

ASHESI UNIVERSITY COLLEGE

EVALUATION OF THE ROLE MOBILE-PHONE AGRICULTURAL SOLUTIONS
PLAY IN THE EMERGENCE OF A KNOWLEDGE SOCIETY IN THE GHANAIAN
AGRICULTURAL SECTOR

BY

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Declaration Page

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

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Date: **22nd April, 2014**

I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of applied projects laid down by Ashesi University College.

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Abstract

In today's world, the notion that knowledge has become the most vital resource in the transformational growth of societies is one that is pervasive. The significance of knowledge in modern societies has been overemphasized by several international bodies; most notable the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the World Bank.

Ghana's desire to craft an economy where knowledge and information would play a significant role is visible on paper in The Ghana ICT for Accelerated Development (ICT4AD) policy document. But, in order for Ghana to achieve its ICT4AD objective of transforming its society into a knowledge economy, it is imperative that it analyzes how effective existing ICT agricultural solutions are in the emergence of an agricultural knowledge economy.

This research seeks to evaluate the role mobile-based agricultural solutions play in the emergence of a knowledge economy in the Ghanaian agricultural sector. It further aims to point out areas where this mobile-based solutions fall short, and also provide ideas on how this gap could be bridged.

Key Concepts: Knowledge Society, Agriculture, ICT, Mobile Phone

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Chapter I – Introduction

1.1 Background

The role knowledge has played in the “evolution” of human society is one that cannot be missed by peeking at humanities past. An example of this is clearly seen in how the knowledge of agriculture culminated in the Neolithic Revolution which evolved humanity from hunters-gatherers to settlement communities (Doren, 1992).

The absence of a well-defined means of transmitting knowledge among other reasons resulted in the Neolithic Revolution taking several millennia before permeating the whole of humanity. Although agriculture was practiced by the occupants of Mesopotamia between 9000 – 7000 BC, parts of the world such as Australia were deprived of this knowledge until 1000 AD (Boren, 1976).

Observing Ghana's agricultural history, one would notice that knowledge has played an influential role in shaping it. Up until the nineteenth century cocoa cultivation was barely known to natives of the Gold Coast. Tetteh Quarshie – a native of Osu in the former Gold Coast – introduced the cultivation of cocoa to present day Ghana after his return from a voyage to Fernando Po, Sao Tome in 1879. As local farmers such as Nana John Kwame Ayew began cultivating this crop, its popularity spread and has since been a significant contributor to Ghana's economy (Ghana Cocoa Board, 2013).

In today’s world, the notion that knowledge has become the most vital resource in the growth of societies is one that is pervasive. The significance of knowledge in modern societies has been overemphasized

by several international bodies; most notable the United Nations Educational, Scientific and Cultural Organization (UNESCO) (UNESCO, 2005) and the World Bank (The World Bank, 1998).

The relevance of ICT in this new economy is one that cannot be overstated. ICT serves as the medium through which knowledge is created, manipulated and used (Britz, Lor, Coetzee, & Bester, 2006). Also, ICT brings to the table a revolutionary means of delivering information which can be reached simultaneously and also can be shared in real-time without time and space barriers (Britz, Lor, Coetzee, & Bester, 2006).

Ghana's desire to craft an economy where knowledge and information would play a significant role is visible on paper in the Ghana ICT for Accelerated Development (ICT4AD) policy document. The policy's objective is to "*engineer an ICT-led socio-economic development process with the potential to transform Ghana into a middle income, information-rich, knowledge-based and technology driven economy*" (Ministry of Communications, 2004).

As a result of both the current and historic significance of agriculture to Ghana's economy, the ICT4AD policy report gives much consideration to how ICT can be relevant in tackling problems in Ghana's agricultural sector. The ICT4AD objective for the agricultural sector in Ghana is to "...*facilitate the modernization of the agricultural sector through the deployment and exploitation of ICTs to improve on its efficiency and productivity*" (Ministry of Communications, 2004).

As of September 2013, mobile phone penetration in Ghana stood at 105.9% [8]. This impressive penetration of mobile telecommunications

has made communication reachable to a wide range of persons. The implication of this success is that people in the rural parts of Ghana who were previously incommunicado now have access to mobile telephone.

Ghana's desire to modernize its Agricultural sector juxtaposed with the success of mobile telecommunications in Ghana has resulted in ICT solutions in Agriculture which is taking advantage of mobile telecommunications. Most of these solutions rely on Short Message Service and Voice Services. Some examples of these solutions include Esoko, Farmline, CocoaLink etc.

In Ghana, Esoko have emerged as one of the most popular. Esoko is a private business, focused on changing the way markets work through innovative mobile solutions. Esoko provides a platform where smallholder farmers can sign up to receive a package of weekly advisory services. This typically consists of current market prices, bids and offers, weather forecasts, and news and tips (Esoko, 2013).

1.2 Problem Statement

In order for Ghana to achieve its ICT4AD desire of transforming its society into a knowledge economy, it is imperative that it analyzes how effective existing ICT agricultural solutions are in the emergence of an agricultural knowledge economy.

Currently, a multiplicity of mobile solutions for agriculture exists in Ghana. Although most of these solutions have permeated the Ghanaian agricultural industry and also received positive media acclamation, little research has been done to evaluate the role they play in steering Ghana's agricultural sector towards a knowledge driven economy.

This research seeks to evaluate the role mobile-based solutions play in the emergence of a knowledge economy in the Ghanaian agricultural sector. It further aims to point out areas where this mobile-based solutions fall short, and also provide ideas on how this gap could be bridged.

1.3 Objectives

This thesis seeks to achieve the following:

- a) Evaluate the relevance of existing mobile-based agricultural solutions in the emergence of a knowledge economy in the Ghanaian agricultural sector.
- b) Identify gaps in the existing mobile-based solution which hinders the emergence of a knowledge economy in the Ghanaian agricultural sector.
- c) Proffer suggestions as to how these gaps could be bridged.

1.4 Theoretical Framework

Central to the understanding of this thesis is the idea of the Knowledge-Based Economy. Knowledge-Based Economy, Knowledge Economy and Knowledge Society are used interchangeably in the literature to describe the post-industrial economy.

The term Knowledge Economy was first coined by Peter Drucker, in his 1969 book, *"The Age of Discontinuity"*. In an article which he authored in 2001 titled *"The Next Society"*, Drucker describes the knowledge society as a society in which knowledge would be its key resource, and knowledge workers will be the dominant group in its workforce (The Economist, 2001). He projected that this knowledge economy would be characterized by:

- “Borderlessness” because knowledge travels even more effortlessly than money.
- Upward mobility available to everyone through easily acquired formal education.
- Potential for failure as well as success because of the ease with which anyone can acquire the “means of production”.

It could be inferred from Peter Drucker’s projections that the key to the new economy – Knowledge Economy – would be facilitated by:

- Information and Communication Technologies
- Education and Information
- Innovation

1.5 Research Question

With Ghana’s desire to craft a knowledge economy around their agricultural sector put alongside existing mobile based solution to Ghana’s agricultural problems, it is imperative to critically examine the role these solutions play in the emergence of a knowledge economy. My research attempts to find an answer to the question R:

R = "What role do existing mobile-based solutions in the Ghanaian agricultural sector play in the formation of a knowledge economy in the said sector?"

1.6 Hypothesis

It is hypothesized that mobile-based ICT solutions contribute to the emergence of an agricultural knowledge economy.

Chapter II – Literature Review

2.1 Knowledge Society versus Network Society

The notion of the Global Economy shifting towards one that is primarily based on knowledge is one that has stirred controversy amongst various scholars. Scholars such as Manuel Castells have put forward counter argument to claims made by scholars such as Peter Drucker who was of the opinion that a society in which knowledge would be its key resource, and knowledge workers will be the dominant group in its workforce is emerging (The Economist, 2001).

Manuel Castells argues that the transformation the world is experiencing is one that was birthed in the 1970's with the popularity of computers. He argues that this transformation is structural in nature and is multi-dimensional and one that is associated with the emergence of Information and Communication Technologies (Castells, 2005).

Castells disagrees with the notion of an emerging Knowledge Society or Information Society, but rather explains what we are experiencing as the rise of the Network Society. He buttresses his claim by saying that knowledge and information has always played a pivotal role in historical societies. He claims that the real change in society today is its microelectronics-base and networking technologies that provide new capabilities to an old form of social organizations (Castells, 2005).

Castells argues that in this new society – Network Society – wealth, power, and knowledge generation are largely dependent on the ability to organize society to reap the benefits of the new technological systems, rooted in microelectronics, computing, and digital communication. He

conceptualized the Network society as the social structure resulting from the interaction between the new technological paradigm and social organization at large (Castells, 2005).

Castells defines the Network Society simply as "*... a social structure based on networks operated by information and communication technologies based in microelectronics and digital computer networks that generate, process, and distribute information on the basis of the knowledge accumulated in the nodes of the networks*" (Castells, 2005).

UNESCO defines Knowledge Societies as societies in which people have the capabilities not just to acquire information but also to transform it into knowledge and understanding, which empowers them to enhance their livelihoods and contribute to the social and economic development of their societies (Souter, 2010).

In UNESCO reports, claims as to how the information revolution is transforming social organization has been made. UNESCO reports indicate that with the proliferation of Information Communication Technology forms of organization have been created that no longer conform to the logic of spatial centrality and the poles of conventional decision-making. Traditional vertical hierarchies are giving way to burgeoning horizontal relationships, often transcending social and national frontiers (UNESCO, 2005).

UNESCO's understanding of a Knowledge Society marries both the Peter Drucker's idea of a Knowledge Economy with and Manuel Castells' idea of a Network Society. UNESCO takes into account the role Information Communication Technology play in the creation of networks that

disseminate knowledge at the same time acknowledging the increasingly important status knowledge has attained in our world today as a result of the seemingly ease at which it can be obtained. For the purpose of clarity, from this point on, this thesis would make use of the term Knowledge Societies as it encompasses both ideas of a Network Society and a Knowledge Economy.

2.2 Types of Knowledge

Knowledge important in this new economy, according to Lundvall could be characterized into four categories know-what, know-why, know-how and know-who (Lundvall, 2003).

- **Know-what:** refers to knowledge about "facts". How many people live in Accra, what are the ingredients in groundnut soup, and when the Ashanti war took place are examples of this kind of knowledge. Here, knowledge is close to what is normally called information – it can be broken down into bits and communicated as data (Lundvall, 2003). With the explosion of the internet and the sophistication and advancement of search engines such as Google, Bing etc. it is increasingly easy to come across such facts.
- **Know-why:** refers to knowledge about principles and laws in nature, in the human mind and in society. This kind of knowledge has been extremely important for technological and scientific development. Access to this kind of knowledge will often make advances in technology rapid (Lundvall, 2003). Traditionally this knowledge was only available to those who were in schools but with the arrival of networks and platforms that provide online course materials and guidance such as MIT Open Courseware, Coursera

and edX it has become increasingly easy for people who are connected to the internet to acquire scientific and technological knowledge that covers several fields of study.

- **Know-how:** refers to skills – i.e. the ability to do something. It may be related to the skills of artisans and production workers, but, actually, it plays a key role in all important economic activities. The businessman judging the market prospects for an agricultural produce or the personnel manager selecting and training farmers exercise their know-how (Lundvall, 2003). Just as with know-why knowledge, the emergence of online courses has made it increasingly easy to acquire know-how skills. Websites such as Investopedia provide access to economic and investment skills that were previously only accessible through formal educational institutions.
- **Know-who:** involves information about who knows what and who knows what to do. But it also involves the social ability to cooperate and communicate with different kinds of people and experts (Lundvall, 2003). The advent of sophisticated computer networks and social media has significantly increased our “know-who” knowledge. With social media our social network – i.e. who we know – transcends the boundaries of distance and physical presence. For example, the social media platform Webicina gives people the ability to create professional networks. A medical doctor in Accra-Ghana can exchange information with a Cardiologist in Johannesburg-South Africa regardless of whether they know each other personally.

Lundvall categorization of knowledge provides a useful model which could be adopted in this research to analyze the role mobile-based agricultural solutions play in the emergence of a knowledge society – i.e. providing stakeholders with relevant information.

2.3 Human Capital and Innovation

Moving forward with the idea of Knowledge Societies raises the important issue of human capital. Since humans play a pivotal role in the creation of knowledge it is imperative that there be a linkage between the Knowledge Society and Human capital.

Britz, Lor, Coetzee, & Bester in their paper *Africa as a Knowledge Society: A Reality Check* argue that the most valuable asset of the Knowledge Society is its intellectual capital. These scholars further argue that for a Knowledge Society to emerge, education and the investment in human capital are fundamental. Britz et al. make a valid claim about knowledge workers in a Knowledge Society having the ability to innovate and make discoveries (Britz, Lor, Coetzee, & Bester, 2006).

This research, would also seek to find out the critical human capital aspects that should be invested in, so as to maximize the value – economic, social and environmental – mobile telephony contributes to the Ghanaian agricultural sector.

2.4 Learning Societies

Closely related to the Knowledge and Network Society is the Learning Society. In Chapter Three of the UNESCO's World Report "*Towards Knowledge Societies*" a learning society is described as a society in which the old limits on where and when organized knowledge could be acquired

- inside educational institutions or immediately after initial training – no longer apply (UNESCO, 2005).

The term learning society was first coined by Robert M. Hutchins who argued that the education systems were no longer capable of responding to the needs made on them (Smith, 2000). With this realization he claimed that it was now necessary for people to take advantage of their free time to learn and fill the void of the educational system. With the ease at which knowledge could be accessed through Information Communication Technology it is has become relatively easier for people to come take control of their education and fill the gaps formal institutions are not taking care of.

The theory of Learning Society is one that key to my research. It raises the question, what role do mobile-based technology play in the fostering of learning societies. In this thesis, I intend to explore how mobile-based technology creates a culture of innovation in the Ghanaian Agricultural industry.

2.5 Agriculture in Ghana

Similar to most African economies, Agriculture contributes a significant portion to the Ghanaian economy. In Ghana the Agricultural sector is the smallest contributor to GDP. Agriculture contributes just 22.7% to the total GDP of Ghana while the industry and service sector contribute 27.3% and 50% respectively as shown in the pie chart below – figure 1[15].

Ghana's GDP Contributors by Sectors

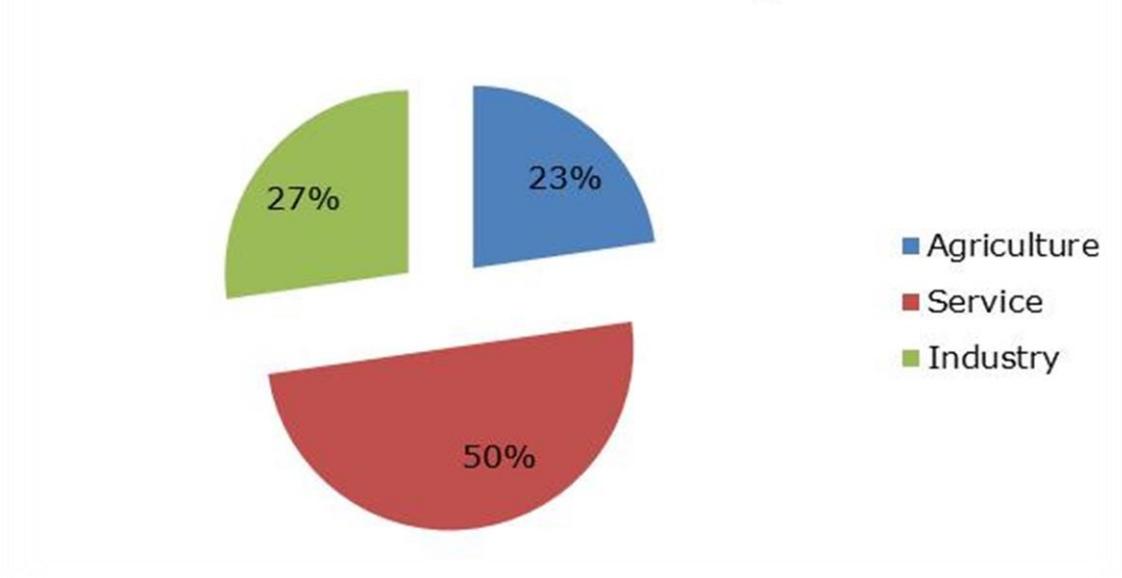


Figure 2.1: Pie Chart of Ghana's GDP Contributors by Sector

The Agricultural sector in Ghana is the second largest employer in Ghana. Of the 25.91 million Ghanaians, the agricultural sector employs 42% of the entire population (Ministry of Food and Agriculture, 2012). The potential for improved growth and productivity in the agricultural sector is evident considering the fact that the agricultural sector in Ghana employs a huge chunk of the populace but only represents 22.7% of GDP. The pie chart below – figure 2 – shows Ghana's share of population workforce by sector

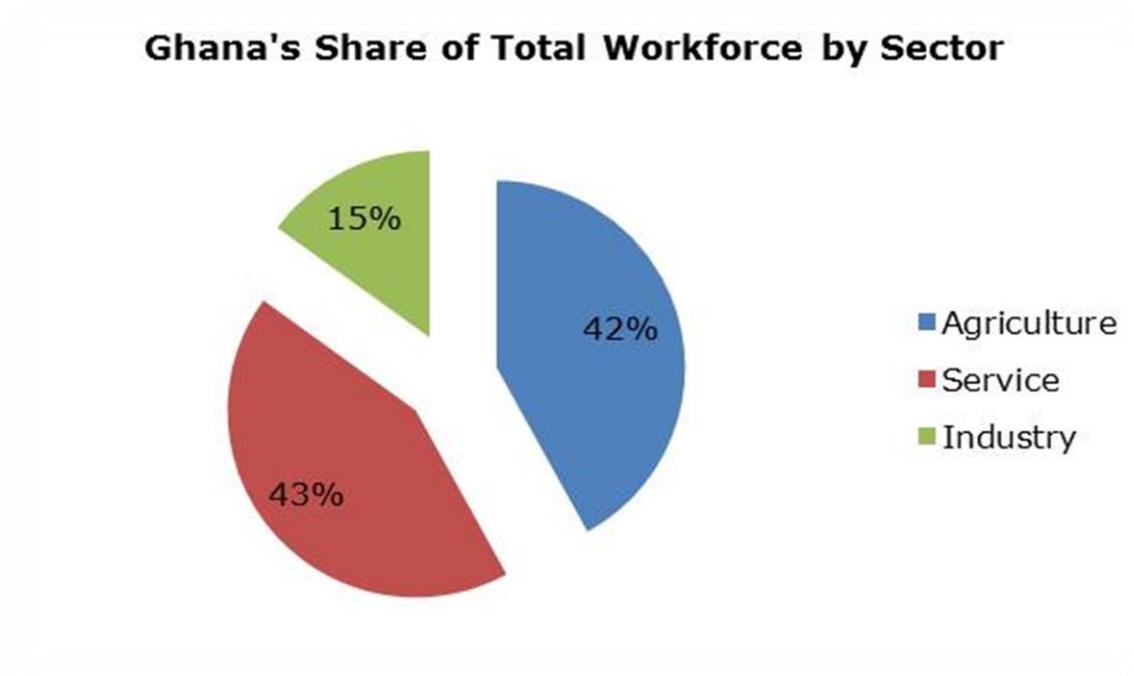


Figure 2.2: Pie Chart of Ghana's Share of Total Workforce by Sector

In Ghana, the Agricultural sector is subdivided into cocoa crops, non-cocoa crops, livestock, forestry & logging and fishing. As of 2012, the cocoa crop subsector constituted 13.3%, non-cocoa crop 61.3%, livestock 7.5%, forestry and logging 11.1% and fishing 6.9% all of agricultural GDP[16]. This statistics are represented in a pie chart below – figure 3. Altogether, the crop subsector contributes – cocoa inclusive – 74.6% to total Ghana’s agricultural GDP. This research would focus on crop agriculture, because it constitutes three-quarters of Ghana’s agricultural sector.

Ghana's Agricultural GDP (%) by Sub-sector

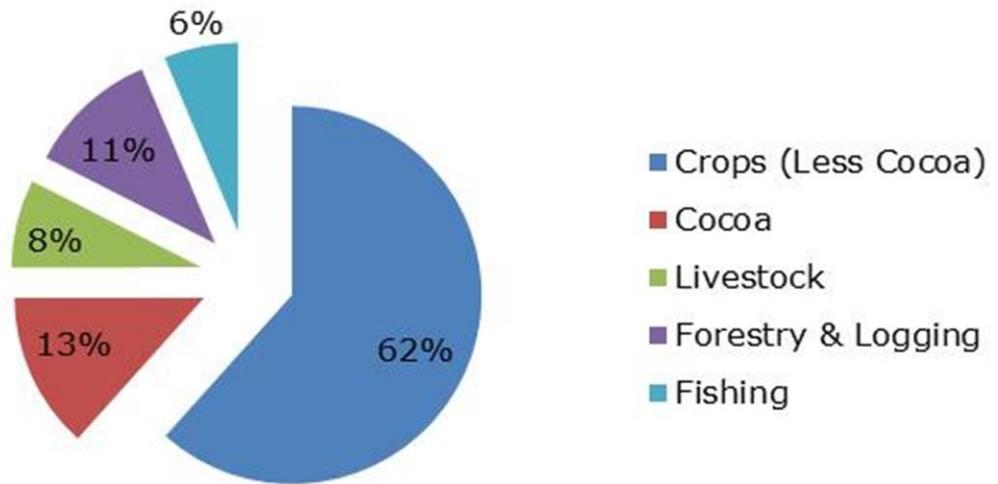


Figure 2.3: Pie Chart of Ghana's Agricultural GDP (%) by Sub-sector

2.6 Knowledge and ICT in Ghana's Agricultural Sector

As highlighted in the introduction of this paper it is evident that knowledge and information has played a pivotal role in Agriculture (The World Bank, 2011). Knowledge such as the most effective planting strategy in particular areas, where farm inputs can be bought, how land titles can be acquired, prices people are willing to pay for produce at different markets are central to agricultural decision making.

Agricultural extension is the function of providing need and demand-based knowledge in agronomic techniques and skills to rural communities in a systematic, participatory manner, with the objective of improving their production, income, and – by implication – quality of life. Extension is essentially education and it aims to bring about positive behavioral changes among farmers (Syngenta Foundation, n.d.).

Historically, agricultural extension services have been bestowed with the responsibility of providing farmers in Ghana with the relevant knowledge, information and skills needed to keep productivity at its uttermost. Agricultural extensions in Ghana have also been responsible for the deployment of new technology useful to farmers (Ministry of Food and Agriculture, 2011).

In recent times, the role of agricultural extension have been weakened due to varied and heavy loads of extension staff, low or non-adoption of new agricultural technologies by farmers, poor farmer access to other resources (credit, land, market etc.) and lack of access to and relevant training by both service providers and farmers (Ministry of Food and Agriculture, 2011).

The proliferation of Information Communication Technology has led to a new way of disseminating information that would have otherwise been disseminated by Agricultural extension services. Before proceeding any further it is necessary that Information Communication Technology be defined. Information Communication Technology is any device, tool, or application that permits the exchange or collection of data through interaction or transmission. ICT is an umbrella term that includes anything ranging from radio to satellite imagery to mobile phones or electronic money transfers (The World Bank, 2011).

2.7 Mobile Phones

A mobile phone is an electronic telecommunications device also referred to as a cellular phone or cellphone. Mobile phones connect to a wireless communications network through radio wave or satellite transmissions.

Most mobile phones provide voice communications, Short Message Service (SMS), Multimedia Message Service (MMS), and newer phones may also provide internet services such as web browsing and e-mail (Webopedia, 2014).

Innovations in the mobile phone industry have drastically driven down the cost of handset thus making them readily available in global markets. Problem solvers in the agricultural sector have taken advantage of this phenomenon and are designing a multiplicity of mobile-based agricultural solutions (The World Bank, 2011). These solutions are often designed to cater for phones ranging from basic phones, feature phones all the way to smartphones.

- **Basic Phones:** Basic phone are phones that offers basic standard wireless services, such as calling and messaging but no access to Internet browsing. Basic phones often use very simple operating system.
- **Feature Phones:** Feature phones are low-end phones that access various media formats in addition to offering basic voice and SMS functionality, capturing the functionalities of multiple ICT devices that are also available as stand-alone appliances (The World Bank, 2011). Feature phones are extended species of the basic phone. They tend to be appreciated more in rural area because of their many features – radio, flashlight, camera, voice recorder MP3 players etc. – and also because of their affordability. Connectivity options on these phones include Bluetooth and second or third generation mobile data (2G or 3G). These phones do not have

advanced operating systems and usually run Java and BREW (Binary Runtime Environment for Wireless) applications.

- **Smartphones:** Smartphones are mobile phones with built-in applications and internet access. In addition to digital voice service, modern smartphones provide text messaging, e-mail, web browsing, still and video cameras, MP3 player, video playback and mapping. In addition to their built-in functions, smartphones run myriad free and paid applications, turning the once single-minded mobile phone into a mobile personal computer (PCMag, n.d.).

At present 25 – 30 percent of the total phone in the world are smartphones (Fitchard, 2013). Analysts have projected that by 2019 this number would be upped to about 60%. Globally smartphones are fast outselling feature phones, last year smartphone sale represented 57.6% of total mobile-phone sales (Gartner Inc., 2014). Projections for 2015 suggest that globally, smartphones revenue would account for 75.8% of total mobile handset revenue (Amoah, 2014).

This trend of rapid smartphone penetration is also taking shape in Ghana. Telecommunications analyst in Ghana, have attributed Ghana's ranking as Africa's number one in mobile broadband penetration as a function of increased smartphone usage (Joy Buisness, 2013). The growing rise in smartphone usage in Ghana would provide strategic opportunities that could be tapped into by the Ghanaian agricultural sector.

Chapter III – Methodology

3.1 Research Question

With Ghana's desire to craft a knowledge society around their agricultural sector put alongside existing mobile based solution to Ghana's agricultural problems, it is imperative to critically examine the role these solutions play in the emergence of a knowledge society. My research attempts to find an answer to the question R:

R = *"What role do existing mobile-based solutions in the Ghanaian agricultural sector play in the formation of a knowledge society in the said sector?"*

3.2 Hypothesis

It is hypothesized that mobile-based ICT solutions contribute to the emergence of an agricultural knowledge society.

3.3 Study Type

This thesis is going to employ Secondary Research methods. It would entirely consist of secondary data sources. As a result of the theoretic grounding of this research, this research is going to be qualitative in nature. In my quest to answer my research question R, I would make use of a research methodology called Evaluation Research.

Evaluation Research is the systematic acquisition and assessment of information to provide useful feedback about some object. Feedback provides relevant information which can be used for decision making (Trochim, 2008). For this thesis, the feedback would be as follows:

- a) How effective are mobile-based agriculture solutions in the emergence of a Ghanaian agricultural knowledge society.

- b) Point to areas in which mobile-based solutions fall short in steering the Ghanaian agricultural sector towards a knowledge society.
- c) Propose solutions aimed at making mobile-based agricultural solutions more effective.

This thesis makes use of a specific type of Evaluation called Summative Evaluation. It examines the effects of some object and summarizes it by describing what happens subsequent to delivery of the program or technology; assessing whether the object can be said to have caused the outcome; determining the overall impact of the causal factor beyond only the immediate target outcomes; and, estimating the relative costs associated with the object (Trochim, 2008). For this research the outcome would be how certain variables – defined in the next section – result in the emergence of a Knowledge Society.

The type of Summative Evaluation that would be used would be meta-analysis which integrates the outcome estimates from multiple studies to arrive at an overall or summary judgment on an evaluation question (Trochim, 2008). Outcomes for this research would be drawn from an assortment of literature relating to the topic.

3.4 Operational Definition of Variables

The model which I seek to base this research on would be Lundvall categorization of knowledge. I seek to find out how mobile-based Information Technology as used in the Ghanaian agricultural sector leads to the emergent of a knowledge society.

For the purpose of analysis I would look at how know-what, know-why, know-how and know-who is affected by mobile-phone technology. Since

knowledge is the most important component of the knowledge economy, I limit variables in this research to Lundvall's categorization of knowledge.

3.5 Data Collection

In Ghana, Esoko mobile agricultural platform is the most publicized mobile Agricultural ICT solution (Nana Boakye-Yiadom, 2013). From preliminary research, my findings suggest that of the agricultural mobile solutions in Ghana, Esoko's platform has been subjected the most to intellectual scrutiny by credible institutions such as New York University, John Hopkins University, National Geographic, The Economist, Africa Business Report, UNDP, Reuters, SciDev.net etc.; the work carried out by this institutions provides adequate data on which this research would be based on. For the reasons highlighted above, the data that would be used for this research would be focused around Esoko.

Data from this research would be gotten mainly from secondary sources such as periodicals, reports, documentaries and journal articles. A number of these data were available on Esoko's website as of the 20th March, 2014.

3.6 Procedure

This research follows this order:

- Critical analysis of how each of the four knowledge types in Lundvall's model is important to agriculture.
- Critical analysis of how each of the knowledge in Lundvall's model is affected by mobile-based ICT as used in the Ghanaian agricultural sector.
- Identification of gaps which mobile-based ICT do not currently cater for.

- Provision of recommendations as to how solutions could be found to some of the gaps identified.

Chapter IV – Data Analysis

4.1 Background of Esoko

Esoko Networks owns and operates Esoko, a technology-based market information system (MIS) classified as agricultural informatics or e-agriculture. Esoko provides agricultural stakeholders like farmers and traders with market information, and also a platform for advertising and negotiating buy/sell offers. For agricultural institutions like farmer associations, Esoko facilitates direct marketing campaigns using short messaging service (SMS). Other services that Esoko provides include a voice helpline and a web-based repository of Agricultural information (David-West, 2010).

Created in Ghana, Esoko is a multi-currency, multi-commodity, multi-market MIS developed to provide information on who has what to sell and where. Esoko was developed for both the Internet and mobile channels. On the Internet, Esoko provides pricing and buy/sell information to all users and serves as a platform for organizations that desire a presence on the World Wide Web. Also, it provides access to vast agricultural information. On the mobile phone, Esoko registers members that have requested to receive SMS alerts of commodity market prices and offers to buy/sell (David-West, 2010). Through mobile phones, the voice helpline connects farmers who need agricultural help with agricultural experts.

Since it was developed in 2006, Esoko has evolved from a donor or NGO-financed project based system to an independent commercial stand-alone system. As a project-based system, Esoko supported the goals and objectives of the funding agency/NGO with the inclusion of commodities of interest and the commodity price tracking; however, as these funded

projects were often time-bound and short-lived, the long-term continuity and sustainability of Esoko, led to its transformation in 2008 from a project-based system to a stand-alone MIS capable of serving multiple markets and projects and commercial ventures in multiple countries. This flexibility makes Esoko adaptable by internationally funded projects, agricultural associations and other participants in the agricultural value chain (David-West, 2010).

Esoko was developed in Accra, Ghana, by a team of local and international professionals for African markets, Esoko or 'markets' in Swahili prides itself of its African origins (David-West, 2010).

4.2 Relevance of "know-what" Knowledge to Agriculture

The knowledge of facts is extremely important to agriculture. Knowledge of this sort equips farmers and extension services with the capability to make the right decisions (Lundvall, 2003). In the following sub-section I would elaborate on how agricultural know-what knowledge is relevant to various user groups.

4.2.1 Farmers & "know-what" Knowledge

If farmers are to make the right decision as to what planting strategy to deploy, they should have access to relevant know-what - facts - information such as: What equipment and materials would be needed to cultivate a particular produce? What the market prices of particular commodities are at specific market locations? What the weather condition - precipitation, temperature, wind speed and humidity - is going to be like over a period of time? Access to these information prior to cultivation, ensures that farmers would be making informed decision when deciding whether or not to invest resources in a particular produce. For example, a

farmer in Ghana would know not to plant grapes if he knows that the average requirement needed for the cultivation of grape is not present in Ghana.

4.2.2 Extension Officers & “know-what” Knowledge

Agricultural extension has been defined as systems that facilitate the access of farmers, their organizations and other market actors to knowledge, information and technologies; facilitate their interaction with partners in research, education, agribusiness, and other relevant institutions; and assist them to develop their own technical, organizational and management skills and practices (Ministry of Food and Agriculture, 2011). This definition suggests that agricultural extension involves the collection and sharing of information among various entities. Best-practice recommendations made to farmers by extension officers are sometimes informed by aggregate individual farmer activity.

This suggest that individual “know-what” knowledge about the approach individual farmers are deploying on a particular cultivation is pooled together. From this pool, extension officers can figure out which methods work best for particular produce. The best methods are then recommended to farmers as reliable method of planting.

4.2.3 Potential Commodity Buyers & “know-what” Knowledge

“Know-what” knowledge is essential to performing any transaction along the agricultural value chain. It is necessary for buyers and sellers to know their value in the market place to prevent them from getting exploited by the other party. For example, a farmer knowing the value of his produce at various markets has power to turn down offers from local buyers who are offering lower prices.

4.2.4 Mobile's Contribution to "know-what" Knowledge

- **SMS-based Information Dissemination:** Esoko has seized the opportunity opened by mobile phones in Ghana to create a solution to persistent agricultural problem – the problem of information dissemination. What Esoko's SMS-platform in Ghana provides is a novel way of putting information in the hands of farmers. By sending an appropriately formatted SMS to Esoko's code, farmers across Ghana could receive information about market prices, weather forecast, agricultural tips, bids and offers (Magada, 2009). Also Esoko's product SMS Push makes it possible for extension services to provide targeted information to specific groups e.g. a farmer cultivating cocoa in Aniyam would not be bothered with agricultural tips meant for a maize farmer in Damongo.

Esoko's SMS information dissemination platform also provide both buyers and seller the ability to track their goods in transit i.e. at every point both the buyer and seller are aware of the current location of the commodity they are selling and buying respectively. Access to these varying facts provides stakeholders in the agricultural value-chain with information that is extremely useful for planning. This facility is available on all kind of mobile phones – basic, feature and smartphones.

- **Voice Helpline:** On the 20th of February, 2014, Esoko Ghana reported in a press release that it has launched a farmer helpline in Ghana. This helpline is accessible to anyone by calling the short-code 1900. The helpline provides answers from agricultural experts to questions asked by farmers around Ghana (Esoko, 2014). In

order to effectively transcend language barriers between farmers and operators, the helpline is available in 12 local languages – Dagbani, Mampruli, Twi, Kusaal, Frafra, Sisali, Dagaari, Wali, Ewe, Ga, Fante and Hausa. Currently, the helpline consist of 8 operators that are experts in 10 different crop varieties – Maize, Rice, Soya, Sorghum, Tomatoes, Cassava, Yam, Mango, Sheanuts and Cowpea (Esoko, 2014).

The helpline infrastructure contributes significantly to Agricultural “know-what” knowledge. Through this helpline farmers are able to figure out facts – Will it rain in Tumu on Saturday? When is the best time to plant corn? Where can I find particular pesticides (Esoko, 2014)? Answers to questions of this sort go a long way in helping farmers plan out their planting strategy. This helpline has the potential of reducing the demand for physically present extension officers i.e. extension officers would only have to be present at farmer’s farm only if it is absolutely necessary. This helpline is available on all kind of mobile phones – basic, feature and smartphones.

- **Data Collection:** Central to the function of extension services is the collection of unit field statistics – data from individual farmers – that is collated into an aggregate statistic. This statistic in most cases enables extension agencies to evaluate the success of a particular farming strategy e.g. If farmers in Larabanga are using a particular seeds for the first time, extension officers maybe interested in knowing the average yield of this particular variety

with respect to several other factors. In order to do this effectively, extension officers have to be able to collect data from the field with ease.

Currently, Esoko provides two ways of collecting data from the field. The first method is called SMS poll (Holland, 2010). This method involves the targeted dissemination of question to farmers by extension agencies through SMS. Also, farmers send their response back to extension agencies also via SMS. This method is effective when response needed from the field is easily understandable by the farmers and also not bulky i.e. (more than 160 character), if this is not the case then, the second method is deployed. SMS-poll is available on all kind of mobile phones – basic, feature and smartphones.

The second method of collecting data from the field requires the use of extension officers. Extension officers are equipped with Android Smartphones which are used to capture data that feature/basic phones cannot capture effectively and also information that is too technical for farmers to collect on their own. Information captured by extension officers are often richer – multimedia format. These smartphones are capable of capturing data such as images, videos and GPS coordinates. The smartphones used by these extension officers are equipped with real-time update i.e. as the extension officer enters individual farmer statistics; it is immediately entered into an online database thus guaranteeing data safety. The ability to collect these data by extension officer provides extension agencies with aggregate “know-what”

knowledge, which is useful for agricultural advising and recommendation.

4.3 Relevance of “know-why” Knowledge to Agriculture

“Know-why” knowledge is extremely vital to agricultural scientific and technological advancement (Lundvall, 2003). An improvement in agricultural science and technology could lead to better yield, fewer wastage, and also adaption to tougher agricultural conditions – such as drastic climatic changes and pest infestation. In subsequent sections I would elaborate on how “know-why” knowledge is important to various agricultural stakeholders.

4.3.1 Extension Agencies & “know-why” Knowledge

“Know-why” knowledge – scientific knowledge – provides the basis for some of the sophisticated agricultural inventions extension agencies recommend to farmers. Extension agencies often serve as the bridge on which the sophisticated agricultural solutions designed by agricultural research institutes ride through to reach farmers on the field. A key role of the extension agency is to deploy new agricultural methods that research institutes have discovered (Ministry of Food and Agriculture, 2011).

In most cases, in order for extension agencies to this effectively, they would have to first make farmers understand the rationale behind the technology. For example, cocoa bean farmers in Ghana know better than air drying their cocoa beans for anything less than five days, because they understand the beans would be more susceptible to mold which consequently reduces the market value of their produce (Food and Agriculture Organization, 1977).

4.3.2 Farmers & “know-why” Knowledge

“Know-why” agricultural knowledge is extremely important to farmers because to a large extent, it determines how effective they would be in carrying out agricultural best-practices as recommended by research institutes. For example, if a farmer has a thorough grasp of why a particular seed which he has planted behaves, he would be able to figure out what nutrients/pesticide to apply to the crop when he realizes that the leaves of this crop is yellowing. Availability of this sort of information would enable him to make timely decision that could prevent his/her crop from dying out.

Also, good grasp of agricultural “know-why” knowledge would enable farmers to make well-informed decisions about methods recommended by varying agricultural institutions. For example, farmers would be able to reject agricultural innovations that would not be beneficial to them such as the terminable seeds. Access to sound “know-why” knowledge reduces farmers chances of being exploited by vicious profiteers.

4.3.3 Mobile’s Contribution to “know-why” Knowledge

- **SMS-based Information Dissemination:** Esoko provides an amazing way for extension agency to pass across information to farmers about certain agricultural phenomena. Through Esoko’s SMS channel, extension agencies are able to inform farmers about disease outbreaks, symptoms and remedies (Banks, 2011). For example, a farmer in Buipe through Esoko SMS-channel would be informed of a disease outbreak that has been spreading southward from the northern border of Ghana – Paga. The farmer at Buipe from the information gotten from the extension agency would be at

alert and would be equipped with the necessary knowledge – “know-why” knowledge about symptoms relating to this disease and also the treatment – needed to prevent the disease from consuming his farm. This service is available on all kind of mobile phones – basic, feature and smartphones.

- **Voice Helpline:** With the ever-changing trends in the agricultural sectors, farmers may find it quite challenging to understand every change that happen on his/her farm. Esoko’s voice helpline provides farmers with the ability to call in and get answers to questions covering a long range of agricultural issues (Esoko, 2014). One may wonder how this service contribute significantly to “know-why” knowledge. The answer lies in some of the solution the voice helpline provides to farmers. For example a farmer who is confused about why his tomatoes fruit are developing hard black-spots can call Esoko’s voice helpline to find answers to his “black-spot problem”. An answer to this question is sure to improve a farmer’s knowledge about tomato diseases and preventions. The helpline service is available on all kind of mobile phones – basic, feature and smartphones.
- **Esoko Knowledge+:** This web platform designed by Esoko provides farmers and extension officer with access to trusted agricultural knowledge. Knowledge+ provides agricultural stakeholders a repertoire of agricultural knowledge – inputs needed to cultivate a particular produce, various methods that could be used to cultivate particular agricultural produce, advisement about the best time for farmers to plant, provision of information about

new agricultural technology and how they could be procured (Esoko, n.d.). Knowledge+ attempts to provide agricultural stakeholders with an avenue to improve their knowledge in agricultural scientific knowledge – “know-why”. It provides a medium through which farmers could get wholesome information about specific agricultural issues. Knowledge+ runs on the World Wide Web, therefore it is only accessible through smartphones.

4.4 Relevance of “know-how” Knowledge to Agriculture

“Know-how” also referred to as skill is extremely important to agriculture.

With the appropriate know-how, productivity could be improved significantly in several areas of the agricultural value chain. This can be achieved by either finding ways to reduce cost and wastage or by improving production through incorporating new technology. In the subsequent sections, I would examine how know-how is important to various agricultural stakeholders.

4.4.1 Extension Agencies & “know-how” Knowledge

Extension agencies are constantly trying to equip farmers with the appropriate skill required to make them efficient. One of the reason these agencies, are instituted is to provide farmers with or point farmers in the direction they could acquire skills essential to the development of their wellbeing and the agricultural sector. For example, some extension agencies train farmers under them with ICT, management and entrepreneurial skills. With these vital skills, farmers would be capable of running their farms more efficiently and also taking advantages of vital opportunity that present themselves in the agricultural sector.

4.4.2 Farmers & “know-how” Knowledge

Farmers who are up to date with agricultural skills have an edge in today’s ever-changing world. The acquisition of skill – “know-why” knowledge – is always beneficial in the terms of innovation (Jim Carroll, n.d.). In a world dominated by computer networks that harbor a large amount of knowledge resources that can easily be tapped into if one has the right skills, it is imperative for farmers to be ICT literate. ICT competence would give farmers the ability to plug themselves into the global network and also the ability to consume a tremendous amount of information. If farmers are equipped with sophisticated skill sets it gives them greater potential of adding more value to their produce. This could ultimately even lead to a kick-start of the manufacturing sector.

4.4.3 Mobile’s Contribution to “know-how” Knowledge

- **Voice Helpline:** Through partnerships with agricultural research institutions both within and outside Ghana, Esoko is always constantly recommending sophisticated technology to local farmers in Ghana. Most times, farmers struggle in implementing technology are often confused as to the workings of this technology – sometimes as a result of blunt skill sets. With Esoko’s voice helpline, farmers can call in to figure out how to work new agricultural technology – sharpen their skill set. A perfect example is of farmers calling Esoko’s voice helpline to learn more about the benefits of Esoko and how it works.
- **SMS-based Information Dissemination:** Esoko’s SMS-platform delivers in attempting to enhance and augment farmers and agricultural stakeholder skill levels – “know-how”. Through this

platform, farmers are provided with information such as crop calendars. These calendars take weather patterns into consideration and inform farmers about the appropriate time to carry out certain farming activities like sourcing of crop inputs, preparing soil for cultivation, removal of weed, inspection of crops, application of pesticide, crop harvesting, sale of crops etc. (aWhere Inc., 2014). This planting calendar is crop specific i.e. a cocoa farmer in Ejisu would not receive the same information as a wheat farmer in Bazua. Through SMS reminders farmer's skills – "know-how" – would be increased because the chance of them forgetting to carry out a critical agricultural activity at the right time is reduced.

4.5 Relevance of "know-who" to Agriculture

"Know-who" knowledge also could be referred to as social or professional network which is extremely vital to agriculture (Lundvall, 2003). With the access to "know-who" knowledge it makes it possible for stakeholders across the agricultural value chain to be more productive and abreast with the newest trend in Agriculture.

4.5.1 Extension Agencies & "know-who" Knowledge

This knowledge is particularly important to extension services. Since extension agencies bear the responsibility of providing farmers with the latest trend in the Agricultural world, it is very important for them to have a large, wide and diverse network – both human networks and computer networks. This would facilitate their ability to draw and collate knowledge from various sources such as agricultural research institutes, tertiary schools, farmers, health service, government and manufacturers.

Extension agencies would have a very efficient way of responding to agricultural needs if they are connected to farmers and their partnering institutions via a reliable medium. For example if there is a new disease outbreak extension agencies would be capable of studying and controlling this phenomenon timely, if they are connected via reliable networks to farmers and partnering institutions.

4.5.2 Farmers & “know-who” Knowledge

The relevance of “know-who” – both human and computer networks – knowledge to farmers is one that cannot be overlooked. If farmers are to keep up with the every changing world demands, they have to be reachable through borderless networks. If farmers are to be able to tap into the vast resources provided by extension services, both would have to be connected on the same network – either personally or electronically. Also, farmers would be capable of coordinating their activities properly if they are networked.

4.5.3 Potential Commodities Buyers and “know-who” Knowledge

If an entity want to purchase a particular commodity, it is extremely important it knows who to contact. If buyers and sellers are to trade effectively, it is necessary that they have a fair idea of what the other person has to offer. The role networks play is that it ensures that buyers and seller meet physically only when it’s extremely necessary.

4.5.4 Mobile’s Contribution to “know-who” Knowledge

- **Voice Helpline:** The significance of being able to seek help from experts is extremely important in any endeavour. The voice helpline operated by Esoko provides a platform – network – for famers to seek agricultural help from experts who are willing to offer help.

Through this network, farmers are capable of getting almost immediate response to their question in a variety of languages. This voice helpline allows extension officers to work more effectively in the sense that they do not have to be physically present at all times to provide help

- **SMS-based Information Dissemination:** Through Esoko's sophisticated SMS-platform, Extension service are capable of disseminating information to farmers through a reliable network that is accessible via mobile phones. Extension agencies now have an efficient way of sending both broadcast and targeted broadcast information to farmers in Ghana. Target groups usually have something in common like farmers who plant the same crops, farmers who plant in the same region etc. For example cocoa farmers in Kwahu could be informed of the availability of a cocoa pesticide in a nearby market.

Networks have a facilitated easier communication among farmers' organizations or cooperatives. Farmer unions have been strengthened mainly in the area of group organization. Farmers through farmer's organizations or cooperatives can coordinate themselves in a more time efficient way by sharing information (Castells, 2005). Esoko SMS services provide coordinators of farmer's organizations with the ability to broadcast information among their groups. For example crop farmers in Accra through Esoko's SMS platform can make their opinions on terminable seeds known to the Ghanaian parliament. This could simply be done by the group coordinator sending out an SMS that ask all farmers to

meet up at Ghana's parliament with placards at a particular date and time.

Chapter V – Conclusion

On the quest to answer my research question R – *What role do existing mobile-based solutions in the Ghanaian agricultural sector play in the formation of a knowledge society in the said sector?* –, I have explored how mobile-phone technology is used in the Ghana's agricultural sector. From my analysis, it is quite glaring that mobile-based agricultural solutions found in Ghana's agricultural sector contributes significantly to the individual knowledge type – know-what, know-why, know-how, know-who. Hence, it can be inferred that mobile-based agricultural solutions used in the Ghanaian agricultural sector plays a crucial role in steering this sector towards a knowledge society.

5.1 Economic Benefits

My stance is consolidated further by reports from Esoko that suggest that some farmers have received up to 40% revenue increase owed to their ability to better negotiate prices, to take their goods to new markets and also to trend prices and sell when those prices are best [36].

An independent study carried out in December 2011 by the French National Institute for National Research has shown that farmer in Northern Ghana have seen a 10% revenue increase attributed to receiving and utilizing Esoko's SMS market prices (Esoko, 2011). The research constituted of 600 smallholder farmers who were comprehensively surveyed on their trading behavior over the harvest cycle of 2008 and 2009. Half of the participants had been receiving market prices via Esoko's SMS platform while the other half had not.

Another independent study by the New York University's Center for Technology and Economic Development has shown preliminary results

that suggest farmers using Esoko received 11% higher prices for yam produce (NYU – CTED, 2013). This research was conducted in 4 regions in the Volta region and consisted of about 1000 farmers spread across 100 villages over a three year period. The intervention in this research involved:

- Text messages from Esoko with market prices for two commodities, sent to farmers twice per week.
- Market prices provided to farmers for 8 markets, local and urban, in Ghana.
- Training farmers on how to send and receive SMS messages, interpret alerts.

These research findings suggest that investment in knowledge is facilitating economic development in the Ghanaian agricultural sector. This conclusion raises the question of how the Ghanaian agricultural sector can harness mobile-phones to find its way to a knowledge society.

5.2 Social Benefits

We see mobile-phones breaking traditional hierarchical forms of social organizations formerly present in the Ghanaian agricultural sector. It has reduced dependencies that have formerly been used to take advantage of the vulnerable – those who are not empowered with information (Castells, 2005). Through Esoko's mobile network, farmers have been empowered with the ability to decline offers from middle-men in the agricultural-value chain that previously had been undervaluing farmers produce.

The proliferation of mobile telephony in Ghana is also helping to create inclusive knowledge societies in the Ghanaian agricultural sector. By providing a voice line that has operator that speak 8 local languages

Esoko through mobile phones have increased the chances of local farmers to also have access to agricultural tips that has significant effects on their crops. This voice helpline also makes it possible for a farmer that speaks English, and the other that speaks a local language – any of Dagbani, Mampruli, Twi, Kusaal, Frafra, Sisali, Dagaari, Wali, Ewe, Ga, Fante and Hausa – to have their agricultural difficulties attended to by experts.

Through the power of mobile-networks farmer unions have been adequately strengthened because they can communicate and share information among themselves with ease. The improved organizational coordination provided by Esoko's mobile SMS-networks empowers farmers to respond effectively to policies that affect them.

5.3 Environmental Benefits

Mobile telephony has plugged in the Ghanaian agricultural sector into a sophisticated network. The benefit of this on the environment is that the ease at which stakeholders in the Ghanaian agricultural sector can communicate with each other without having to get into vehicles, thus reducing the carbon emission that results from vehicular transportation. A farmer who owns a motorcycle can easily just check the market price of his commodities via SMS-communication rather than going to the market to find the price and then take his goods to the market thereafter if the price is suitable.

5.4 Recommendations

Mobile-phones have made several contributions to the Ghanaian agricultural sector, but one area that is still largely left unattended to is that of financial services. In Africa mobile financial services have recorded huge successes. In Kenya mobile platforms like M-PESA have provide

financial services to a large number of Kenya's who had no easy access to such services (Amoah, 2014). In Kenya, 74% of the adult population makes use of mobile money (Castri, 2013). This statistic suggests large success in the Kenya mobile money playing field. Unfortunately in Ghana, this trend has not quite picked up. A research carried out in February, 2014 by PEW Research Center indicates that only 11% of mobile phone users in Ghana use their mobile phone for financial transaction.

Some technology analysts (Cofie, 2013) have argued that part of the reason mobile money has not succeed in Ghana as compared to Kenya is as a lack of proper customer segmentation. This is a compelling argument as mobile operators have been employing a "one size fits all" strategy to all sectors in Ghana. A more strategic approach to making mobile money a success in Ghana would be to design solutions that are sector specific. The agricultural sector provides enormous opportunity for the deployment of mobile money as 76.1% of farming households in Ghana are rural and struggle with access with financial services (Ministry of Food and Agriculture, 2012). Mobile Network Operators and financial institutions could leverage agricultural specific financial services – agricultural mobile insurance, mobile credit and savings – accessible on mobile phones to provide financial services to the "difficult to reach".

A study carried out by Business Works for Development in partnership with the United Nation Development Program shows that the one of the major obstacles limiting the progress of Esoko is illiteracy (David-West, 2010). Results from the 2010 Population and Housing Census carried out by the Ghana Statistical Service indicates that 44.1% of the head of

agricultural households had no formal education and only a meagre 10.7% had post-middle school education while the others fell in between the latter and the former (Acheampong, 2013). This obvious literacy deficiency in the Ghanaian agricultural sector provides an enormous challenge for the sector's ICT4AD agricultural developmental objective.

Inability to read and understand is hampering the many benefits farmers can derive from mobile based agricultural system. Illiteracy makes dissemination of information through text problematic because those who are in need of this information may not be able to interpret it. This poses a serious challenge to the potential mobile-telephony has in driving the Ghanaian agricultural sector to a knowledge-based economy.

If Ghana is to achieve its ICT4AD objective of "*engineering an ICT-led socio-economic development process with the potential to transform Ghana into a middle income, information-rich, knowledge-based and technology driven economy and society*" then it would have to invest heavily in basic literacy, because it is through it that stakeholders of the Ghanaian agricultural sector, would be capable of leveraging mobile telephony. Adult literacy would be the most effective literacy strategy to deploy as the average age of farmers in Ghana is 55 years (Ministry of Food and Agriculture, 2011).

Furthermore, if agricultural stakeholders – farmers especially – are equipped with basic literacy skills it opens the door for the Ghanaian agricultural sector to use mobile telephony as a tool to provide farmers and other stakeholders with other useful knowledge. With the future prospect of smartphone in Ghana, which would open the way to

ubiquitous access to richer content and more sophisticated networks that could be used to efficiently convey a wide range of knowledge among agricultural stakeholders, it is imperative that the Ghanaian agricultural sector is positioned to harness these opportunities that could propel it to its desired knowledge economy.

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