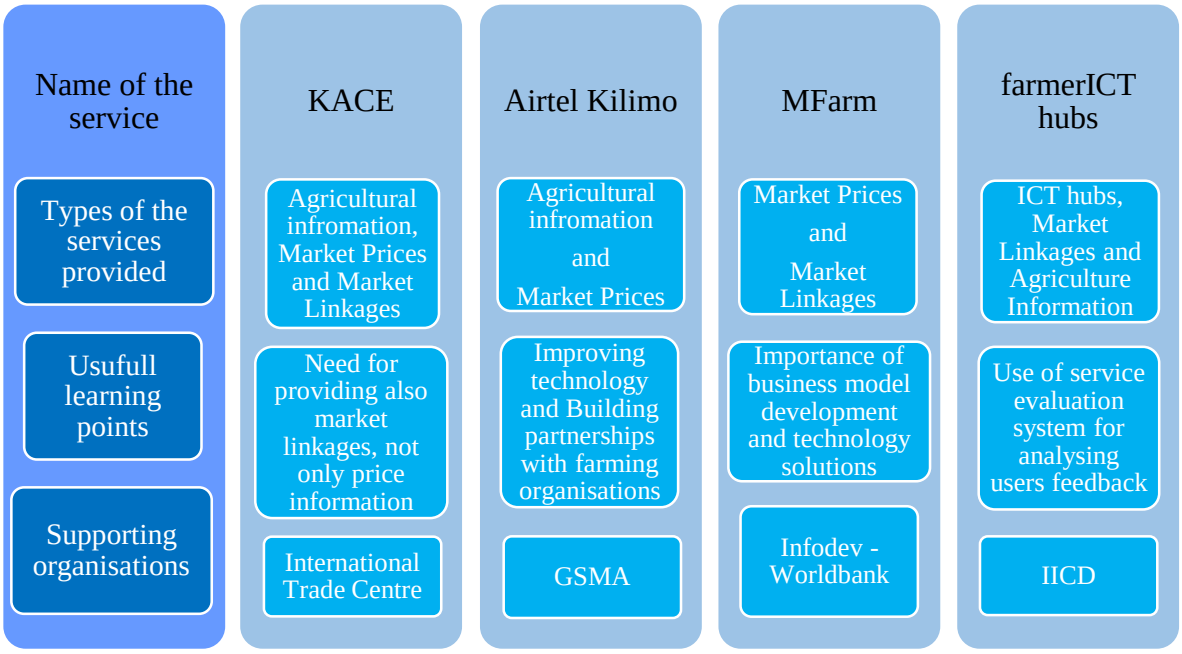


Figure 9. Summary of the mAgriculture services in Kenya, their learning points and support organisations.

4.10 Other mAgriculture applications

From the Table 8 can be found a summarised information of a few other type of mAgriculture service, which are existing in the African market currently. These examples provides an additional view on the type of services available, however they are not covered in a more detailed way, mainly because of a lack of available research data.

Table 8. Descriptions of some other mAgriculture services available in Kenya.

Name of the service	Type of the service	Target users	Main idea
Mkulima Young	Web-site	Young farmers	Encourages young to interact and share agricultural and business advices
FarmDrive	Financial application	Farmers	Allows farmers to keep track on their financial matters and that way help them to get a loan
WeFarm	Peer-to-peer based knowledge sharing platform for farmers	Farmers	Farmers can ask questions by SMS and receive answers from the other farmers
Agrinfo	GIS-application (web and mobile)	Farmers	Mapping farms
Manobi	Value chain tracking application	Actors in mango value chain	Tracks products each step in the mango value chain

(AYF and CTA 2014; Crandall and Kieti 2013; CTA 2014; Mulligan 2015)

5 LITERARY REVIEW OF THE mAGRICULTURE SERVICES

This chapter covers the outcome of the literary review about the usage, lifecycle and learning points of the current mAgriculture applications. mAgriculture start-ups and external factors affecting the popularity and use of these services are also covered in this chapter.

5.1 Usage and impact of mAgriculture services

This chapter covers the knowledge and usage numbers of the mAgriculture services among the farmers in Kenya. Also, a commonly witnessed path, of how farmers start to use mAgriculture services, is covered. Studies, regarding the positive impacts of the mAgriculture services to farmer's livelihood, are also covered in this chapter.

5.1.1 Knowledge and usage among farmers

Although there is generally a lack of data on how well known these mAgriculture services are among rural farmers and how these farmers are actually using these services, a few studies has been conducted in those matters. One was conducted by the IICD, in Kenya in June 2013. They interviewed total of 1100 rural farmers about their experience on the usage of the mAgriculture services. Outcome was that 90% of the participants have been using ICT solutions in their farms. They were using ICT for obtaining best market prices, keep records, find crops in high demand, access new farming practices and agricultural technologies, as well as communicate with other farmers. (Plechowski 2014.)

Other study was made by researchers Namisiko and Aballo and it covered 800 farmers in the Trans Nzoia County, out of which 80% had access to mobile phones. There 32% of the farmers have been using mobile phone to conduct business, but on the other hand 63% of the farmers were not aware of the mAgriculture services (Namisiko and Aballo 2013). These figures clearly point out the importance of marketing, in spreading knowledge about these mAgriculture services to farmers. First research also reveals the most used services types and this finding can be utilized in the developing of new products, which are in demand.

5.1.2 Path of how farmers start deploying ICT in their farms

One common path, on how young farmers start to use the ICT tools in to their farms, is presented in the Figure 10;

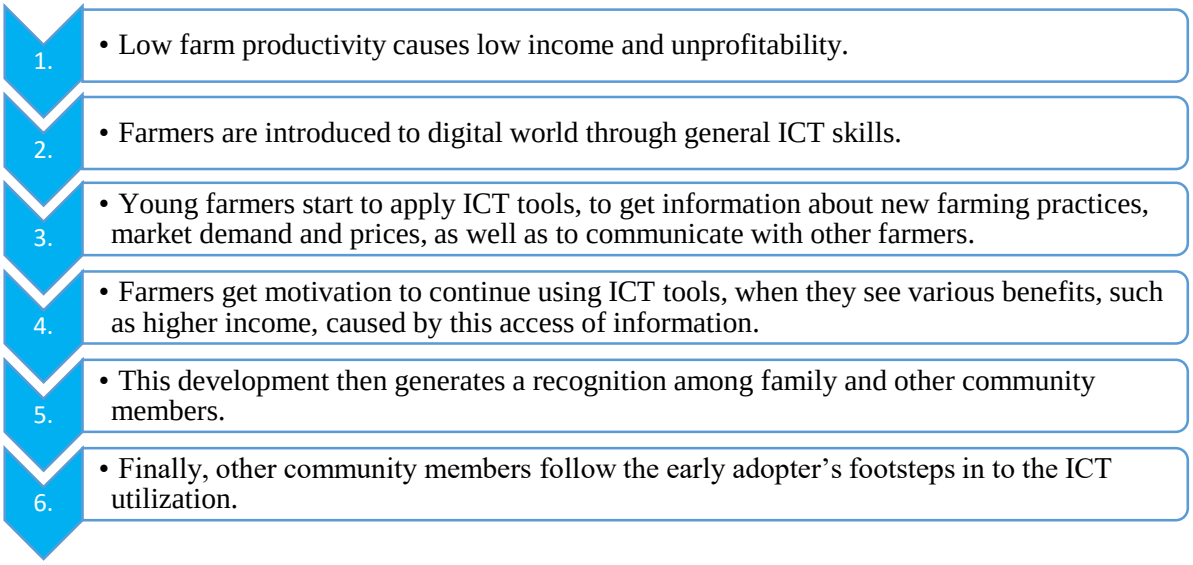


Figure 10. Common development path on how young farmers start to use ICT in their farms (Plechowski 2014)

5.1.3 Assessing the actual impacts

Measuring the actual positive impacts, caused by the use of mAgriculture services, to farmers can be challenging. Generally speaking, there is a clear lack of factual evidence of the effectiveness of these services in improving the farmer's livelihood. This is partly because of only a few applications have reached widespread popularity, while other applications are not able to allocate enough resources to marketing and customer acquisition - which would be needed in order to scale-up - since they are financially struggling (Danes et al. 2014). Also, it can take many years, even decades, before the impacts of these services are clearly shown (Awuor et al. 2013). There how, generally there is not enough data currently, to which base the research about the impacts of the mAgriculture applications.

However, some positive impacts can be observed regarding the price information and market access, for instance in the case of price stabilisation and increased income among farmers. In the other hand, weaker examples can be found regarding impacts to the efficiency and

sustainability of the agricultural activities (Danes et al. 2014; OXFAM 2013). Based on that founding, it can be noted that there is a need for improved mAgriculture services, which provide information about sustainable and efficient agriculture.

5.2 Lifecycle of the mAgriculture applications

Typical lifecycle of a mobile application can be divided in to four different phases (see Figure 11 below). It starts at concept state, where the core functions of the application are designed, based on the market research and available resources. Also, at this phase, the right partners for the application are identified. Then, once the application is launched, follows the piloting, scale-up and sustainability stages. (OXFAM 2013.)

During the pilot stage, application is tested with a relevant target audience and the further developed based on the collected feedback. Before starting, it is a useful to set clear goals and a timeframe for the pilot. Actual testing happens usually so, that application is given free-of-charge to the small group of target customers. Their application usage is then continuously monitored, in order to find out which functions work and which don't in the application and also to find out the actual impacts of the application. Based on this data, selected changes are made to the application, before moving to the extension stage. However, in some cases developers could decide not to move to extension stage, since they find out that there is no need or demand for that type of application. During piloting, it is also advised to plan - and even start - the marketing campaign. Also, expansion plan should be generated during the pilot stage. During this stage, donor or government support is generally a necessity. (Danes et al. 2014; OXFAM 2013.)

The scale-up stage. This is the most challenging stage; the one where most of the mAgriculture applications will fail. The aim at this stage is to get more users for the application and increase its revenues, making it financially sustainable. Major factor here is that some applications are designed only piloting stage on the mind, causing then issues in the scaling-up, since this stage adds complexity to the application development. Issues faced in this phase are related both to the business and to technical factors. In technical context, applications capacity might fail when the user base grows to be multiple times more than in the pilot phase. In the business case, the importance of user training (capacity building) and

marketing could be underestimated. Usually also the actual revenue model will change in this stage. Also, some customization - in order to fit local conditions (such as languages) - is usually needed at this stage. These factors causes major issues to most of the applications. (Danes et al. 2014.)

In the sustainable stage, application has reached financial break-even point or even profitably level, meaning that they are economically sustainable. As a rule of thumb, user base of 150 000 users is usually required to reach financially sustainable level. In this level, growth is however still a major issue, but the business model has proven to be valid and medium term sustainability is guaranteed. Also, the low margin, high volume business model, which is the most common one among mAgriculture applications, poses issues on the service providing side, since it might be hard to reach enough customers by only providing agriculture information. Therefore, it could be wise to combine them with other type of information, such as market prices and weather forecasts (Danes et al. 2014).

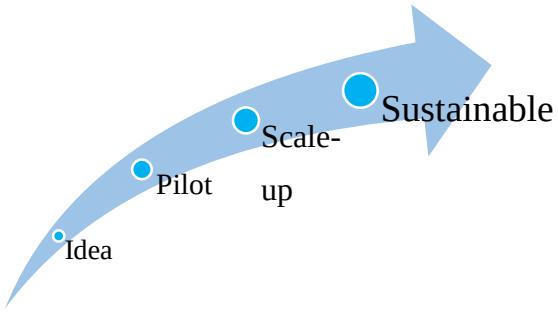


Figure 11. Application development stages

Figure 12 presents a graph, which shows the findings of World Bank study from 2011, covering 92 different mAgriculture applications and their lifecycle stages. From the graph can be easily seen, that only small part (16%) of the applications have reached the economically sustainable level, while most are still in the pilot or scale-up stages.

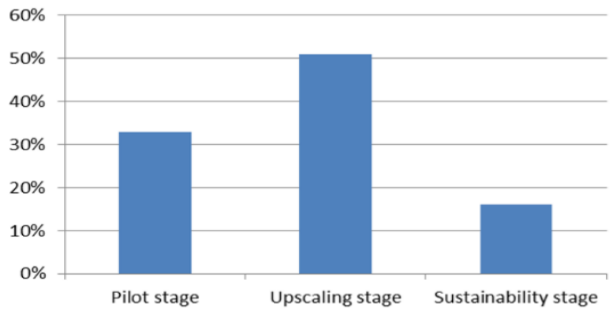


Figure 12. Distribution of mobile applications based on their scale-up level (Danes, et al. 2014)

5.3 Learning points from the current mAgriculture services

Despite the availability of all those various services and support from many large international organisations, the uptake of mAgriculture services among the farmers in the developing markets has been disappointingly slow (Omwansa et al. 2013). There is a lack of analysis of which things work, which doesn´t and - especially - why, in the mAgriculture service development and scale-up faces (Crandall and Kieti 2013). Although, various organisations, such as CTA, have developed analysing toolkits to be used to evaluate the mAgriculture services. Thought, currently existing data seems to be too scarce to allow profound analysis on these matters (Batchelor et al. 2014).

However, some issues can still be pinpointed. This section will cover the matters affecting the mAgriculture service development, up-take and scale-up states. Issues related to the internal factors of the companies will be covered in the following 5.4 chapter and issues related to external factors, such as a lack of prober infrastructure, are covered in the chapter 5.5.

5.3.1 Lack of coordination and cooperation

One of the most profound issues is the lack of coordination, collaboration and cooperation among mAgriculture service developers and other parties involved. Services are developed in isolation of each other, often in different countries, causing creation of many applications for the same purposes, while having lack of applications for some other purposes. There is a lack of consistency in the application development; each project is struggling with their own learning points and pitfalls. Applications should be built on existing models and approaches - which have been proven to work - in order to have a greater chance for the real impact (CTA 2014). Therefore, greater collaboration and exchange of good practices should be developed, allowing development of joint practices and collaborative development of, for example, open source protocols and applications, as well as making existing data available (Danes et al. 2014; OXFAM 2013).

To overcome this issue, few cooperation scenes have already been launched. CTA launched a “living database” initiative, called ICT4Ag, which keeps track of the development of these

services and works as a framework for assessing their effectiveness (CTA 2014). FAO has created e-agriculture portal, with an aim to stimulating experience sharing among NGOs and private sector actors. Another form of cooperation is between Bill and Melinda Gates Foundation, USAID and GSMA, where MNOs, public and private funders come together to join forces (Danes et al. 2014). Among international mAgriculture community there is general interest towards collaboration, for example in a form of round table conferences (OXFAM 2013). It seems that the lack willingness is not the main issue, but instead the lack of suitable tools and ways, to keep up the constant communication and interaction, is the profound issue.

5.3.2 Forming relationship with the local actors

While developing the mAgriculture applications, it is crucial to form connections to local farmers, which are the actual target group of these services. It is important that the application development is user driven (Danes et al. 2014), meaning in practice listening the farmers to understand their needs and risks which they face (OXFAM 2013). One of best ways to achieve this is to visit their plots and forming one-to-one connections with farmers and that way actually becoming part of the agriculture community (CTA 2014). This would maximise the user's ownership to the service and create potentially more scalable service (OXFAM 2013). However, it is still rare to see developers spending time on the fields of their customers and testing their services together with them (Omwansa et al. 2013).

While scaling the service, it is also important to form connections early enough to the other stakeholder groups in the agriculture value chain - such as various public and private sector partners - in addition to local communities. This seem to be a foundation of a successful mAgriculture service, since this helps to obtain commitment towards these services. It also seems that there is more value in strengthening regional policymaker networks, rather than national networks (Batchelor et al. 2014). This applies especially to counties, whose governments are generally more important decision makers locally, than the country's government. Also, those county governments should know about various challenges in the agriculture value chain, which local farmers are fazing and about the ICT solutions, which can be used to empower local farmers (Tenge and Wambaya 2014).

5.3.3 Provided information need to be trusted by and relevant to farmers

In the information providing side, the most important factor is that information needs to be trusted by the users of these services, meaning local small hold farmers. There is a great chance that application developers will witness creditability challenge with the information, what they are providing in their applications. This issue can be tackled by forming strategic partnerships with credible agriculture information experts and institutions, in order to acquire the information from them. Developers should not act as a legit content provider, unless they have persons with agriculture expertise on their team or other similar resources available. Later on, when the company has grown up, they can acquire this type of talent. (Crandall and Kieti 2013.)

Information provided by the application should also be relevant to the farmer's location, climatic zone, current position in the agricultural cycle, income level and availability of agricultural inputs (OXFAM 2013). It would also be beneficial to combine data from various sources into to one service, in order to have wide view on the farmer's situation and on different factors, which have effect on it. Data could be acquired from the ministry of agriculture, agriculture extension officers, agriculture traders, various research institutions and weather stations. Summing this data up, in such way that farmer can easily understand it, would help them to make more educated decisions on - for example - what crops to grow. It would also allow farmers to develop more customized farming systems, based on their actual needs and conditions, while operating in way which uses natural resources in a sustainable way and minimizes emissions, for example, in a form of agroforestry system (Awuor et al. 2013).

However, there might be issues related to accessing the data. As an example, some civil servants dent to safeguard information, which they have collected and stored, rather than helping developers to have access to it. Also, certain data is not always easy to collect fully, for instance price information might be collected by observing bargain conversations between farmers and traders, generating a possibility of misunderstanding. Also, certain criteria related to the quality of the agricultural products, such as freshness, might be hard to include into the price information. (Danes et al. 2014.)

5.3.4 Role of the different organisations in the mAgriculture development

Various national and international organisations play a key role in the development and up-take stages of the mAgriculture services. They can be divided into four different category's, based on their role. These categories are donors, research institutions, private sector and NGOs. Donor group includes various international organisations, such as World Bank, public services and charities. Their role is to support development of new initiatives, mainly financially, but also by providing strategical development help and assistance in bottom-up initiative development. It should be noted, that donors funding decisions are generally affected by their own motives and objectives. (Danes et al. 2014.)

Research institutions, on the other hand, provides the content for the mAgriculture services. They are in a key role when filling the farmer's information gap with the latest research findings and knowledge. However, there is a divine between research outcomes and practical appliances of those results, which generates a lack of relevant knowledge to farmers and extension services (Danes et al. 2014). Therefore, more effort should be made on refining research results to be more suitable for the local context and that they could be easily utilized by the farmers and other actors involved in the agriculture sector (CTA 2014).

Private sector have multiple roles; traditionally they have act mainly as donors or funders of the projects and application development, but nowadays their role is seen in a wider way. Private sector has also potential for bringing business know-how to the mAgriculture services, which could be useful when improving the financial sustainability of these applications. Companies can also start providing these mAgriculture services by themselves, in order to induce farmers as a new customer base or as a raw material providers (Danes et al. 2014).

This wider role is already seen among MNOs, which are currently the leading private sector stakeholders, involved in the development of the new m-Agriculture services. These services are usually part of MNOs rural connectivity strategy, where they want to attract new rural customers, by providing them services in the areas such as agriculture (Danes et al. 2014). Besides this business case, there are also more technical and infrastructure related issues behind the MNOs large effect on the development of the mAgriculture applications. Traditional SMS, USSD, IVR and call centre based services requires developers to have a

strong relationships with MNOs, since they are heavily dependent on the services which only selected MNOs can provide, such as phone number short codes and SMS handling capacities. However, it is expected that this position will change, once the new web and mobile data based services become more popular, since they are not that much reliant to certain MNOs services and can work over a data connection, provided by any local MNO (Batchelor et al. 2014).

Non-Governmental Organisations, NGOs, could set up and manage the projects where the mAgriculture applications are used. They could also work as a link between donors and local application developers. They also have key role in allowing the bottom-up development of these services, by forming links between farmers and application developers. (Danes et al. 2014.)

5.3.5 Conclusion figure of the learning points

Figure 13 will summarise the main learning points of the current mAgriculture services, which were presented in the previous 5.3.1 – 5.3.4 chapters.

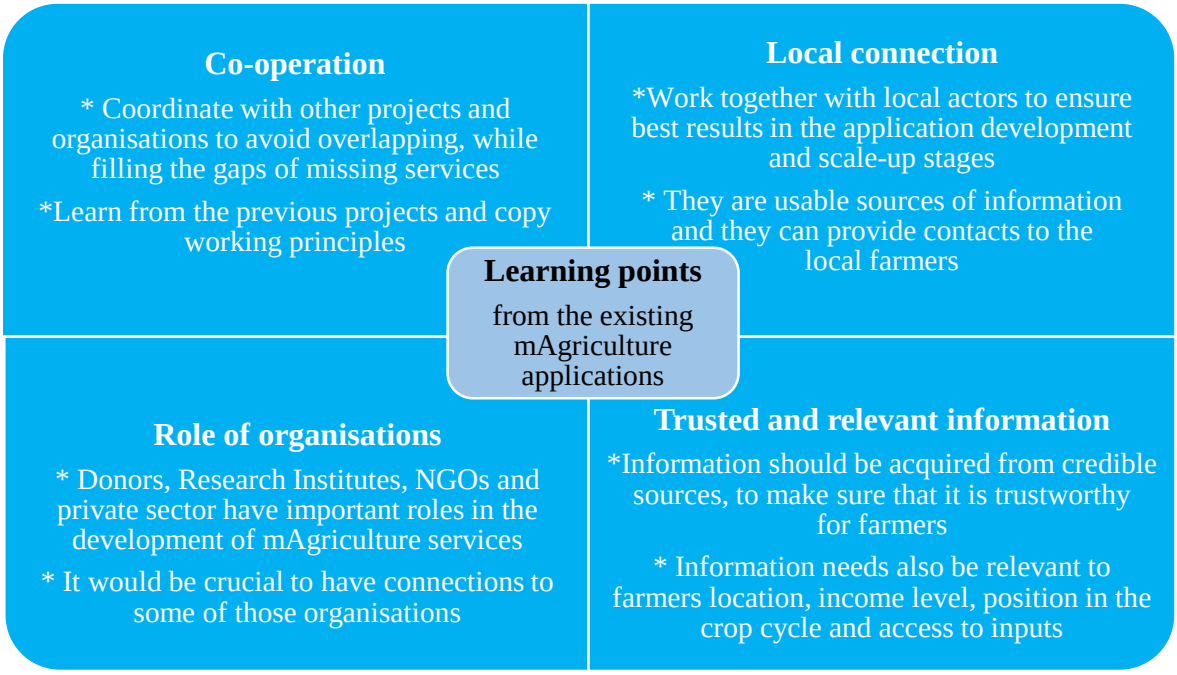


Figure 13. Main learning points from the existing mAgriculture services

5.4 mAgriculture start-ups

This chapter covers the main factors in the currently existing mAgriculture start-ups; their structure, funding sources and the internal issues, which they are typically facing.

5.4.1 Start-ups in Kenya

During recent years, a lot of interest have raise up to develop mAgriculture applications from various companies, out of which most are so called start-ups. Start-up is defined as a young company looking for rabid growth, with a repeatable and scalable business model. They are also able to learn from the existing business models and improve their own model based on those findings, while aiming to develop a business model that can be scaled up. These mAgriculture companies are usually founded by teams of young (between 18 – 35 years) adults, who are ambitious and native to digital technologies. Since they are able to learn from others, solutions which these companies are developing, are contributing to quality improvement of available mAgriculture services. (Crandall and Kieti 2013.)

Popularity of the mobile applications has been clearly seen in Kenya during the recent years and it could be said that it has become the leader country in the ICT4D application development in Africa. According to one estimate by InfoDev, there was over 80 mobile phone applications existing, which are trying to solve various social issues (Omwansa et al. 2013). This development has also been seen in the various pitching competitions in the East-Africa region, where up to 80% of the participating companies has been Kenyan (Crandall and Kieti 2013). Kenya has also one of the highest mobile penetration rates in Africa, which can be regarded as one of the key reasons for the popularity of these applications.

Other important factor, affecting the development of these start-ups, are the ICT hubs, which provides various support and coaching to companies, as well as connections to other companies, public sectors actors and funders. In Kenya, at-least the following hubs are operating: iHub, m:Lab, iLab Africa, Nailab, Startup Garage Nairobi and C4DLab. (Omwansa et al. 2013.)

5.4.2 Typical internal issues in the start-ups

mAgriculture start-ups are commonly facing following internal issues; lack of access to funding, lack of marketing efforts, poor project management and, most importantly, developing the solid business models is not given priority (CTA 2014; Crandall and Kieti 2013; OXFAM 2013). These issues are closely linked to each other (see Figure 14). However, similar issues are not unfamiliar in the ICT projects in the develop world either (Awuor et al. 2013).

These issues clearly show up in the low take-up numbers and in the scale-up stage, with which most companies are struggling. As an example, out of those 80 companies - which were mentioned in the previous chapter – only a few have reached financially sustainable stage. Lack of awareness about these applications among farmers, caused by lack of marketing efforts, can be named as a key reason for those low numbers. Underlying reason being lack of financial and social capital, which are needed in the marking activities (Omwansa et al. 2013). Main reason, for this lack of availability of financing, has been named the poor profitability of the current applications, which is limiting the private sectors interest to fund these companies (AYF and CTA 2014).

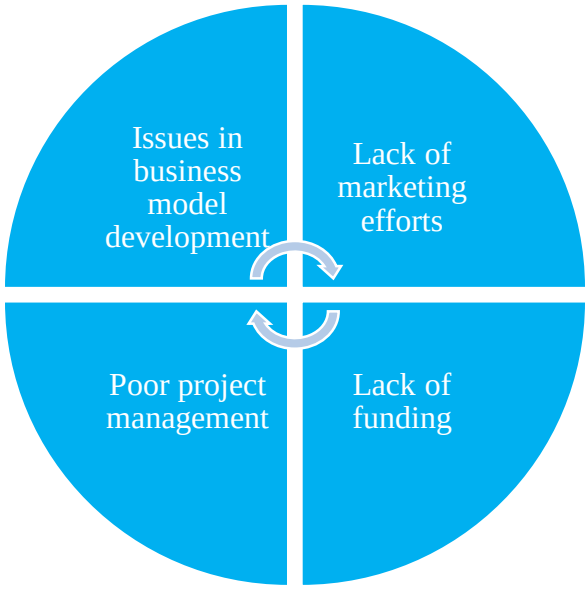


Figure 14. Typical internal issues, which companies are witnessing and their connection to each other

5.4.3 Availability of funding for start-ups

As it was mentioned earlier, acquiring funding is a challenging process for mAgriculture companies, as well as many other start-ups as well. Funding needs differ from company to company, based mainly on the development stage which they are. Service developing and testing stages require usually a relative low amount of funding, compared to scale-up stage, which may require hundreds of thousands of Euros, in order to be running in a full steam. Traditional sources of funding has been various seed funds and donor based funding. Usually seed funds are operated by the various governmental or intergovernmental organisations, while donors being the various national or international NGOs. Funding provided by these organisations is mostly grand based, thought also loan based funding is available. Example of seed funds, which are operating in Kenya, are Tandaa grand and the National Council for Science and Technology grand. (Crandall and Kieti 2013.)

It is crucial to find an access to funding early enough, to maximise the resources available for the development of commercially viable business model (Crandall and Kieti 2013). Funding can be also part of wider public-private partnership, which can be fruitful relationship, with positive results in the adaptation of mAgriculture services in the developing markets (Awuor et al. 2013). These could also be used to support developers, when they are testing new markets. Doing this would limit the risk associated with entering the new markets and would provide a bridge funding, until the actual results of the application usage can be seen and the company is ready to bear the full costs (AYF and CTA 2014).

Recent development of Impact investment funds - which are trying to find projects which, besides providing financial returns, also support environmental, social or financial development among certain area or group of people - have bring one new funding option available to the mAgriculture companies (Crandall and Kieti 2013). This might be the way of bringing traditional private investors to the mAgriculture business, who have been previously almost non-existent in this field. Lack of private investments might be caused by the miss-match on a relative small sums of funding needed and a relative large sums of funding provided by those investors (Batchelor et al. 2014). Private investors would, in opposite to donors, take certain share of the company's stocks, in exchange of the funding. They will also usually provide business coaching to companies that could be in great help to

companies, while they grow their business. However, this requires that special nature of these companies and their business is taken into consideration while providing this guidance.

There is also risk of mAgriculture services being too dependent on the donor support, leading for them not investing enough though on the business model development, which is clearly needed to make the projects financially self-sustainable. When the donor funding ends, the service might also end, thought it might have otherwise been a viable service (CTA 2014.)

5.5 External limiting factors for ICT in agriculture

This chapter will cover the external issues, which are affecting the popularity of the mAgriculture services. They are divided to two main categories; Infrastructure and User capacity. These both are then divided into three different sub-categories.

5.5.1 Access to the infrastructure

Lack of infrastructure is a major factor, both in the terms of limiting the scale-up of mAgriculture services (in the case of lack of electricity), as well as in the general agricultural development (in the case of poor road network).

5.5.1.1 Communication networks and equipment

Lack of network coverage and connections is still a major issue in some places in Kenya, especially with 3G data network coverage, since 3G data networks are more expensive to build and requires higher density of linkage towers, than normal GSM networks (Danes et al. 2014; Wyche et al. 2013). Lack of network coverage leads to low adaptation of mAgriculture services. Also, ownership figures of smartphones and tablets are still rather low, though they have been grown rapidly during previous years and this growth is expected to continue in the future also.

People, who don’t have access to computer or internet at home, could use Internet cafés, which are common in the city areas. Many rural villages have Digital Village hubs, which

are also equipped with computers and Internet connection and aimed to fill the needs of the farmers and other villagers (Awuor et al. 2013). Cost of using Internet in those cafés are typically between 0,5 - 2 KES (0,005 – 0,02€) per minute, resulting cost of around 50 KES (0,5€) for 30 minutes of usage, which is price equivalent of buying enough maize porridge to feed a family for a few days (Wyche et al. 2013).

5.5.1.2 Electricity

Electricity connection is generally scarce in many African countries, Kenya included. Even if there is an electricity connection available, power outages are common. They are caused by weak quality of electricity grid and inadequate power generation capacity (Danes et al. 2014). They can be either pre-planned; when insufficient power is distributed only to certain areas at once, while cutting power off from other areas, or caused by other factors such as storms or vandalism. They can be as common as one in every 1-2 hours and lasting from a few minutes to many hours. Access to electricity becomes a practical issue when farmers want to charge their phones and there is no power available. One common way to access the power is to use special charging kiosks, which either have connection to grid or use aggregate to produce electricity. In one research, it was found out that an average cost of charging one phone was 20 KES (0,2€) (Wyche et al. 2013). There is evidence that lack of electricity has slowed the adaptation of mAgriculture services (Tenge and Wambaya 2014).

To overcome this issue, many governments in the developing markets, Kenya included, have roll out rural electrification programs. One of the most prominent technology to archive rural electrification is the use of solar power. This is well suited to Africa, since they have all year around intensive solar radiation (Awuor et al. 2013) and - as a decentralized systems equipped with batteries in the village or household level - they wouldn’t require new transmission infrastructure, as centralized power plants would do. These solar units could also be locally owned and operated, thus creating “green” business opportunities to the villagers (CTA 2014).

5.5.1.3 Road infrastructure

In addition to weak electricity and data infrastructure, poor quality of roads generates an obstacle for farmers to increase their income. In order to get better prices on their products, farmers often need to travel to more populated markets in the cities and since roads are not in good condition, it takes a long time to get there. This could lead to a situation, where products are not anymore in a good condition, once they arrive to markets (AYF and CTA 2014) and increase in transportation costs, which would lower the farmer's profit margin (IICD 2014). With this issue, the government plays the most important role, since they have the resources needed and the power to execute these large projects. Improving the road network would have great effect on general agricultural productivity, as well as to other economic activities (AYF and CTA 2014).

5.5.2 Users capacity

Second main category is User capacity. In a simply form it means that users might not have the capacity to know that there is a need for a certain information or they are not able to identify, locate, evaluate or effectively use the information to solve to the problem or issue at hand (OXFAM 2013). Profound reasons for these issues could be user's lack of reading and writing skills, general lack of education, cultural issues or local customs. Since these reasons, also these topics are covered in this chapter, together with willingness to pay for the services, since it is close to linked into this topic of user behaviour.

5.5.2.1 Educational issues

As a barrier of utilization ICT in farming, low education level among farmers is often pointed out (Plechowski 2014; Danes et al. 2014). This issue can be answered by improving formal education, as well as having training about ICT usage (Awuor et al. 2013). However, research points out that actual minimum requirement to use of ICT in the farming, is ability to write and more importantly having interest towards use of ICT and confidence to persons own abilities to use then (Plechowski 2014).

5.5.2.2 Culture, social and gender constrain issues

Various social and cultural structures, which surrounds farmers in their communities, have their effect on farming too. These are either organisation, custom or law based and they can affect both in aiding or constraining way to people's efforts. They have effect on how to we think about things. They also effects on persons confidence of their own abilities and beliefs, which persons have regarding to his or her power to change their own situations (Plechowski 2014). Mostly these structures affect to the life of young and women.

Women are important actors in the farming sector; in sub-Saharan Africa they provide, on average, 48% of the farm workforce and agriculture provides 65% of the workplaces for women. They are working both in the farm level, on tasks ranging from leaders, unpaid family workers to paid farm workers, as well as in the outside of the farm as traders and other agriculture entrepreneurs (Batchelor et al. 2014).

However, family farming structures are usually highly male-driven, leading to limited involvement of women in the farms decision making. In addition, women can have limited access to various farm relates factors, such as information, education, technology, financial services and markets (AYF and CTA 2014). Also, there could be other limiting factors for the women involvement, such as constrained mobility or lack of time, since they are also usually responsible of the household and children (Batchelor et al. 2014; OXFAM 2013).

To tackle these issues, ICT have a crucial role by supporting women´s involvement and empowering their participation, by providing access to information and other resources, such as financial services (CTA 2014). Mobile services could also help to overcome women's mobility and time constrains. These factors could address the imbalances both in the household and in the farm community levels. However, those services need to be designed and implemented in such ways, that women's need, constrains and motivations are taken into account (OXFAM 2013). These services should be available in a convenient, secure and reliable way (Batchelor et al. 2014) and in a close location to women daily activities, to ensure high participation rate (Plechowski 2014). In this sense, mobile services are in a key role, since they allow targeting the information directly to the customer, without using network of middleman's (OXFAM 2013). Also, women are generally more curious and motivated to learn, which provides good starting point for the utilization of ICT technologies (Plechowski 2014).

Mobile services could bring various benefits to women in the farming communities. Most importantly, they provide improved connectivity and access to information, which together provides an opportunity for collective economic and social actions. These could then help in rebalancing the unequal distribution of roles between men and women. Mobile technology could also lead to promotion of women's right outside the agriculture field and facilitate their integration to social networks and even to political processes. (OXFAM 2013.)

Overall, all the farming related mobile services should enforce women's role in the agriculture sector and take into consideration cultural and education barriers, affecting the usage of these services, for women and other marginalised groups. Otherwise, usage of these services could even lead to enforcing these existing inequalities. (OXFAM 2013.)

There is also financial factors limiting the women's usage of these mobile services, which are related to buying phones and paying for these services. Also, lack of literacy, both in the language and in the technology point of view, have their effect on the usage of these services by women. These could also be part of the reason in women's lower willingness to pay for these services, especially information services (OXFAM 2013). To tackle these constrains, the capacity of rural women's should be strengthened, especially in the mobile technology side (AYF and CTA 2014).

5.5.2.3 Willingness to pay for ICT services

Lack of willingness to pay, - and uncertainty related to it - for the mobile services, among the farmers has been seen as a one of the key barriers for the spreading of these mAgriculture services (Jain 2014). This could be the case even with services, which would clearly bring financial savings to their users (Batchelor et al. 2014). However, willingness to pay for ICT services seems to vary quite a lot, even from village to village. Main dividing factor seems to be the educational level and how well the effect of these ICT services are seen by the farmers. If the effects are clearly seen, people are more willing to pay for these services, but if the service seems not to provide any clear benefit, people are less willing to pay for it. Also, if the service is provided for free during piloting phase, it might lower the customers' willingness to pay for the service after the pilot has ended (Danes et al. 2014).

Farmers have also been accustomed of getting certain agricultural related information, such as weather forecasts, for free from the governmental or NGO sources. Also, farmers tend to

learn from each other, by visiting more progressive farmers and demonstration farms. Agricultural information is not also regarded as a priority among the households information needs (Batchelor et al. 2014). However, the rise of various mobile money and payment systems could help in increasing the popularity of paid services in the near future. In the case of general ICT trainings, farmers seemed to be more willing to pay a relative small sums for those and in some cases community leaders even paid participation fees of the young community members. This shows that ICT skills are valued among the communities (Plechowski 2014).

One way to overcome this lack of willingness to pay could be to include the service payment to some other service, what farmers are already using. These could, for example, be extension services or even phone calls, which price automatically includes the usage fee of the agricultural call centres. These models could be more acceptable by the farmers. Also advertising could be used to bring the revenues to mAgriculture services, but there is a risk of conflict of interest between the content that the service is providing and products and services, which are advertising on it. Hence, great emphasis should be put into the selection process of those advertisement partners, in order to make sure that their products are in line with the service itself. (Batchelor et al. 2014.)

5.5.3 Conclusions table of the external factors

Figure 15 sums up the chapters 5.5.1 and 5.5.2, presenting the external factors, which limit the adaptation of mAgriculture services among farmers in Kenya.

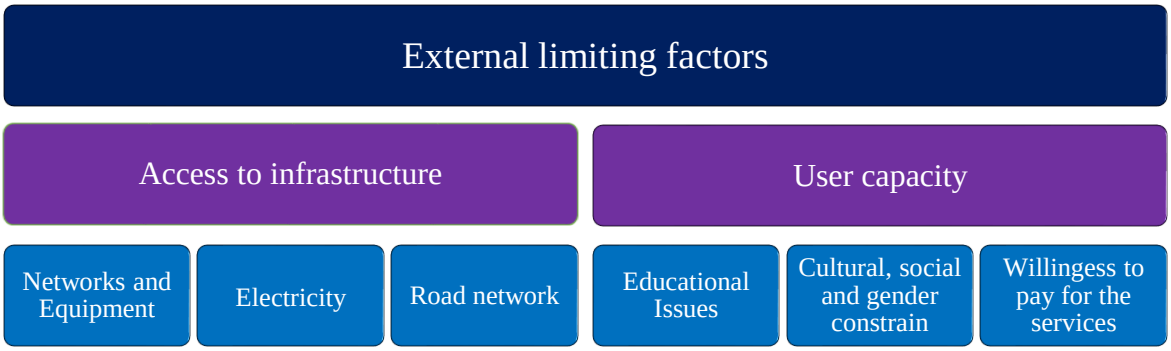


Figure 15. External limiting factors for the adaptation of mAgriculture applications among farmers

6 TOOLS FOR IMPROVING mAGRICULTURE SERVICE DEVELOPMENT PROCESSES

This chapter presents four tools, which are aimed to solve some of the issues, with which mAgriculture companies and services are dealing. They can be seen as developing blocks of an ideal mAgriculture service. Among them are business model development, marketing and Lean start-up methodology, which are presented in order to help develop services, which are based on solid business models, marketed properly to potential users and developed faster and in such way that they meet the needs of the users and that users are willing to pay for them. Gamification is also presented as a tool for improving user-experience and attracting young as users for these services, by making then fun and enjoyable to use.

These tools are covered in the separate chapter from the rest of the results, – which are presented in the chapter 7 - since these topics contain a lot of background material and information. They are also focusing mainly on the business and design matters of the mAgriculture services, when to findings in the chapter 7 are mostly related to the content matters of the mAgriculture services.

6.1 Business model development

People have many definitions to business model, depending on how they are using the term. Michael Lewis defined business model as “how you planned to make money”, Peter Drucker as “assumptions about what a company gets paid for”, Joan Magretta continued on Drucker’s work, claiming that business model must answer to question “How to we make money in this business?” (Ovans 2015). Casadesus-Masanell and Ricarts widened the term to “a set of choices that company does and set of consequences derived from those choices” (Jain 2014). Business model is often mixed to business strategy. The difference between these two terms is that the model is description of how your business run and strategy explains how you will do better than your competitors (Ovans 2015).

Some commonly used business models in the digital services are; Freemium, Subscription, Bundling and Disintermediation. In Freemium, the basic service is free, but if user wants

additional services, he/she needs to pay for it. In Subscription, users are charged a subscription fee in order to gain access to the service. In Bundling, multiple services are packed into together. In Disintermediation, services are delivered straight to consumers, passing traditional middlemen's. (Ovans 2015.)

However, in the mAgriculture application development, business model has usually been in a back burner and most of them are not currently user revenue driven, but rather dependent on donor funding. However, it has been emphasized that in order to scale-up, applications needs to be financially sustainable. Like one ICT4Ag conference participant, who had over 20 years of business experience, put it "This sounded like non-profit session. For me, business should be come first, technology second" (CTA 2014).

Sustainable business model is a key factor in successful applications and all the stakeholders working in the agriculture field, such as policy makers and NGOs should ensure that start-ups will develop those (CTA 2014). Developing the business model should be the starting point of the application development process and it should be included to all the aspects of the process, from technical matters to the marketing (OXFAM 2013).

Alexander Osterwalder and Yves Pigneur have created a tool to help entrepreneurs in the business model development process. This is the Business Model Canvas (see Appendix 2), where entrepreneurs could see all nine building blocks of the business model, from Key Partners to Revenue Streams, in a single page. Each of these nine components contains a set of hypothesis, which entrepreneurs should test. In the middle of the canvas is the Value Proposition block, which tells the problem that the company is trying to solve and what value they bring to customers. (Blank 2013.)

Most important part of the business model is to find a reliable revenue stream. It would also be useful to have multiple sources of income, in order to guarantee revenue stream, which is not depending on one source (OXFAM 2013). In addition to donors support, income could come from consulting, sponsorship or user fees (see Table 9) (Batchelor et al. 2014).

Many of the current applications collects revenue from multiple of these sources (Danes et al. 2014). Pricing of the application should be in adequate level compared to user´s ability and willingness to pay. Expected revenues should be enough to cover the operational cost of the services, to ensure its financial sustainability.

Table 9. Difference between various revenue models for the mAgriculture applications (Danes et al. 2014)

Revenue Model	Customer	Business Proposition
Subsidy	International donors, local governments	Public organizations subsidize particular costs to develop public goods
Fee for service	Farmers and farmer cooperatives	End-users pay direct for the access to information and services.
Franchise/Consulting	NGOs, agricultural purchasers, research organisations	Basic technology/platform distributed open-source, consulting services offered for pay
Sponsorship	Agricultural purchasers, input providers, local retailers, research organisations, MNOs	Organizations pay fees for advertising, data collection, increased market access, new mobile subscribers.

To archive high enough revenue level, target markets need to be large enough. One useful way, to archive larger user groups, is to bundle multiple services and data streams together into one main service. Also, it would be important to keep future demands in mind, when designing the business model, so that the model would be easily scalable in medium to long term. (OXFAM 2013.)

Certain other key factors, - besides the market size - which should keep on mind when developing the business model, can be pointed out also. They are; customers' willingness to pay, their education level, exact focus points and, most importantly, usefulness of the application (Danes et al. 2014). Generally speaking, it is easier to get people - who are already believing that those applications are relevant to them, have confidence that they can use them beneficially and have general interest towards them - as customers, than people with no previous knowledge on any ICT systems (Plechowski 2014).

6.2 Marketing aspects

Lack of marketing efforts could be regarded as one of the key reason for the low scale-up figures of the mAgriculture services. For instance, a study made by InfoDev in 2011 revealed that only a few of the mAgriculture start-ups were heavily focused on marketing their products (Omwansa et al. 2013). Marketing is crucial in the scale-up face, because potential customers' needs to be aware that certain application exist (Crandall and Kieti 2013).

Strong brand is one key part of a successful application, unfortunately only a few mAgriculture application has been able to develop a strong and well-known brand. Importance of brand has been seen for instance with M-Pesa service, which success is based to a strong brand, as well as to trust, consistent user-experience and to a right pricing model

(Omwansa et al. 2013). All of which are also important factors regarding a mAgriculture applications.

One useful marketing tool would be utilizing the experiences of the early customers, who have been happy with the application, in the marketing. They could recommend the service to their friends and relatives, based on the benefits it has bring to them. This could create a viral phenomenon and bring lots of new users for the application (Crandall and Kieti 2013). These early customers could then be somehow rewarded for this recommendation, for example giving them a free usage of the service for a certain period of time.

Other way to get new customers would be to partner with some other organisation, which then markets your product to their customers. By giving out vouchers or coupons, partner organisation could bring new customers to the mAgriculture service. These vouchers would also help to validate the source, where the customers came from. There how, the partners could be rightly compensated. However, efforts should be used to ensure that utilization of this type of model is as transparent as possible (Callan et al. 2014). Also the level of compensation, as well as other details in the partner contract, should be carefully planned.

As been mentioned already, Facebook and other social media platforms are already widely used among the rural population also. Therefore, Facebook is a vital marketing channel for reaching the potential customers. Users of Facebook tend already be technology oriented and have higher chance of owning a smartphone, so they fit well to the target user profile. Also, traditional marketing in the billboards and, for instance, in transport vehicles – for example in the Matatus vehicles in Kenya - could be beneficial as well. (Wyche et al. 2013.)

All the marketing efforts should be pre-planned and executed based on the plan. Planning should be made early enough and it should include ways which are the most relevant to the target group. Based on the plan, marketing campaign should be launched simultaneous of the application launch (OXFAM 2013). After the campaign, its effectivity should be assessed, in order to learn which marketing methods works well and how much it cost to acquire a one new customer.

6.3 Lean Start-up methodology

One assessment noted, that a development time - from concept to launch - for mobile application service in the developing markets, could be over five years. For example, it took M-Pesa five years to move from concept to nationally launched product. (Batchelor et al. 2014) In this fast changing world, five years development time can be regarded too long. To overcome this issue and get the service out to the hands of the users as soon as possible, the lean start-up methodologies should be used in the application development process. Lean start-up is concept presented by Eric Ries in his famous book “Lean Start-up”, in 2011 (Ries 2011).

Lean methodology assumes that every start-up is fundamentally an experiment, which is trying to answer to a certain question. Most of the entrepreneurs are building their product based on the “can this product be build” question. However, they should instead ask “can we build sustainable business around this set of products and services” and then fundamentally ask “should this product be build”. If answer to later questions is positive, it gives the manager a mandate to start acquiring early adapters and add resources in further experimentation and eventually start developing the product. Then, once the product is ready, it already has some customers and it had solved real problems and has clear specification on the features, which needs to be built to the final product. (Ries 2011.)

Main component of this methodology is Build-Measure-Learn-loop, which helps company to solve defined problems related to their product or services. First step is Build, where product is on tested on the market, secondly results of this test are Measured and finally in the Learn step, company needs to decide that will it continue with the same goals (“Persevere) or change some aspect of the strategy (Pivot). Beginning of this loop is so-called Minimum Viable Product, MVP, which has just the core features allowing it to be deployed. Utilization of MVP allows bringing the product into hands of the early adopters as soon as possible.

By working this way, start-ups can start learning about what customers really want and for what they are willing to pay for. In this process, called Validated Learning, it is crucial to have actioned metrics, which can show cause-and-effect of the certain action. Actioned

metrics could include number of users or time user spend with the application. Action, on the other hand, could be, as an example, a new feature. (Ries 2011.)

One useful tool to help in this process is split-test, or A/B-test, where users are divided randomly into two different groups. Users in one group has the new feature in their application and the users in the other group not. Then comparing usage patterns between these two groups, the value of the new feature can be noted. Meaning in practice that if the users in the group, which have the new feature, uses the application more, the new feature is valuable addition to the customers. (Ries 2011.)

Ries has said that start-ups operate "under conditions of extreme uncertainty", which could cause some start-ups to totally abandon all the management processes and adopt "just do it" approach. Lean Start-up methodologies try's to bring order into this chaos, by providing tools, which allows them to continuously test their vision. (Ries 2011.) This methodology, together with agile methodologies, are constantly being used by the start-ups in the develop markets, in order to develop their products, services and business models. These methods should also be used by the mAgriculture service developers, to find out the value creating features in their solutions, to which them focus on their development resources (Crandall and Kieti 2013.)

Using these methodologies in the mAgriculture application development processes, would allow to tackle the most profound issues in the development process; lack of understanding the customers, utilization of customer feedback and making developing process faster and more agile. Avoiding these issues would most probably affect in a positive way both to the quality of the application - meaning that they would answering better to customers' needs - and in the adaptation of these applications among the users, since services would be something what they would be willing to pay for.

To bring these learnings to the application development teams, trainings about Lean methodology should be arranged for them in regular basics. These training could be for instance combined to the funding, which is provided by various international organisations. In any case, it would be helpful to have coordination among training providers, so that the learnings form these trainings, such as the best practices, would spread widely.

6.4 Gamification

Gamification is a term, which refers to using game dynamics, such as competition with others, gaining points, gaining positive feedback and interactivity, to various non-game activities (Monu and Ralph 2014), with an aim to make those activities more enjoyable and rewarding to the user (Sandbrook et al. 2014). These achievements, points and badges, could then be shared in Facebook, to add sense of social accomplishment (Monu and Ralph 2014).

In the world where farming simulations, such as Facebooks Farmville and mobile game HayDay are among the most popular games, it would be relevant to evaluate on how some gamification elements could also be included to the applications aimed for real farmers. Game elements could possible make the application more attractive to users, especially to the young and there how make them generally more interested about farming as a viable career option. Here the question is just that how well farmers, who relay to farming as their income, would trust and take seriously advices from application that have gamification elements?

The term itself is rather young, only being widely used since late 2010. It became known to major audience after the success of scientific gamification project Foldit (Monu and Ralph 2014), developed in the University of Washington. Foldit aims to predict the structure of certain proteins, by using players as a workforce. It works so that players are given task of folding certain protein, with an aim to find out the most stables form of it, by trying out different forms. Knowing the exact form of the protein is key in understanding how it actually works and that way finding right drugs to deal with it. Finding the right structure has been regarded as one of the hardest things to do in biology currently, even with the help of supercomputers, since in some cases there are almost unlimited amount of different possibilities (Coren 2011).

Foldit utilizes people´s natural puzzle-solving ability and crowd sources player's findings. In autumn of 2011, players of Foldit solved the crystal structure of M-PMV (Monu and Ralph 2014), critical enzyme in the reproduction of AIDS virus, in a just three weeks. By the help of this, researchers were able to identify targets in the enzyme, which drugs could use in order to neutralize it. This created huge step in the HIV virus research, since researchers had been working to solve this structure since the 1980´s (Coren 2011). Foldit is

a great example of one of the game's best functions; allowing comparison of different strategies, in order to see which ones work and which won't, in easy and fast way.

Games relate to humans primary sources and causes of motivation; autonomy, mastery and purpose. When playing the games, people have different motivations towards it, such as competing, exploring, collecting, archiving and storytelling. Therefore, in order gamification application to succeed**,** it needs to appeal for the diverse motivations of the players. Options – such as archiving thought leader boards, exploration by discovering new skills, or only collecting badges – appeals to different people (Monu and Ralph 2014). Therefore, there is a need to find out, which elements are appealing to the farmers.

Similar terms to gamification are "serious gaming" and "purposeful gaming", which both refers to games, which are primarily designed for other than entertainment purposes. (Monu and Ralph 2014). These games are emerging trend among gaming industry and various types of them are being develop in order to make a contribution to addressing the real world problems (Sandbrook et al. 2014). So far, these games have been used in the educational context in the areas of health and safety, firefighting, aviation and law enforcement. However these types of games are less studied and under-theorized, so it is still unclear which elements are the most important regarding the user motivation (for example; trophies vs. progression) and how effective purposeful games actually are (Monu and Ralph 2014).

There are two main fields where gamification has been successfully used; marketing and education. In the marketing segment, they have been used to translate business objectives into desired customer and employee behaviours. This has been made by utilizing points systems to award the desired behaviour. It has also been used to create personal connection between the company and the customer (relationship marketing), as well as collecting data about customer habits.

In the educational sector, games potential is widely recognised. Games allow three important factors of learning 1. Generating opportunity for experimental learning, which is considered to be more effective than traditional learning. 2. Games allow repetitive play, which provides more learning opportunities to players. 3. Most importantly, they make learning experiences fun and enjoyable (Sandbrook et al. 2014). Some training system also use "practice, feedback, and guidance" loop, in order to facilitate user's skill improvement (Monu and Ralph 2014).

This could be a useful method also in the farmers training application, in a form of providing constant feedback on the actions and giving additional training, when needed.

6.4.1 Gamification in the agriculture context

Gamification, as well as serious gaming, have a potential to bring new innovative solutions into complex real world problems. They could also be used in activating citizen's participation and in the data collection, all of which are part of the concept known as "citizen science". In the side of bringing new solutions, gamification can be used as a tool for crowd-sourcing ideas, which is used in the previously mentioned Foldit and in the similar type of game called Fraxinus. In the data collection, gamification can generate a strong incentive for submitting data, helping to provide large amount of high quality data in a cost efficient way. (Sandbrook et al. 2014.)

Besides of those two examples, other important factor is that games can be used to test different actions and policies and their outcomes, in a safe environment, without a fear of real life consequences. This could help to find the most adequate solution to the real problems. Practical application of this model is planning the allocation of scarce resources, in the most beneficial way, among different stakeholders. Though, this works only in the conditions which can be modelled in a relatively certain way and even so results will always have some sort of uncertainty among them. There might always be a sudden natural or man-made phenomenon, which might make the plan unsuitable. Also, if the conditions are modelled wrong or there are important factors missing, outcome of the model might be even damaging in the real world (Sandbrook et al. 2014). Therefore, a lot of emphasis should be put into modelling all the possible variables as well as possible. Games also tend to feed the players "I won't give up" attitude, meaning that players are seeing that the answer is near and won´t stop trying to find it, although they have failed many times before, which is clearly a useful attitude also in a real life agriculture.

As a downside, use of gamification can lead to oversimplifying the actual problems and distract users form the real world. They can also cause people to think, that they have actually made some positive changes to the real world (Sandbrook et al. 2014). Latter one could specially be the case with the sustainable farming practise simulations, proposed in the

chapter 7.2.2.Therefore, there must be emphases in the game, that there is still the actual farming work to be done, after the simulation has help in the planning and designing phase.

Overall, it is important that organisations working in the agriculture sector understand the gaming world and the game industry. Applications and games for these purposes should be develop together with the game design experts, have a clear focus-group on the mind and most of all, be fun to play. Also, when looking at the successful serious games, can be noted that most of them have only one goal, rather than general aims (Sandbrook et al. 2014). By having understanding of this phenomena, these organisations could be able to see what types of solutions game industry might be able to provide to them, related to issues, with which they are dealing. This might also open some innovative approaches for dealing with the complex problems, which we currently face in agriculture. Following two practical examples covers usage of gamification in this context.

6.4.2 Farm Defenders game

This is a farm simulation game, which covers farming in the Africa. Players starts the game with a simple farm and then grow it step by step, based on the success in the game. Player needs to select right crops, plant them in the right time, store them and finally market them. Player will also learn about the soil, how to heal it and how to fight against pest and diseases. Game uses actual soil, climate, botanical, and ecological data and each farm environment has been modelled to reflect the real world conditions. There is also option to share experience and form cooperatives, associations and trading partnership with the other players, generating various benefits to players. Game view can be seen in Figure 17. (Farm Defenders 2012.)

Game is mainly targeted for people who want to pursue careers in the economic development sector and people who like challenging strategy simulations. The game aims to show conditions of how some one billion of the world's poorest persons are making their living from the subsistence agriculture. It also aims to show the weak business environment, where small hold farmers are operating daily. Game development was supported financially by INSEAD, the Bill and Melinda Gates Foundation and ICON Group International Inc. (Farm Defenders 2012.)

Figure 17. Game view from Farm Defenders game (Farm Defenders 2012)

6.4.3 The Basin Challenge

This is a simulation game taking place in a fictional river basin area. Game aims to give everybody a chance to participate in the river basin development. Player is given a 3 billion dollar budget and a 50 years' timeline to develop the area. Player can choose various actions, such as building a hydropower plant or developing various agriculture and livestock activities in the surrounding areas. Game also mimics random natural events, such as floods or droughts, and other real life scenarios, such as corruption or increase of taxes. Game can be played in a single or in a multiplayer mode. Results of the actions taken by the player will be visualised, including both the short and the long term effects to water, energy, food, population and environment. (Matthews 2014.)

Data, which game uses, is drawn from scientific research, but it takes certain liberties, and it is not meant to be as accurate as traditional model would be. Game has shown to be good learning tool and it has been utilized in various conferences, such as in the Stockholm World Water Week, and in teaching of undergraduates in the Kings College London. Game has bring up a lot of dialog, when showcased in the conferences, around the topics of food security, rural poverty and sustainable management of natural resources. Therefore, it is a useful tool in showcasing the complex interconnectivity between water, food, energy and environment, since it visualizes the effects, which are caused by actions in one function, to the other areas. (Matthews 2014.)

6.4.4 Conclusion table of the gamification factors

Figure 18 covers the elements in the gamification chapter and how they relate to the mAgriculture case. The first layer is the theory base of gamification and serious games, which explains the benefits of using gamification in training applications. Then are the mAgriculture related examples, although they are meant for slight different users, they seem to work well in this agriculture teaching and training context. Top layer is the mAgriculture case itself, where possibilities of using gamification in mAgriculture services is pondered.

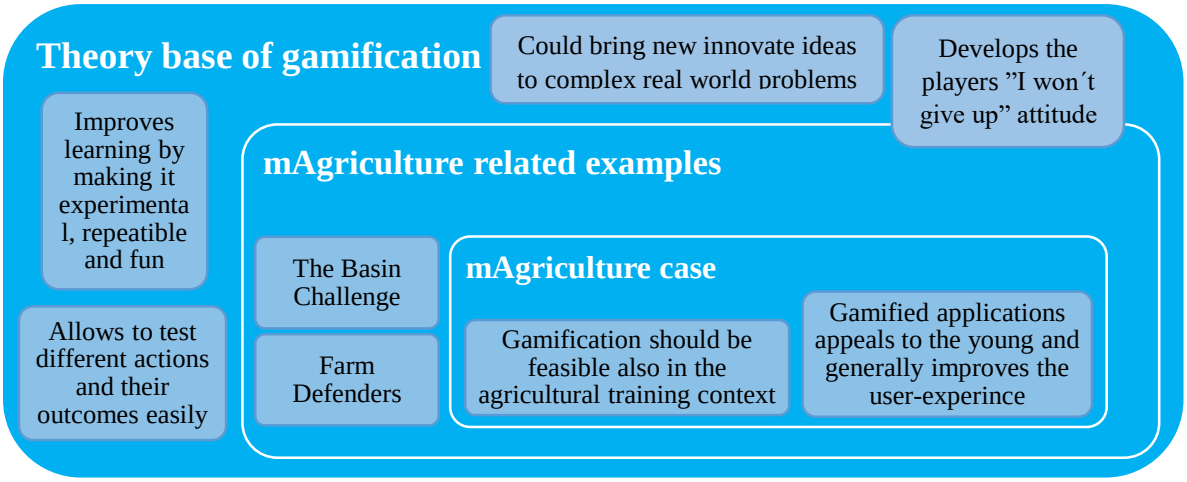


Figure 18. Conclusion figure of the gamification elements

6.5. Conclusion table for the development tools of the ideal application

Figure 19 sums up the tools, which were covered in the previous chapter, and their role as a development tools for ideal mAgriculture application.

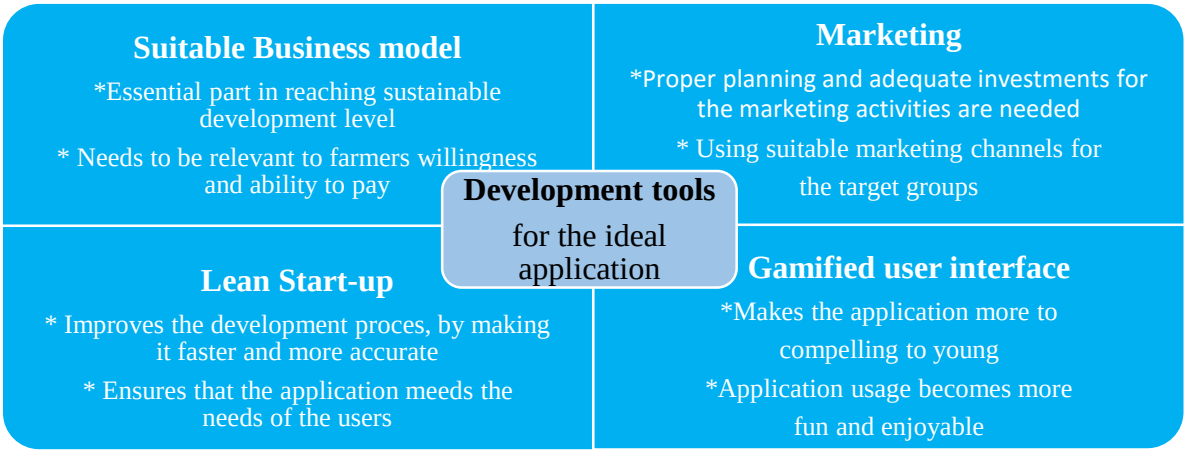


Figure 19. Conclusion figure of the development tools for the ideal application

7. RECOMMENDATIONS

What kind of application would then be the one, which would most likely succeed? There is no absolute blue print available, which could be used in the mAgriculture development. However, based on the research material, some key points should be keep in mind when developing the applications. First of all, their development should be based on bottom-up model and be "tailor made", in order to truly fit to the local conditions. (CTA 2014; OXFAM 2013.)

More effort should be made into understanding the potential customers and their needs, since lack of it has been named as one of the biggest challenges in the application and sustainable business model development. For instance, it is still rare to see mAgriculture developers spending time regularly in the fields of their customers, to see the actual operating conditions and the way how customers are actually using the service. Therefore, users and their needs should be put in the focus of the application development. However, this action should not only limit to the development phase, but should rather be a constant policy of customer feedback and piloting result utilization when developing the application through its whole life span. (Omwansa et al. 2013.)

Information, which is provided through these applications, should be timely, relevant and accurate (CTA 2014), since modern agriculture is knowledge intensive in all the stages, from utilization of naturel resources to market information. Therefore, applications should also provide services and information on wide range of matters; soils, seeds, weather and various financial services (such as insurances, microfinance) (Namisiko and Aballo 2013). As well as marketing, processing and logistic related services (CTA 2014; Danes et al. 2014; IICD 2013). Thought, it would be wise to start with simply and focused service and then expand its features, once it has become a trusted service among its users (OXFAM 2013).

Thought, it should be more important to focus on the content, than on the technical details, some guidelines can be set to technical matters too (CTA 2014). Applications should be built on open source platforms, which are widely supported among the ICT community. Also, these applications should be flexible enough to adapt to different user needs, since there is not usually a single solution to certain problem (OXFAM 2013). They should also be easily scalable (Awuor et al. 2013).

Most importantly, applications should be designed to be user-friendly (Danes et al. 2014) and the user-experience should be consistent over different development versions and in different devices, to SMS to mobile applications to web applications. Utilization of this user-centric development model would also create chance for higher user acceptance for the service. To help start-ups to better understand the local conditions, talented developers and other team members should be acquired from the target country to the development team, which would help to bring knowledge and understanding of local conditions to the application. (Omwansa et al. 2013.)

It is challenging to reach financially sustainable situation with mAgriculture applications. One estimation is that in order to reach that, application should have a user base of 150 000 users. To reach this number, application should integrate multiple services among agriculture supply chain and there how being appealing for large group of farmers and other stakeholders (Awuor et al. 2013; Danes et al. 2014). Also, pricing of the application should be relevant to customers' ability to pay and their cash flow, meaning charging the user when they are having the income (Omwansa et al. 2013). Based on the earning figures from the other mAgriculture services and M-Pesa, it could be estimated that a monthly revenue per user could be as high as 0,5 - 1 €, if the service is clearly benefitting the farmers and therefore they are willing to pay for it.

Before selecting the target group for mAgriculture service, market segmentation exercise should be done, in order to identify the target groups' different characteristic, such as language, gender, culture and – most importantly - their ability and willingness to pay (Danes et al. 2014; OXFAM 2013). It would be wise to focus on those farmers, who have already selected agriculture as their livelihood and are more likely to apply ICT in their farming activities (Plechowski 2014). Also, role of diverse early adopters and other role models, in bringing new customers to the application, should be emphasized (IICD 2013).

Overall, mAgriculture services should empower farmers to increase their performance, in both efficiency and knowledge sense (Danes et al. 2014). It would be especially important to design applications in such ways that they would empower young role in the agriculture (IICD 2013), by for instance supporting their networking and information exchange (AYF and CTA 2014).

mAgriculture applications have a huge potential in reaching large group of farmers at a relatively low cost. It would also help rural people to access relevant information and do trade, by allowing them to communicate with the outside world (OXFAM 2013).

Based on the points presented in this thesis, a set of recommendations - divided into following two main category - were made;

1. Tips to improve currently existing services.

2. Topics for four new services.

7.1 Existing services

As was mentioned during the interviews, in many scientific papers and in other sources, the essential issue among farmers is finding where to sell, when and in which price and on what quality products should be. The existing mAgriculture services are mainly covering this topic, so there is not necessarily a need for other similar services. Therefore, a focus should be on helping them to improve their current services and allow them to share their learning points and market data. Therefore, this chapter is dedicated to the tips, which were formed during the thesis process and which seem relevant and a useful in their cases.

This section is divided into three main categories, each with a different focus-group in the mind. The aim is to provide answer to some of those issues, which were raised in the chapters 5.3, 5.4 and 5.5, which presented issues faced by the mAgriculture services from three different viewpoints; service related, companies' internal issues and external factors. Therefore, first part is meant for ideas related improving currently running services. Second part is meant for improving processes and activities of companies who are currently, or planning to start, designing, developing or operating mAgriculture services. Third part covers ideas which deal with some of the issues regarding external stakeholders. They could be utilized by the application developers, as well as other mAgriculture stakeholders, such as NGOs, private sector and governmental agencies.

These presented ideas are not trying to solve all the mentioned issues, since some of them are clearly out of the hands of the application developers and other stakeholders, as well as out of topic of this thesis. Some of them were also already answered in the previous chapter 6. Also, these ideas are rather compressed, so there is a need for develop them further.

7.1.1 Improving existing services

This part covers ideas, which are meant for improving currently running mAgriculture services.

7.1.1.1 Data visualization

Often the data in these applications is poorly presented. Therefore, more effort should be used to improve the ways which data is shown and visualized. As a solution, application developers should take advance on the latest development in the data visualization field. Improving the data visualization will make the user-experience better and increase the chance that users will be able to receive and understand the information. Especially using graphs, figures and pictures while presenting various processes or actions is helpful for the users (CTA 2014).

7.1.1.2 Clear menus

In few cases, - especially with USSD based systems, but also among some of the mobile applications - the data menus turns out to be too complicated for the normal user. They are not able to find the information which they are looking for or find additional information. As a solution, more effort should be made to make them more simple and logical. This could be done by observing users, while they are looking for information from the service, and figuring out usage patterns, to which base the menu layout design of the application.

7.1.1.3 Dynamic search engine

This means developing a search engine function, which selects search results based on the recommendations given by other users. These suggestions are selected among the information, which farmers nearby, farmers crowing the same crops or set of crops have

accessed or which has been accessed on the same time period. Information, which have been pinpointed as useful by the other farmers, is given the priority in the list of suggestions. This would tackle the issue of finding the most relevant information, with which farmers are commonly struggling. After the results are presented, there should be an option, which would give user a chance to evaluate the usefulness of the results. Based on this review, the information in question would be re-organised in the list of recommended information.

7.1.1.4 Utilization of test groups

In many cases the local farmers are not fully understanding the information, which is provided to them through these mAgriculture services. Therefore, it would be useful to have a test groups - consisting of diverse group of local farmers - which would test all the content, which is provided by the application. To make sure that this method works, it would be important to select diverse test group - representing both old and young, female and male, less educated and more educated and technologically oriented and not technologically oriented farmers. If it turns out that test group is not fully understanding the information, adequate modifications should be made on how the information is presented, in order to make sure that it would be understood by the users.

7.1.1.5 Utilization of experienced users

Agriculture professionals or even locals, which have suitable experience on the certain farming related activity, could be employed as a persons, who will visit the application users, who are not able to solve certain issues by using only the application and could be helped by having additional assistance from the persons, who have already solved similar issues. This system could be set-up by using a database, which has list of persons based on their location and their agriculture experience. Then the system would select the best candidate for each situation. Each visit would be reviewed by the customer, to the system, in order to ensure that these workers are trustworthy and skilful enough to solve those issues. Adequate service fee would then be charged from the customer or additionally some organisation would subsidize these cost.

7.1.1.6 Agriculture input identification tool

To tackle the issue of providing information and advices, which are suitable for the individual farmer, tool, which identifies the various agriculture inputs which farmers have in hand, could be developed. At first, the application would ask the farmer, that which tools,

seeds, skills and physical conditions (such as rivers, wells, trees) are in his/her possession or in his/her land. Based on those answer, the application could give more accurate suggestions on the methods and processed, which would be easily and successfully used in that case. To help this function to work, agriculture information in the databases should be sorted into a form, where needed tools and skills, in the each state of the process, are easily found out.

This service could be expanded to cover users need to find out where to get certain inputs. It could work so, that the user tells what she/he is looking for and then the application would give ideas of were to get that service, knowledge or product. These sources could be other applications, government services, private services, NGOs, neighbours and communities. In some cases, the application might show up a demand for something that is not yet available, generating a business opportunity for service or product which would fill this gap.

7.1.2 Improving processes of the mAgriculture service developers

This part is meant for ideas regarding improving processes and activities of companies who are currently - or are planning to start - designing, developing or operating mAgriculture services.

7.1.2.1 Using stories in the marketing

Role of stories in the marketing has been emphasized a lot lately. There is no reason why these stories could not be used in advertising mAgriculture applications as well. In this case, farmers - who were struggling before, but after using this service were able to increase their earnings and that way were able to invested in their agriculture business and improve their life by schooling their children, using healthcare services and acquire various products - could be used as marketing examples. However, great emphasized should be set in making sure that these stories do not create false expectations by overpromising potential benefits.

7.1.2.2 Field visits

Lack of understanding the potential customers, has been named as one of the key problems among mAgriculture start-ups. Therefore, these application developers should frequently visit diverse group of farmers in to their fields and find out which types of information they

really need from those services, when and in which form. Some type of "standard" should be develop to achieve a maximum outcome of these visits. These visit should not limit only to the development phase, but they should continue also when the application has been launched, in order to find how the application has been adopted in use among the farmers and to find out if there is something to be corrected in the service.

7.1.2.3 Emphasizing user's feedback mechanism

All the m-agriculture services should include an option for users to give feedback about the application. This could be easily achieved with the smartphone applications, but could also be done in some levels with the SMS or USSD based services as well. By collecting constant feedback from the users, developers can quickly see if there is a feature which is missing, which should be modified, or even removed. Feedback mechanism being constant - not limiting only to the development phase - also allows better connection to the user.

7.1.2.4 Forming board of advisors

It could be useful for mAgriculture service companies to have a board of advisors, which could advice the company on various matters and actions. It should consist on diverse range of experts from the areas of agriculture, mobile technology, business and international development. In this way, company would get wider picture on the matters related to their operations and would keep up with the latest trends in those areas.

7.1.3 Tips for external stakeholders

This section is meant for ideas regarding the other stakeholders in the mAgriculture scene, such as international organisations, NGO´s, education and research institutions, MNOs and device manufactures.

7.1.3.1 Arranging teaching about marketing methods for the developers

Lack of marketing skills has been named as one important issue among the mAgriculture developers. Therefore, there could be demand for intensive a few week long crash-courses on marketing, which would teach developer teams about relevant marketing tactics and

methods on how to reach the target farmers in the most efficient way. Short, but intensive courses would not take too much of time from the development work and various online tools could be utilized in the follow-up phase, without a need to travel to meet the teachers.

7.1.3.2 Standards for the type of the data

General standards, on how data from agricultural research, agricultural markets and climate models are entered in various data systems and how it is withdrawn from those to the applications, should be agreed on. This is crucial in establishing a common data system, which would allow collecting of agriculture information from all the available sources into one database. It would also make the application developers work easier, by having only one type of data, with which work on.

7.1.3.3 Improving cooperation with the actors in the mobile industry

Once the manufacturers and other stakeholders are looking for markets, which are not fully developed yet, they should look to the BoP markets, where the future market potential is the highest. They could develop models, where certain mobile applications would be included to their phones as a stock and use that as a marketing aid. These applications could cover topic such as agriculture, health, education and finance. Device makers would compensate certain fixed sum to the application developers and users could then use these applications for free. This would provide benefits to all the parties; to customers, to developers and to device makers. Customers would benefit by having a free service for a certain period of time, developers by having a wider user base and fixed revenue from the device makers, which would benefit by having a competitive edge and larger sales of their products. This model has been previously used, for instance, by Nokia, which had Life Tools application package pre-installed into most of their mobile phones sold in the developing markets.

7.1.3.4 Database for usage logs

This information would include the data about the amount of users, how often and long they use the service, which parts are used the most and when (by season, month or day), how they feel about the service and is there parts which should be improved in the application. This database should contain user information from as many various mobile services as possible. Developers could be persuaded to provide their own data to the database, by providing them an open access to the whole database. This access to data would work as incentive, because other ways companies might be reluctant to give out this information, since having

monopoly to the data generates a competitive advantage to them. To kick things of, various publicly funded projects should start this by trend by given their data to this database

Availability of this data would allow higher development rate of both the future and the current applications, since there would not be a need to start collecting the information from the scratch, since you could already get access to it in the beginning of the development. It has been proved that companies who take advantage of this usage data, are the ones succeeding the best and providing the top quality service. If the access to database is not encouraging enough, these companies or projects could also be financially compensated by this provision, to cover the cost of potential loss of profit and also to make incentive for information providers.

7.1.4 Conclusion figure of the improving tips

Figure 20 will summarize the tips presented in the previous 7.1.1 – 7.1.3 chapters.

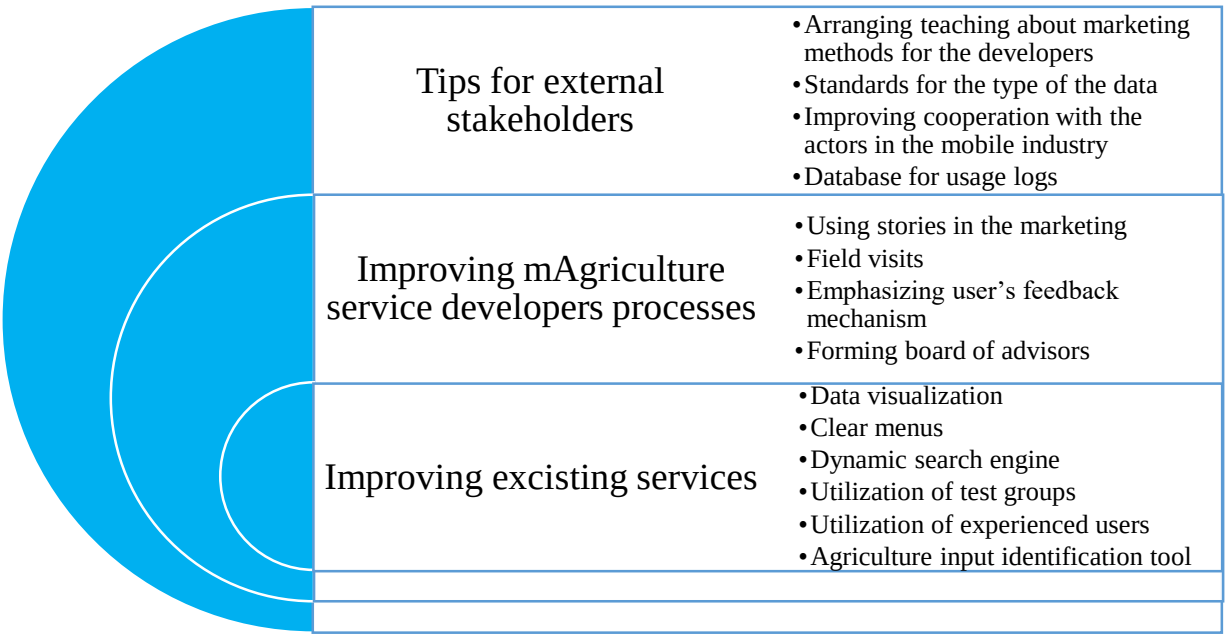


Figure 20. Conclusion figure of the improvement tips

7.2. New services

This chapter covers four new mAgriculture service ideas, which – based on the source material and interviews – could have demand in the Kenyan market, as well as elsewhere in the developing markets. All of these ideas should be develop by keeping in mind the issues presented in the chapter 6, as well as some of the ideas presented in the previous 7.1 chapter. Especial focus should be put on utilizing Lean start-up methodology - in order to make sure that service meets the needs of the farmers and make the application development process faster - as well as use of Gamification - to improve the user-experience and make the application compelling to youth. Also, they should include build-in monitoring and evaluation systems, to ensure and measure the positive impact to the user's livelihood (OXFAM 2013). Close cooperation with various national and international organisations would also be crucial during the application development and scale-up phases.

These presented ideas are just drafts, so they should be further studied and developed. This could be done, for example, utilizing Business Concept Statement (see Appendix 3), to refine the ideas further, based on the selected business model, target audience and available resources. Also, there is a need to conduct a survey among the farmers, which are selected as the target group, in order to find out which service types are the ones with the highest demand. Exploration was the strategy used in defining these new service ideas. In this strategy, lack of formal services - or poor level of them - in certain fields, creates a business opportunities to start-ups, which are generally eager to identify new opportunities for value creation, both for them, as well as to their customers and partners (Jain 2014).

New application ideas have the following themes;

1. Entrepreneurship training in the agriculture field.
2. Sustainable agriculture practice, such as agroforestry, permaculture and Climate Smart Agriculture, training
3. Long term planning tool, which breaks users goals into small steps and keep track on the progress, allowing farmers to have long term vision in their agriculture activities.
4. Following tool, through which emerging farmers can virtually follow more experienced and successful farmers, allowing them to learn and inspire from their example.

As been mentioned many times before in this thesis, business model is an important factor in the mAgriculture application success. Therefore, with each of the presented application idea, there is also two suitable business models presented, with reasoning why they would be suitable in that case, their advantages and limitations, as well as list of things which developers should focus on when utilizing that model. Based on the examples of the similar services, estimated income per user could be as high as 0,5 – 1€ per month, if the farmers are benefiting from those services and therefore willing to pay for them.

Youth have been the focus-group of this thesis work and these presented ideas also have been developed that user group in the mind. However, there is no profound reason why these ideas could not work with other users as well. When defining even more detailed market audience for these application ideas, it could be wise to focus on the growth oriented farmers, for instance to Telephone farmers - meaning those who live on cities, but still practice agriculture elsewhere.

Focusing on this group would make sense both in the financial and user motivation terms, since they, generally speaking, have more disposable income, as well as having higher interest towards improving their agriculture activities. Also, since lack of growth among small hold farmers have been named as one of the lacking sides in the agriculture sector in the Africa, supporting the growth oriented farmers - by providing them a services, which are tailored to their needs - would also support the whole agriculture sector development in Africa. Helping small hold farmers to grow their farm size, to form mid-size farms, might provide one solution to some of the issues faced by the agriculture sector in Africa. These farmer also tend to focus on agriculture as business, by developing their agriculture operations and investing to their farms (Leenstra 2014).

This applies especially to the entrepreneurship training service case, since the entrepreneurial skills would be crucial in archiving the growth in the agriculture sector and also in the following tool case, thought which young could get advices and inspiration, to develop their own farms, from the more experienced farmers. Therefore, they would be a good customer base for these mAgriculture services and would be able to pay for those as well. These services should also have connection to various financial services, such as banking, insurances and loans, since they clearly bring benefits to farmers and are essential in allowing them to develop their agriculture business.

Revenue flow, acquired from the customers representing these groups, would potentially help support the service scale-up and further development, allowing moving to other customers segments later on, while having existing income source to relay on.

7.2.1 Entrepreneurial training application

As was raised in the interviews and discussions, as well as in many of the source material, there is a need to see farming as entrepreneurial based activity, instead of something that people just end up doing or which is considered just a part of the broader livelihood strategy. However, there is clear lack of entrepreneurial focused trainings, which are available to the rural farmers. Therefore, there could be a demand for the application, which would provide specialize entrepreneurial training for farmer's need. Here is presented one example of how this kind of application would look and work. Also, current status of the entrepreneurship training in Kenya is covered.

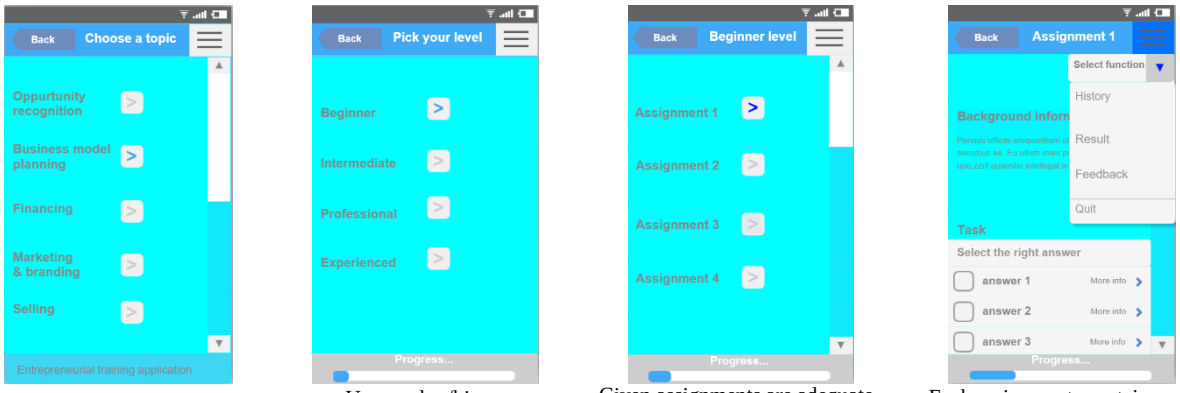
7.2.1.1 Entrepreneurial training in the agriculture sector currently

Traditional source of agricultural entrepreneurship training have been different agricultural colleges, as well as trainings organised by various NGOs and other international organisations. One example of those is United Nations Environmental Program, UNEP, Youth Entrepreneurship Development Training in Kenya. This training operates under Kenya National Youth Development and Training Programme. It focuses on training practical farm management skills and supporting youth in unlocking their potential. The ultimate aim is to transform youth form job seekers to job creators. (UNDP in Kenya 2015.)

Other example of such organisations is Agribusiness Incubator Trust, AgBIT, which is working in Zambia. This agribusiness incubator organisation is focused on accelerating the growth of scalable enterprises in the agriculture sector. Part of their activities is to organise special two week long boot camps, where participants can learn, for example, how to generate a prober business model, how to start a business, how to finance it and how to sell and market your products. (AgBIT 2015.)

7.2.1.2 Application

The application would be based on the various training sets, which give farmers practical information of the topic in question and then some assignments to be done. These assignments would be graded and also other constant feedback would be given, such as which areas should be improved, based on the user's progression. In Figure 21, the reader can see an example of how this type of the application would look like.



User select the topic which she/he wants to practice

User set her/his experience level

Given assignments are adequate for users experience level

Each assignments contains a small introduction and a task

Figure 21. Application view on the entrepreneurial training tool

Table 10 covers the business model options for this entrepreneurial training application case.

Table 10. Business model options for the entrepreneurial training service application

Model	Reason	Advantages	Limitations	Focus points
Paid (User pays for the whole use).	User clearly benefits from the use of the service, by learning valuable entrepreneurial skills	Developers have certain source of revenue. Users are more commitment to use the service, since they pay for it.	Might limit the amount of users. Keeping the user interested over long period of use is a challenging.	Level of the fees? One time purchase or subscription model? How to manage the payments? Free trial period?
Freemium (Some functions are free, others are paid).	Users might not be willing to pay for all the functions, so some are provided for free.	Users gets the most of the content for free Increases the user base.	How to ensure revenue stream for the developers?	Which functions are free, which paid? Level of the fees?

7.2.2 Sustainable farming practice training applications

In the age of climate change and scarce and declining agricultural resources, such as soil and water, the need of more sustainable farming techniques is ever more actual. However, they are currently almost non-existent among the mAgriculture services. Therefore, there is a need for new services filling that gap. In this chapter, Agroforestry, Climate Smart Agriculture and Permaculture are shortly covered and short description of a suitable application for each of the case is presented. In the case of Agroforestry, more detailed description and layout view is provided to show how that kind of application could look like.

In these cases, link to the existing digital market places would be important part of the application. Through the platform users could sell their crops and other farm products and that way overcome the issue of not been able to fully benefit on their yields, which was raised in the interviews as one of the major obstacles when utilizing these practices. Videos could also be used as a way to provide information about sustainable farming practices on different topics and in different contexts of location, climate type, soil condition, income level and crop selection. They have been noted to be useful and relevant way to teach farmers about new agriculture practices.

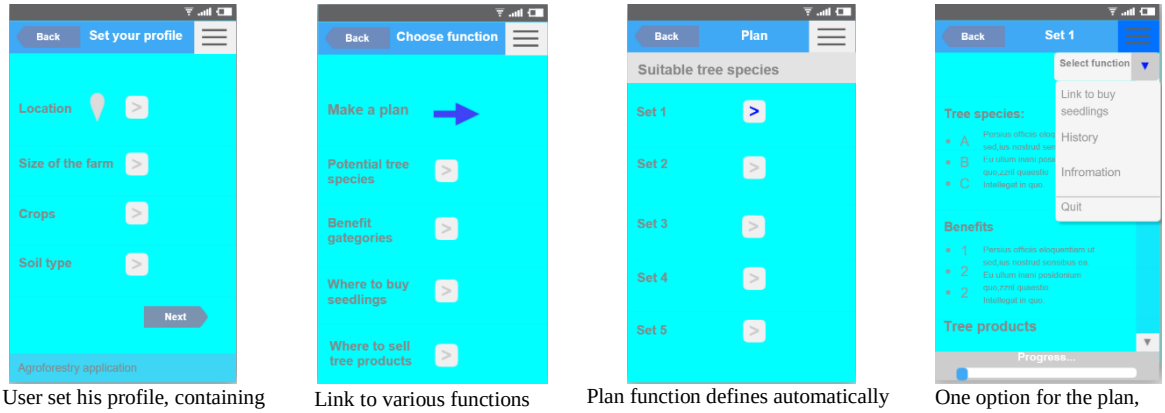
7.2.2.1 Agroforestry

Term Agroforestry means land-use systems, where woody perennials and crops are deliberately used in the same plot of land. Agroforestry type of agriculture has been practices around the world in a past few thousands of years, though it has been largely displaced by the modern agriculture, at least in the developed countries. However, during the last few decades, it has resurfaced and currently is been practiced by more than 1,2 billion people globally. Trees provide variety economic and environmental benefits to the land user, such as fertilizing, soil protection, fruit, fodder, fuel wood or even edible gum. (FAO 2013.)

There are over 50 different ways on how agroforestry systems can be applied to the land. These include shade systems (crops planted under the trees canopies), alley cropping (trees are planted in a rows) and boundary systems (trees work as living fence). Base of selecting the right system and three species, are needs of the farmer and the local conditions, such as soil type, climate and native species. (FAO 2013.)

7.2.2.2 Application

There is currently no application, which would provide information about agroforestry systems and the benefits which they provide. However, agroforestry system have the potential to improve many aspects in the current agriculture systems. Therefore, there could be a demand for applications which would tell farmers, in a simply and understandable way, how trees would help them in their own case. These topics could include; which trees to plant and where, where to get the seedlings, how to manage them, which benefit they would bring to the farmers and where to sell the tree products, such as fruit, charcoal or edible gum. The application could also be used to visualize the benefits which the trees provide over the long run, to help farmers to make the decision to invest on the seedlings. In this visualization part, utilization of gamification elements (see chapter 6.4) could be useful. In Figure 22, the reader can see an example of how it would look like.



User set his profile, containing a basic information of the farm

Link to various functions of the application

Plan function defines automatically the suitable tree species, based on location and criteria set by the user

One option for the plan, containing information about the selected species

Figure 10. Application view on the Agroforestry planning tool

7.2.2.3 Permaculture

Permaculture can be defined as “Consciously designed landscapes, which mimics the patterns and relationships found in the nature, while yielding an abundance of food, fibre and energy for provision of local need”. Term originated from 1970´s, form two Australians David Holmgren and his student Bill Mollison. Fundamentally it is a design philosophy, which aims to mimic patterns and relationships found in the nature, to the agriculture. The basic principles remains always the same, but strategies and techniques used to apply these depends hugely in location, climate conditions and available resources. Science foundation of Permaculture lies in modern science of ecology, in the branch of systems ecology.

There is 12 main principles, as presented on Figure 23, on which the Permaculture thinking is based on. (Holmgren 2013).

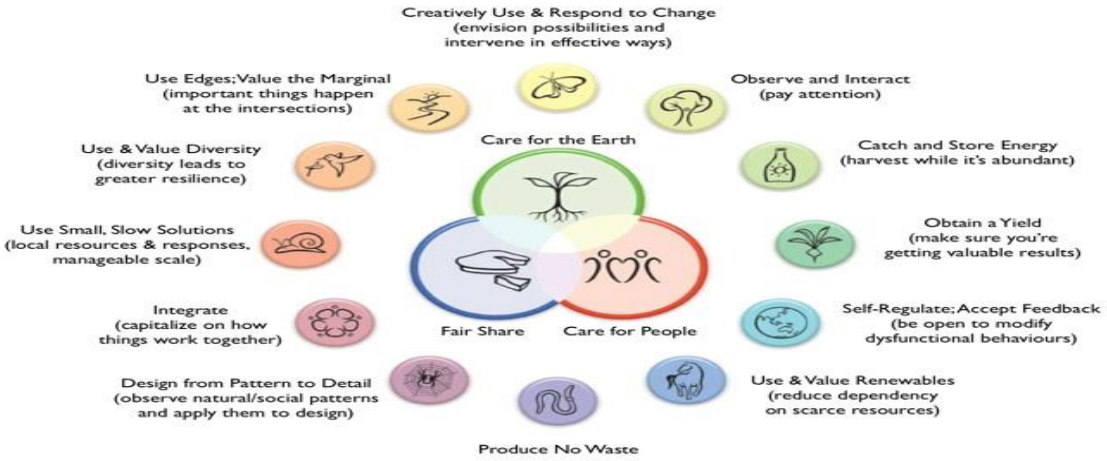


Figure 23. Permaculture design principles (All Ireland Permaculture Gathering 2015)

7.2.2.4 Application

There could also be a demand for the application, which would provide a simply tool to help farmers to use Permaculture principles into their lands. Permaculture is a complex design system, requiring a deep knowledge, which is traditional acquired by participating in a few months long design course. However, these courses are often out of reach of a rural farmers, since they are either too expensive, arranged in distant locations or limited with the amount of participants. Therefore, the application would be a good method to bring these learnings to a great number of farmers, in a cost-effectively and rapid way. Complexity of these design principles brings various challenges to the application development teams, but with help of experts, in the both from the Permaculture and mobile technology side, these issues should be able to overcome. Also, having a testing period among the rural farmers, would ensure the applicability of these principles through the use of mobile applications.

7.2.2.5 Climate Smart Agriculture

Climate Smart Agriculture, CSA, is an approach, which aims to increase productivity and income of small hold crop and livestock farmers, fisheries and forestry activities, in a holistic and effectively way. It was launched by FAO in 2010, as a conference background paper. It has three objectives; "1. Sustainably increasing agricultural productivity, to support equitable increases in farm incomes, food security and development;

2. Adapting and building resilience of agricultural and food security systems to climate change at multiple levels; and 3. Reducing greenhouse gas emissions from agriculture (including crops, livestock and fisheries)". Different elements of CSA are used, depending on the local context. CSA relates to actions both on-farm and beyond the farm, for example in the ecosystems and landscapes. (CCAFS and UNFAO 2014.)

7.2.2.6 Application

The application could share to the farmers local context related advices on how to mitigate the effects of the climate change in their lands. These methods should be simple and easy to be applied by the farmers. However, the whole CSA concept is under development, so there are not necessary complete set of tools and techniques available for the certain location, so there would be constant need to update the material, area in which mobile applications work well.

Table 11 covers the business model options for these three previous mentioned applications. In this case the business model could also be based on third party subsidy, since many organisations are aiming to change the agriculture sector into more sustainable form, so it would make sense to them to support the development of applications, which would educate and motivate farmers into using sustainable agriculture practices.

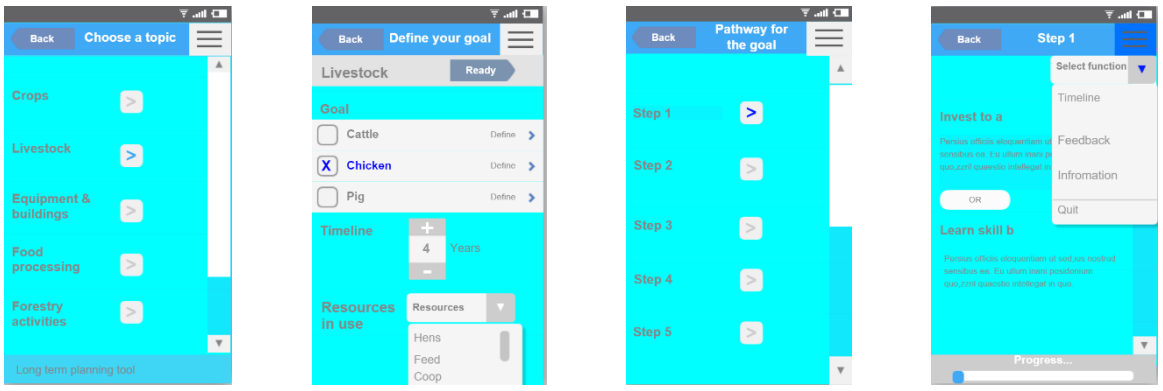
Table 11. Business model options for the sustainable agriculture training service applications

Model	Reason	Advantages	Limitations	Things to focus
Subsidy (Third party organisation pays the use, in behalf of the farmers).	Various organisations are looking for solutions, which would bind farmers into use of sustainable practices.	Free service for the users. Increased amount of farmers practicing sustainable agriculture. Developers have certain revenue stream.	Will the organisations be interested of supporting the service? Making sure that users are commitment to the use the service.	Finding suitable organisations to partner with Contract type? Payment type (per user or overall payment?)
Market place linkage (Application have link to virtual trading floor and takes a certain per cent of the farmer's sale).	There is a need for farmers to sell their crops and other products, to which providing a link to virtual market place could help to archive.	Easy way to collect revenues for the developers Users have ready link to sell their crops, which benefits them Market place operator gets more users.	Developer's income depends on the sale revenue of the farmers. Will the market place operators be willing to share the revenues?	Finding a suitable digital market place Which percentage to take from the deal?

7.2.3 Long term planning tool application

Farmers generally lack tools which could help them in their long term planning. Therefore, they are stuck with the loop of not having enough resources to manage the farm properly, caused by lack of investment to farming, caused by uncertainties related to landownership, future developments and lack of credit. To help solve this issue, system - which would allow the farmer to envision where she/he would want to be in the 5, 10 or 20 years and how she/he could reach to that goal - should be developed.

This application would allow farmers to set various goals related to which crops to grow, which animals to have, which equipment and buildings to acquire, developing of possible side businesses, processing of farm products and forestry activities. The application would then give development paths on how the user could archive those goals. They would be based on the research and datasets about available resources, market demand, aid and development programs and other training courses. By combining research and these datasets, the application would give suggestions on which skills and knowledge acquire and which tools, equipment and inputs to purchase. It could also calculate the cost and pay-back time for those investments. It should also keep track on farmer's progress and give constant feedback on the farmer's actions, in order to keep the farmers motivated on archiving the final goal. However, it should be noted that there is always certain level of uncertainty associated with the long term planning, related to unexpected events, which might bring issues to the development and to the users. Figure 24 presents the application view of long term planning tool.



User selects the category of the goal

User defines the goal in a more detailed way

Application will divide the goal into simple steps

Each step contains a certain options for the user

Figure 11. Application view on the long term planning tool

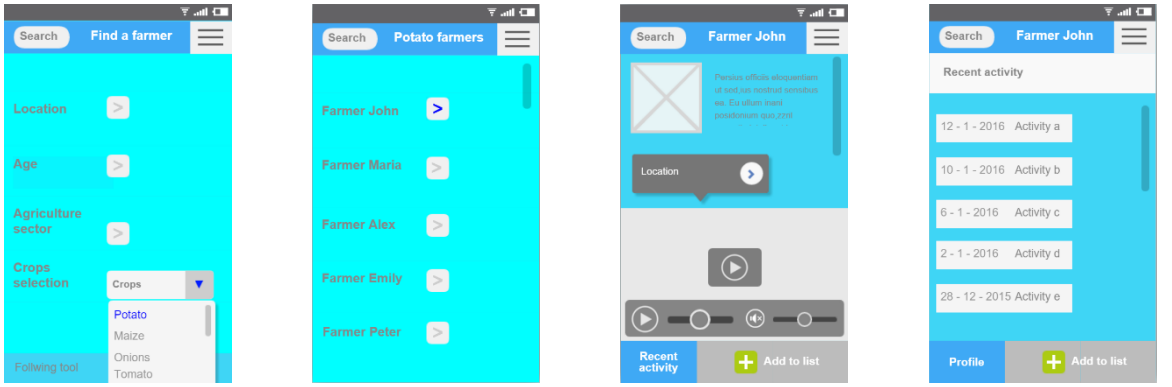
Table 12 will present the business model options for the long term planning tool. In this case, this service could be part of other service, such as training or financial service, since they could benefit from their users for having this long-term focus, which this tool would help them to develop. In this case, these service partners could share their revenues between them.

Table 12. Business model options for the long term planning tool application

Model	Reason	Advantages	Limitations	Things to focus
Bundling (Tool is a part of other service).	Service suits to be a part of other service, such as agriculture training, since it fulfils their service.	More users for the service. Partnership benefits both services.	Will the other services bee interested to co-operate? How to keep customers over long-term period?	Finding a suitable service provider, which to cooperate with partner. Revenue sharing contract.
Freemium (Some functions are free, others are paid).	User might not be willing to pay for all the functions, so some are provided for free.	Users gets most of the content for free. Increases the user base.	How to ensure revenue stream for the developers?	Which functions are free, which paid? Level of the fees?

7.2.4 Following tool application

This tool would allow emerging farmers to see how more experienced and successful farmers are running and developing their farming operations. It could help aspiring farmers to see that farming can be successful business and learn a useful information about agriculture and business from the peer farmer. There would be an option to choose the right farmer as a person to follow, based on the location, crop selection and other agriculture practices. With this case, the issue could be how to acquire those farmers, who are the ones to be followed, so it would be needed to find out how to motivate people to share their experiences. This service could be named as farmers Instagram. Figure 25 presents the application view of the following tool.



User set criteria for the "role model"

Farmers, which fills the set criteria

Basic information of the selected farmer and video of his/hers agriculture

Farmer's latest agriculture activities are presented here

Figure 12. Application view on the following tool

Table 13 will present the business model options for the following application.

Table 13. Business model options for the following application

Model	Reasoning	Advantages	Limitations	Things to focus
Advertisement (Free for user, income comes from the advertisers).	Service would be suitable for advertisers, since it would be a good way to reach farmers.	Free for users Increases the user base. Developers have certain revenue source.	Reliance on the advertisers. Is there enough interested advertisers? Risk of conflict of interest between advertiser and developers.	How to get the advertisements? How to present the advertisements in the application? Level of the advertisement fees?
Freemium (Some functions are free, while others are paid).	Basic functions should be free, since there is not clear direct benefit, but some features, such as direct messaging to other users or access to training, could be paid.	Users gets most of the content for free. Increases the user base.	Is there enough functions, which would be interesting enough for the user to pay for?	Which functions are free, which paid? Level of the fees?

8. CONCLUSIONS

Overall it can be said that there is a great demand for the mAgriculture applications, but because of reasons, most of which were covered in this thesis, they have not managed to spread as widely as their potential. Hopefully the ideas and other topics presented in this thesis will help in the up-take of future mAgriculture services. New service ideas, which were presented earlier, will hopefully someday see daylight in one form or another. To end this thesis, a list of action is included as a path to follow, when moving into execution phase of these new service ideas.

1. Form connections to different actors working in the relevant fields, both in Kenya and internationally.
2. Study the market demand in a more detailed way, by using for example Service Statement Concept, and select the most promising idea or a set of ideas.
3. Form a diverse team, who is able to execute the idea as well as possible.
4. Spend time and effort to develop proper business model and modify it if necessary.
5. Connect to other mobile service providers and form strategic partnerships, pay special focus on the financial services and virtual trading floor operators.
6. Apply for funding, from various grants, NGOs and private sector actors, for the piloting phase.
7. Develop a Minimum Viable Product and test it in market, based on the Lean start-up Build-Measure-Learn loop, to make sure that is something that the users want.
8. Make sure that the application is user-friendly and even fun to use.
9. Develop a marketing strategy for the service, with a focus on the story telling based marketing and utilize social media and peer-recommendation.
10. Full launch of the service.

Answer - based on studied sources and the findings of this thesis - to the question presented in the thesis title is clearly positive; mAgriculture services can provide one solution to the quest of sustainable agriculture practices. However, most of the currently existing - agriculture information, market information and virtual market place - services are struggling to scale-up, so there is a need to improve their operations - for instance using tools and tips presented in the chapters 6 and 7.1 - to fully unleash their potential.

Also, in order to fulfil all the three aspects of the sustainability (environmental, economic and social), information and training provided by these services need to be more sustainable and entrepreneurial focused, since these fields would be essential in helping farmers to improve their agriculture activities and ultimately their lives. Therefore, there is a need for services providing training and information about sustainable agriculture practices (see 7.2.2) and entrepreneurial training (see 7.2.1). Aspiring farmers need also a role models (social aspect), who could provide an example of farmers who have built successful agriculture activities. To this factor, the following tool (see 7.2.4) aims to bring an answer. Finally, all of these aspects need a long term focus in order to be fully adopted, issue to which the long term planning tool (see 7.2.3) is aiming to provide one solution.

Ideas for future research topics

Besides further research on the topics of adaptation of mAgriculture services among small hold farmers, issues faced during development of these services and the actual impacts of these services to improving farmer's livelihood, as well as ideas presented in the previous chapter, following topics should also be further studied. Further research findings would hopefully help increasing the popularity of these services among the farmers.

Research on mobile service business models

Lack of knowledge regarding business models, which could work in the mobile services in the developing markets, can be regarded as a one of the main issues in the mAgriculture service popularity, as well as in the whole ICT4D service sector. Therefore, additional research is crucially needed in this field.

Research on how farmers plan their future

There seemed to be lack of research on the topic of how farmers plan their future activities, both in the side of farming, as well as expanding or transforming to other areas in the agriculture sector, such to tradesmen's or breeders. Therefore, research is needed to find out how farmers plan their future activities, which are important factors in that decision making process and how that process could be supported. Having a long term view is crucial especially when adapting sustainable farming practices.

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APPENDIX

Appendix I: Interview questions

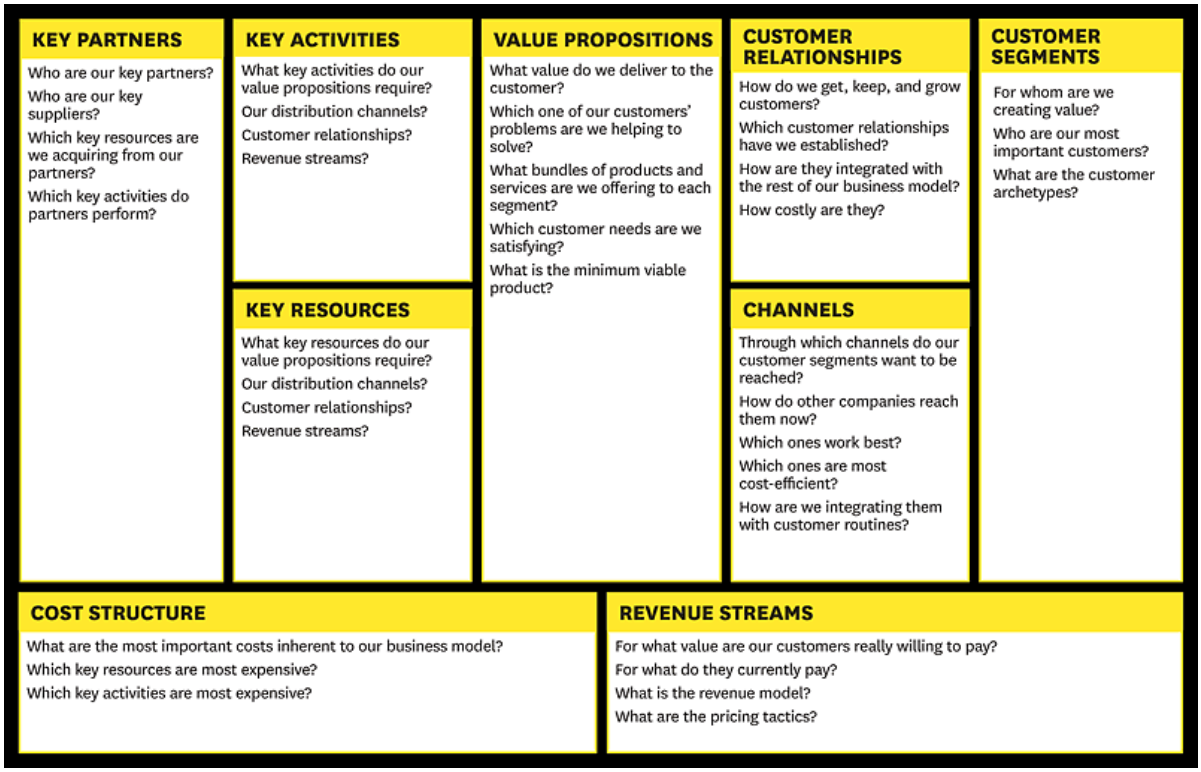
Interview 1;

- What three topics would be most important, when talking about problems that small scale farmer's face?
- How you would solve them?
- What topics you see as an issue, when considering spreading of an agroforestry models to farmers?
- How people could be reached in most efficient way?
- What you see as a bottle neck in bringing research result to practice?
- What is your opinion about carbon credits?
- Does farmers know about these, would they value those over their farm products?
- What you see as a bottle neck in bringing research result to practice?
- What is your experience of professional mobile apps or software's? (How would you improve them?)
- What do you think, how farmers would react to them?
- Issues related to long term planning among farmers?
- What three steps world leaders should do today?

Interview 2;

- Which are the most essential factors, which affect to farmers life negatively?
- Challenges in spreading the agricultural information to farmers?
- Role of market information to farmers?
- Issues related to logistics, transportation and storage?
- Issues in supply chain?
- Who else to talk to?

Appendix II: Business Model Canvas (Blank 2013)



Appendix III: Business Concept Statement (Janeczko 2013)

1. A brief description of the **Business Concept**

2. The **Market Need**. What is the void in the marketplace that your business idea is going to fill? There's something that's missing, something you believe the market needs. There is an opportunity for a new idea.

3. The **Solution**: how your business idea is going to solve a marketplace problem and why you are the person to make it happen.

4. The **Business Model**, which is how you are going to make money. Are you going to charge your customers a subscription or membership fee? Will you charge a set fee for a given service or charge by the hour? Will you sell a product outright? Will you sell ongoing and/or maintenance contracts? Or will your business bring in revenue using a combination of these approaches?

5. Why anyone should buy your product instead of buying something else? When you can answer that, you have your **Value Proposition**. Explain what's new about your idea. Which unique attributes will your business bring to the table: customer service, technology, a special process, better taste, lower price, faster delivery, or a combination of things?

6. To really be sure that your new business will fill a market need, you must consider the **Competition**. Ask yourself who else is providing products or services that could meet your potential customers' needs. Keep in mind how big your competitors are in terms of annual revenue; estimate, if you have to. This can give you an indication of both the market size and market potential.

7. **Marketing** your idea will be critical for success. How will you spread the word about your new business?