



Research Article

# Appraisal of the Agro-Tech Smart Extension Model in Ghana, Payment options and Challenges in ICT-enabled extension services delivery

Wilhemina Quaye<sup>1</sup>, \*Nana Yamoah Asafu-Adjaye<sup>2</sup>, Alfred Yeboah<sup>3</sup>, Cecil Osei<sup>4</sup> and Emmanuel Edem Agbedanu<sup>5</sup>

<sup>1</sup>Industry and Services Division, Science and Technology Policy Research Institute (STEPRI), Council for Scientific and Industrial Research (CSIR), Accra, Ghana. Box CT 519, Accra-Ghana

<sup>2</sup>Agriculture, Medicine and Environment Division, Science and Technology Policy Research Institute (STEPRI), Council for Scientific and Industrial Research (CSIR), Accra, Ghana. Box CT 519, Accra-Ghana

<sup>3,4,5</sup>Programmes and Implementation Department, Grameen Foundation (GFUSA), No. 21 Asoyi Road, East Legon, Accra-Ghana

The role of ICT-enabled extension services delivery for enhanced agricultural productivity cannot be overemphasized. In this article the effectiveness of AgroTech Model piloted by Grameen Foundation in Ghana is assessed. The AgroTech Model is a private led ICT-enabled extension and support services. The study methodology involved two pronged approaches including a desk review of existing literature and a primary survey of 402 agricultural value chain actors. Data collected was analysed using Statistical Package for Social Sciences (SPSS). Study findings showed that the Agro-Tech Model has high performance rating among farmers interviewed. More than one third of the farmers rated the performance of the AgroTech Model as Excellent (above 70%) while 27% rated the performance as Good (70 - 50%). Factors such as timely supply of inputs, cost implications and improvement in crop yields that translate into additional income influenced farmers' decisions on the performance rating of the AgroTech Model. Awareness of the AgroTech model among males in the communities surveyed was higher than females. Overall, willingness to pay for extension and support services was estimated at 58%. However, willingness to pay for extension and support services was slightly higher among male farmers (59.1%) than female farmers (55.3%).

**Keywords:** *Agro-Tech Model, ICT enabled Extension, Grameen Foundation, Farm Radio International Foundation, Smart Extension, Willingness to Pay, Ghana*

## INTRODUCTION

The traditional extension services delivery system in Ghana has been characterized with high cost and limited scale of outreach. The public extension agent to farmer ratio in Ghana is above 1:1500 (MoFA/WAAPP, 2014). According to Manfre *et al.* (2013) gaps in the traditional extension services delivery system in Ghana include weak coordination at the national level, inefficient performance and the over-focus on production side issues without sufficient concern for farm-level profitability. The traditional and public sector led agricultural extension delivery

system has been characterised as not being demand-led or farmer-led, production oriented and much has not been done on marketing issues.

**\*Corresponding author:** Nana Yamoah Asafu-Adjaye, Agriculture, Medicine and Environment Division, Science and Technology Policy Research Institute (STEPRI), Council for Scientific and Industrial Research (CSIR), Accra, Ghana. Box CT 519, Accra-Ghana **Email:** yamoah45@gmail.com

Crop productivity in Ghana is far below its potential (SRID/MOFA, 2013) and efforts towards crop productivity increase cannot be achieved without addressing deficiencies and issues confronting the traditional agricultural extension system in the country. There is a gradual shift from the traditional methods of Farmer Field Schools (FFSs) and on-farm demonstrations to the use of community based extension services and e-extension systems. The community-based agricultural extension model is being based on the idea of providing specialised and intensive technical training to agricultural extension services volunteers in communities who in turn provide extension services to farmers with occasional support from a supporting organization. E-extension approaches use Information and Communication Technology (ICT) to improve outreach and performance. Basically e-extension approaches involve the use of mobile software application for smallholder farmer management and delivery of agricultural extension and support services.

The issue of whether or not e-extension can be fully commercialised and meet the huge demand for extension services delivery particularly among smallholder farmers is still under discussion. Some authors advocate for full commercialisation of agricultural extension services delivery (Kidd *et al.* 2000) while others are against (Anderson and Feder, 2004; Mbanda-Obura *et al.* 2017). Those against commercialisation of agricultural extension services delivery explained that smallholder farmers cannot benefit from agricultural extension which is seen as a public good. There are concerns also about the effectiveness of e-extension approaches.

To this end, Grameen Foundation (GFUSA) and Farm Radio international are implementing a private-sector led ICT-enabled extension service project that seeks to extend the reach of agriculture information, improve the efficiency of local extension by training agents in effective outreach, and promote the adoption of good agricultural practices. The GFUSA Project used 2-pronged approaches in its implementation to reach out to the targeted groups and beneficiaries, (i) Agent mediated approach: Personal customized interactive engagement for planning, implementation, evaluation and (ii) Direct to farmer approach which is being handled by Farm Radio International, an Interactive Radio Programing timed to crop seasonal calendar. The e-extension package covers actor needs along the selected commodity value-chains (maize and rice) including farm management support knowledge, linkages with credit providers and market outlets and Interactive platforms for information sharing among others.

This study seeks to (i) understand the AgroTech model, (ii) assess performance of the Agro-Tech Model among various stakeholders, and (iii) establish the level of awareness among users and capacity of extension services providers to use the AgroTech Model.

## LITERATURE REVIEW

This section reviews the various extension services models used in Ghana, the payment options available and some of the challenges in the extension and advisory services delivery.

Research studies such as Mittal and Mehar (2016) have found that farmers use multiple information sources that may be complementary or substitutes to each other and this also implies that any single source agricultural extension services delivery may not satisfy all information needs of farmers.

### Extension services models

Extension services models reviewed include the nucleus farmer and outgrower schemes, direct private extension services provision, farmer organization provision and ICT-enabled models.

### Nucleus Farmers and Outgrower Schemes

The embedded extension services delivery in Nucleus Farmers and Outgrower Schemes in Ghana are worth discussing. Outgrower schemes in pineapple, mango and vegetables industries worked with non-governmental supported extension services delivery because of the market demands and assured markets system. A common feature is the private sector embedded extension services primarily with input supply companies and dealers. Payment for extension and advisory services is embedded in the sales price. That is payment indirectly as an unidentified component of the input sales price. With this approach, extension information and advice have a wide range and multiple delivery methods. It may be as simple as providing basic advice on use and application of input at the point of sale. In some circumstances it may entail one or more visits by technical specialists to the production site. This is more likely when there are multiple sales in an area, particularly if the sales process includes a farmer group. For example, the USAID-funded Agricultural Development and Value Chain Enhancement (ADVANCE) project is supporting this approach in their promotion of input supplies and improved seeds. Input supply companies are establishing demonstrations, usually on the farms of the project's nucleus farmers. (MEAS, Ghana Report 2012).

### Direct Private Provision Model

A more direct approach for provision of advisory services is private processors/marketers who provide agriculture related information and advisory services to farmers. In this approach the company generally wants to ensure a specific amount of production and often with a specific market quality requirement. Therefore, it is in the company's self-interest to provide advisory services.

There is usually no direct charge for this service but there may be an “in-kind” payment through part of the crop produced or the cost of the system is factored in as part of the determination of profit margin. Olam International employs such a service in its cotton enterprise (MEAS, Ghana Report 2012).

### Farmer Organization Provision Model

Another method of direct supply of advisory services is through direct provision by producer cooperatives/associations. Through these types of organizations advisory services are paid for by the cooperative/association as part of the cost of doing business. Payment can be made by farmer cash contributions as part of the cost of being a member of the cooperative/association or if the cooperative/association handles the marketing of the commodity, the cost of the provision of advisory services is part of the cost of the cooperative/association doing business. One such example is Kuapa Kokoo, which is a cocoa production union. Kuapa Kokoo is fair Trade certified (MEAS, Ghana Report 2012).

### ICT and Multimedia Models

Models such as the Africa Cashew Initiative, serves approximately 400 farmers in the Brong-Ahafo Region, which provides pricing, weighing and other advisory services via SMS. Also Cocolink is an outreach program created by the Hershey Corporation in collaboration with the World Cocoa Foundation and the Ghana Cocoa Board. The Cocolink program combines voice and text messaging which provides farmers with training on technology usage, agronomy and social issues, such as child labor. The platform is a two way vehicle which provides farmers the opportunity to send inquiries to experts via SMS. Whereas Farm Radio International is executing the Ghana portion of a multi country African Farm Radio Research Initiative (AFFRI) project in Ghana. They work with radio stations in each country, training station personnel on how to create engaging and entertaining programs which would be responsive to

farmer’s needs. The programs are based on farmers’ interest and listening habits (MEAS, Ghana Report 2012).

Another ICT model is a mobile application platform developed by Esoko that currently focuses on the provision of market and weather information by SMS. Others include Nutrient Manager for Rice, which is a decision making tool utilizing web-based and mobile application to provide rice farmers with specific information about growing rice. There is an e-extension platform for MoFA, a mobile application called Farmer Direct. Farmer Direct is an interactive voice response (IVR) mobile service allowing farmers to call in and receive pre-recorded production and market information (MEAS, Ghana Report 2012).

### Approaches and Financing options

Ozor (2010) researched into the approaches in the Provision of Agricultural Extension Service. The approaches considered includes privatization, commercialization, decentralization (delegation, devolution, and transfer to private firms and NGO), and cost-sharing. One of the key features of all the reforms is that, they aim at recovering a part or all of the cost of the provision of extension service so as to take the burden away from the public sector, cut down on expenses, improve management and staff professionalism, and make users’ problems become a main priority.

Agricultural extension and advisory services delivery and financing mechanisms are intertwined. And for a continuous delivery of agricultural extension services, the financing mechanisms involve three main options:

- Public Financing of agricultural extension services delivery
- Private sector financing of agricultural extension services at full cost recovery
- Public – Private Partnerships where cost is shared between the public and the private sector actors

Table 1 and Table 2 represent Providers of Agricultural Extension and Advisory Services and Financing options respectively

**Table 1.** Providers of Agricultural Extension and Advisory Services

Public and Semi-Public Sectors	Private for-Profit Sectors	Private for Non- Profit Sectors	Producer Organization
Government Ministries	Consulting and Media Enterprises	Local NGOs	Farmer based Associations
Universities and Research Organizations	Production, Processing and Marketing Enterprises	International NGOs	Community based Association
International Development Organizations	Input Supply enterprises	Religious Organizations	Village Savings and Loan Scheme Associations
	Trader Associations	Projects funded by Bilateral and Multinational Aid agencies	

**Source:** Adapted from Katz (2002)

**Table 2:** Providers and Financing options in Extension and Advisory Services Delivery

Category of Extension Service provider	Rationale for Extension service delivery	Funding Mechanism
Commercial input providers or output buyers	Securing customers selling products guaranteeing certain qualities of products bought Increasing customer satisfaction with products bought	Incorporating costs of services in selling/ buying prices making advisory services part of contract farming
Farmers' associations	Providing support to members influencing policy	Membership fees donor subsidies/ contracts government subsidies/ contracts
Private extension services/ consultancy firms	Satisfying an apparent need Maintaining jobs for staff making profits	Direct fees for service contracts with governments contracts with commercial organizations
Conventional government extension service	Developing/ realizing policies that are considered to be in the public interest (e.g. Economic growth) controlling rural/ farming population	Tax Payers money Product levies Direct fees for service (sometimes) Donor subsidies/ contracts
Non-profit NGOs	Realizing certain political/ developmental aspirations maintaining jobs for staff Access to resources	Donor subsidies/ contracts donations from individual's membership fees government subsidies/ contracts

**Source:** Adapted from Leeuwis (2006)

**Table 3** Available Options

Options	Description
Full-Cost Recovery	Contracts drawn up between farmers and extension providers. Farmers agree to make a payment in return for the delivery of agreed-to services and these payments benefit the field level extension staff directly
Decentralization	use of farmer groups, promotion of demand-led extension, strengthening institutional links, encouraging participation, increased targeting of services on the poor and disadvantaged and use of a range of media
Partial privatization	Privatization of some of the services previously monopolized by the government to strengthen extension services at field level. Government can then focus on developing well trained and equipped staff at the provisional and district levels.
Privatization	Privatization of extension services and implementation of cost-recovery mechanisms. Now the service is more demand-led and there is increased farmer participation.

**Source:** Chukwuone, Agwu and Ozor (2006)

Katz (2002) admits that the context in which an approach to cost-sharing in agricultural extension is shaped by a variety of factors; which have important influence on the success of the programme. These conditions may include; the policy environment, institutional landscape, importance of agriculture in the national and local economies, fragility of eco-systems, agro-ecological systems, production systems and agrarian structures, socio-economic and cultural structures. Introducing cost-sharing after the expiration of the World Bank component of the agricultural extension funding arrangement in Nigeria was expected to face some challenges due to the fact that agricultural extension had been seen as a public good. Chukwuone, Agwu and Ozor (2006) recommends proper dissemination of information on cost-sharing before implementation, creating enabling legislation, decentralizing extension system and building the capabilities of extension staff. Table 3 represents the Available Options

### **Challenges in ICT-enabled extension services delivery**

Some of the challenges faced in the ICT-enabled extension service delivery had to do with limited awareness of ICT initiatives in agriculture, infrastructural challenges, the ineffective use of innovative digital tools and socio-cultural challenges.

**Awareness** in terms of cost and mode of service delivery are very important (Okeke, Nwalieji, and Uzuegbunam, 2015). Sustainability has been a challenge. Most of the ICT initiatives are launched by different organizations with the (financial and/or technical) assistance from one or more development partners. Another challenge has to do with the validity of information received via ICT.

**Validity of information** is a very vital issue to the farmers. Entrepreneurs collect information from different sources which are not always validated by the competent agency. The ICT-enabled agricultural extension delivery has to be a clear and focused service, simple and user-friendly, accurate information, well organized and easy to find. Applications developed for e-extension need to be regularly updated with new information and customized to meet the needs of different farmer groups. Validity of information also contributes to building trust (Cynthia and Nwabugwu, 2016).

The **interactive nature** of ICT-enabled agricultural extension delivery is of relevance. In Australia, Swanson (2008) reported on an increased focus on farmer-to-farmer exchanges and, in some instances, on farmer-driven, bottom-up approaches. However, while agricultural extension services in Australia and elsewhere have made

significant efforts to incorporate such approaches, their delivery is still subject to a range of practical and logistical constraints. Feruglio and Gilberds (2017) cited extension through specialized interactive radio broadcasts with an interactive voice response tool created for gathering and analyzing feedback and questions from audience members. Their research discussed the potential of building on a tech-enabled feedback model to enable collective civic action for extension services that are responsive to the priorities of smallholder farmers in Tanzania. The discussion support aspect of the scripted conversations designed to enhance this type of collaborative social learning behavior.

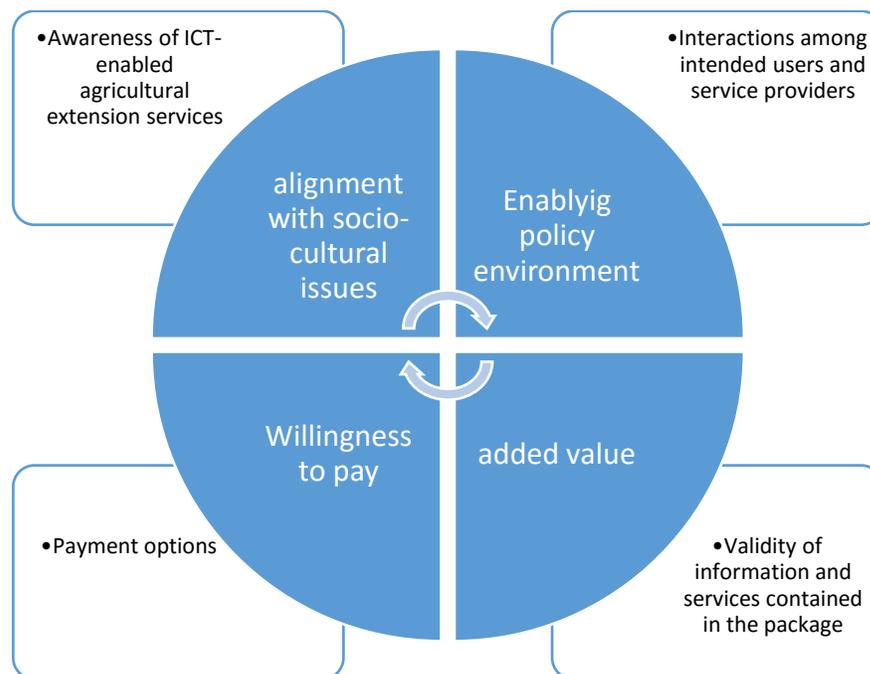
**Infrastructural challenges** – Digital Platforms and other ICT-enabled Extension services that use smartphones and tablets may require high-speed internet facilities even in rural locations. This could be a challenge in effectively influencing farm management decisions of large numbers of farmers (Francis and Carter, 2001; McCown, Hochman and Carberry 2002) to use e-extension services. According to Mudda, Giddi and Murthy (2017) the main impediments to ICT adoption in India cited are the lack of 'tailored' ICT applications, their increased sophistication which imposes enhanced human capital requirements, their lack of synchronization with production, market and the local environmental conditions.

**Gender and other socio-cultural limitations** – Wawire, Wangia and Okello (2017) found that several farmer characteristics, farm and capital endowment factors affect

the use of ICT tools, particularly mobile phones. Gender, age, literacy level, affordability, perceived importance, mobile ownership and group membership were found to be significant in influencing the decision to use KACE ICT tools and the intensity of use of these tools for agricultural transaction activities. Also discussed earlier in the Ghanaian context, the issue of socio-cultural limitation has been emphasized (Quaye *et al.* 2017; unpublished). Lamontagne-Godwin *et al.* (2017) studied quality of extension advice: a gendered case study from Ghana and Sri Lanka. In this study they highlighted the importance of appropriate advice, according to farmer's gender and crops cultivated. They suggested greater focus on local knowledge about women's role in agriculture to help achieve more tailored advice.

## METHODOLOGY

This study methodology involved two pronged approaches. A desk review of existing literature was done to develop a framework for understanding and identifying the investigative variables for assessing performance of an ICT-enabled agricultural extension services. From the literature, factors influencing success of ICT-enabled agricultural extension services include adequate awareness among potential users, validity of information provided, effective payment options and strong interactions among users and service providers. Figure 1 presents the analytical framework used in assessing the effectiveness of the Agro-Tech Model in this study.



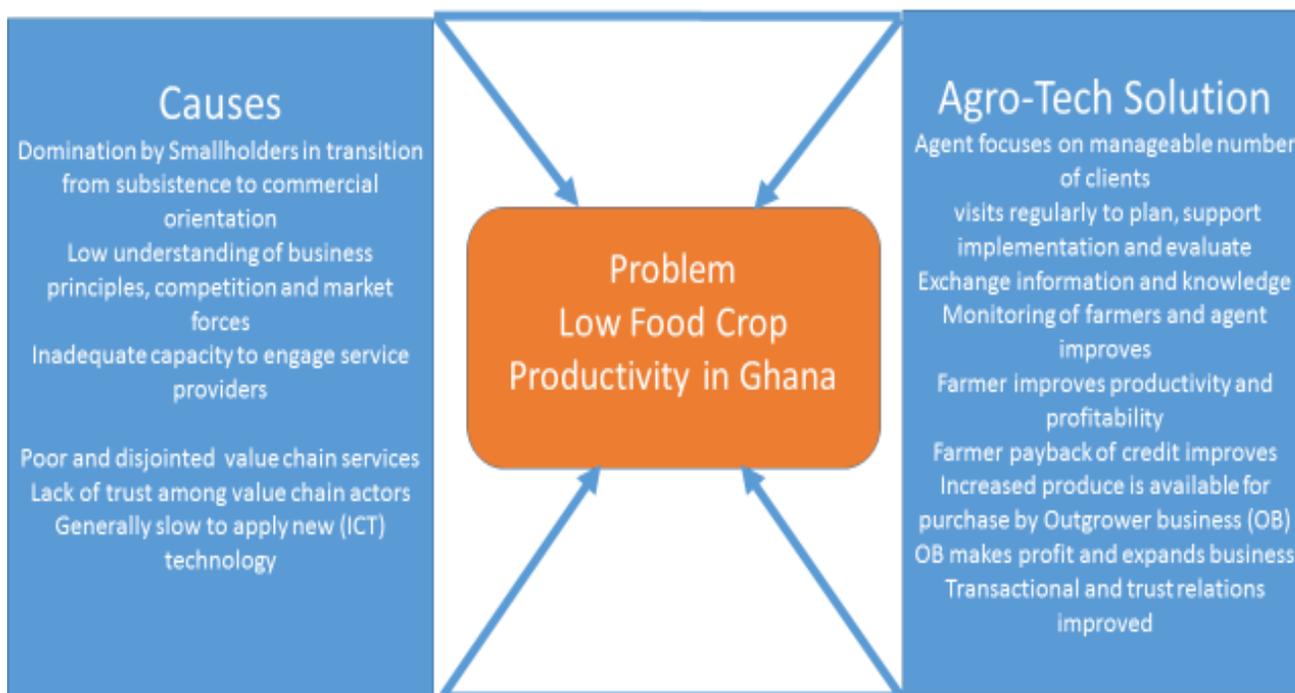
**Figure 1:** Analytical Framework for assessing the effectiveness of the Agro-Tech Model.

### Description of the Agro-Tech Model

GFUSA developed a mobile software application (AgroTech SmartEx) for smallholder farmer management and delivery of agricultural extensions services. The application's content, include a directory of services and service providers, including tractor and other farm machinery services. Specifically, AgroTech is a multi-media extension solution that enables last-mile actors in agricultural value chains to leverage ICT and human networks to provide extension support to smallholder farmers. AgroTech provides extension to farmers through both intermediated and direct-to-farmer extension services. AgroTech's mobile-enabled agent services leverage buyer agents and government extension agents to deliver in-person service to farmers. The solution's interactive radio and SMS (text message)/interactive voice response (IVR) services deliver direct extension to farmers. The SmartEx mobile application which is an integral part of AgroTech, is designed to improve farm

business productivity and profitability. It is primarily a tool for field agents and supervisors to support smallholder farmers and out growers to optimize their decision-making process through coaching and handholding. SmartEx provides an opportunity for the Agent to know and understand the smallholder farmer in order to provide tailor services that will convince the farmer to retain his or her services.

The key actors of the Agro-Tech Model include Smallholder Farmers, Farmer-Based Organizations, Input Dealers, Outgrower Businesses, Microfinance Organizations and Equipment Owners/Operators. The Agro-Tech model is demand - driven which response to the need-based services, in addition to accessing agro-inputs and tractor services on credit, farmers are linked to market and are educated on production planning and farm records keeping (including field measurement). Figure 2 represents proposed solutions contained in the Agro-Tech Model.



**Figure 2:** Proposed Solutions contained in the Agro-Tech Model

The value proposition for the various actors are summarized below:

#### Business Service Provider

- Reduced cost of logistics and overhead
- Increased product availability
- Increased profits
- Improved transactional relations and trust

#### Smallholder Farmer

- Improved knowledge, skills and operational efficiency
- Increased productivity
- Increased profits

#### Other service providers

- Increased client base
- Increased sales output
- Improved transactional and trust relations

Based on the understanding of factors influencing performance of ICT-enabled agricultural extension services delivery as shown in the analytical framework, a structured questionnaire was designed and used for one-on-one interviews. This involved structured questionnaire for farmers, agents and outgrower Businesses (OBs). Each set of questionnaire was designed to collect data on the socio-economic profile of the respondents, awareness

of the Agro-Tech Smart Ex- Model, perceptions about performance, willingness to pay for e-extension services delivery and challenges.

In consultation with the AgroTech Model implementers, study areas were identified. Three (3) regions were selected for the survey. These included Northern, Brong Ahafo and Volta regions of Ghana. A purposive sampling strategy was employed among the following units:

- Field agents engaged in the mediated e-extension delivery;
- Listeners clubs/groups involved in Farm Radio direct to farmer intervention;
- Individual farmers/beneficiaries by gender;
- Other out-grower schemes; and
- Program (e-extension package) designers and implementers.

The study used data collected on a total of 402 respondents including farmers and agents who benefited from the Agro-Tech Model. The data collection team included a staff each from Farm Radio International and

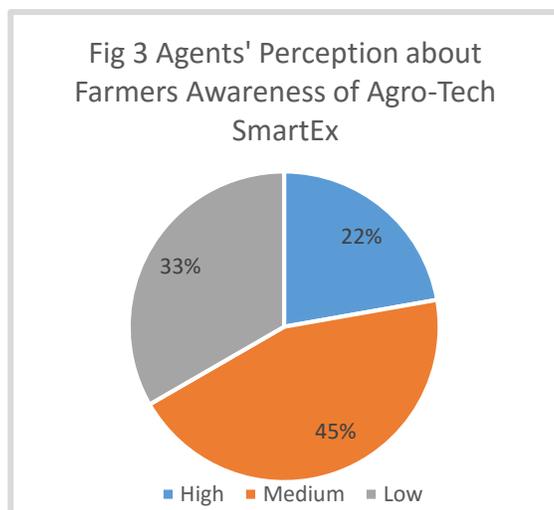
Grameen Foundation. Data collected from the field were cleaned, analyzed in SPSS and exported into excel for the generation of graphs and cross-tabulations.

## FINDINGS

The analysis of effectiveness of the Agro-Tech model borders on four main themes including awareness and capacity to use among farmers and the agricultural extension agents, willingness to pay for extension services delivery and perceptions of performance of the Agro-Tech Model.

### **Extent of Awareness of AgroTech SmartEx Model**

Awareness of the AgroTech Model in the communities visited was very important and this was basic information needed to make a decision to join a group benefiting from the Agro-Tech package or not. As indicated in Figures 3 and 4, awareness of the Agro-Tech model in the communities surveyed was largely above average (here described as medium level of awareness).

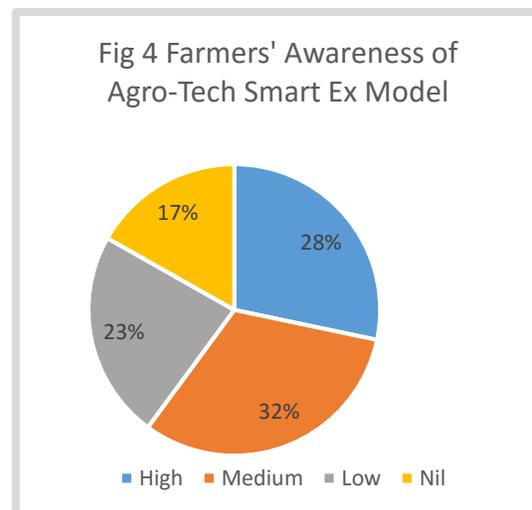


Source: Field Survey (2017)

For example, only a third of the agents interviewed mentioned that the awareness level of the Agro-Tech model among farmers in their area of operation was low. Interactions with the farmers also indicated that about 16.8% had no information about the Agro-Tech Model and had not yet benefited from the package. Figure 5 shows the gender diversity in level of awareness about the Agro-Tech SmartEx Model.

From the perspective of the farmers and agents, awareness creation of the Agro-Tech Model at the community level was very important. For example a group chairman interacted with, had this to say;

..... 'I was able to get a lot of women in my group. I have 227 female farmers and 87 male farmers in my group. Getting the women involved required strong awareness creation and sensitization, break cultural restriction and make the women to understand that they



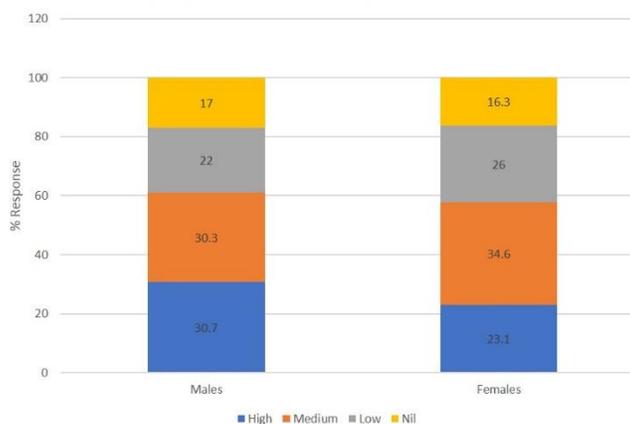
Source: Field Survey (2017)

can also work and make money. One could also make use of the village savings and loan scheme that targets women and the disadvantage in terms of access to formal credit to get the women involved in the Agro-Tech model. This Includes trading activities and not just production'.....

### **Performance of the Direct Extension Delivery through Farm Radio**

The evaluation indicated a positive response to the overall performance of the Farm Radio International program content on improved practices and agriculture related issues, and time of airing particularly for women. Farmers interviewed confirmed the variety of approach used by Farm Radio International mentioned by the production team. Approaches used are participatory radio campaigns, regular farmers' program, listening post and participatory radio series.

Fig 5 Awareness of Agro-Tech Smart Ex Model by Gender



Source: Field Survey (2017)

### Suitability of Airing Time by Gender

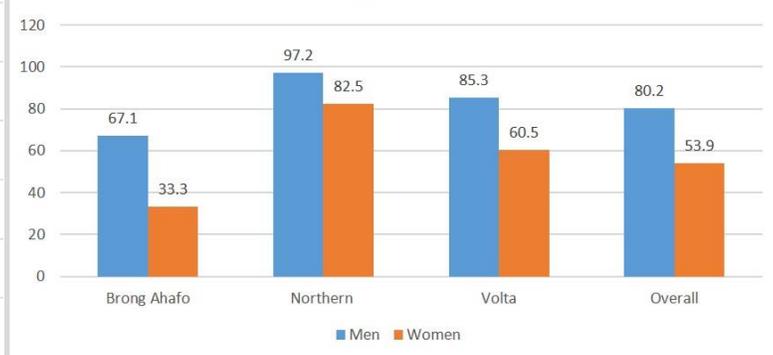
This study found that men tuned-in to listen to the agricultural related discussions and took part in the interactive programme most often than their female counterparts. As shown in Figure 6 majority of the men (almost 80%) were more comfortable with the airing time of Farm Radio Programs. About 54% of the female respondents indicated favourable airing time of the farm radio agriculture related programs.

Northern Region had the highest percentage (82.5%) of women who accepted the airing time for agricultural programs as highly favourable. However, access to radio set or phone by women to tune-in during the agricultural program was problematic. This challenge was ameliorated by the creation of listen clubs for women to listen in groups. As one respondent indicated below; *.....'For women to benefit from the agricultural programmes, either they are in listeners club or have to rely on the household radio set which usually belonged to the men'.....*

For example in Tanoboase (a village in Brong Ahafo Region of Ghana), interactions with farmers indicated that airing time of Farm Radio programs were on Fridays and Tuesdays 7:00 - 8:30pm. On Fridays most of the Moslem communities do not go to farm and therefore were able to create time to tune-in.

To increase the radio e-extension outreach to female farmers, women resource persons from the community should be engaged during the radio programs on agricultural related issues, male gender champions could be used to create awareness on the Agro-Tech Smart Ex Model and to sensitize the community women on the need to listen to such programs. The Radio Production team should be gender balanced and the program design should focus on the roles of men and women along the agricultural value chains. There should be an intervention for women groups to own radio sets and women incentivized to participate in the call-in sessions of the radio program.

Fig 6 Percentage response to favourable airing time by gender

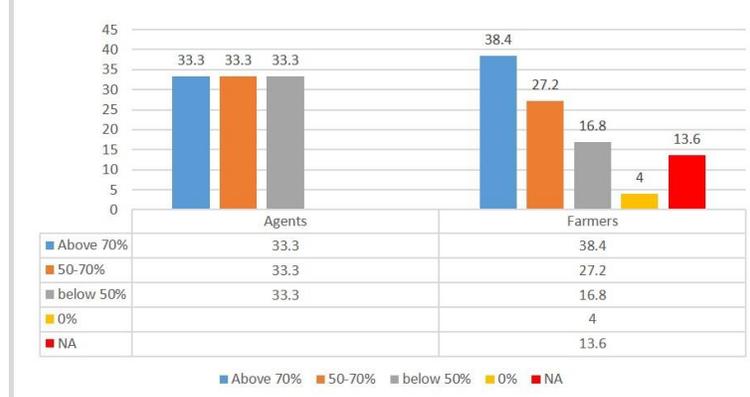


Source: Field Survey (2017)

### Performance of Agro-Tech Smart Ex Model

Agents and Farmers were asked to rate the performance of the Agro-Tech Smart Ex Model given their experiences as beneficiaries of the intervention. Figure 7 shows the results of performance rating by the Agents and their farmers in the surveyed areas. Responses by Agents on the performance of the Agro-Tech Smart Ex Model were evenly distributed among above 70%, 50-70% and below 50% categories.

Fig 7 Rating the Performance of the Agro-Tech Smart Ex Model



Source: Field Survey (2017)

Results by farmers showed that more than a third of the farmer sample interviewed rated the performance of the Agro-Tech Smart Ex Model above 70% (Excellent). About 27% of the farmer's interviewed rated performance of the Agro-Tech Smart Ex Model 70 -50% (Good) and 4% rated performance of the Agro-Tech Smart Ex Model 0% (poor). About 13.6% of the farmers interviewed could not rate the performance of the Agro-Tech Smart Ex Model because they had just started with the program or had not gotten adequate experience to make any meaningful evaluation in terms of performance.

Farmers who rated the performance of the Agro-Tech Smart Ex Model as poor were concerned about the timeliness of the intervention particularly timely supply of inputs. Interactions with farmers showed that factors such as timely supply of inputs, cost implications, improvement in crop yield and value addition that translates into additional income influence their decision on performance rating of the Agro-Tech Smart Ex Model.

Also, there was a positive and significant correlation between performance rating of the AgroTech Smart Ex Model by farmers and willingness to pay (see table 4). This

is actually expected given that farmers will consider factors such as timely supply of inputs, cost implications, improvement in yield and value addition that translate into additional income to commit themselves to the terms of the intervention. Thus, the issue of how farmers are willing and their capacity to pay for e-extension and services delivery actually hinges on the value added. The rational decision is influenced by the improvement in yield, availability and access to efficient market linkages and the climatic conditions as well as other factors that affect crop productivity.

**Table 4:** Correlation between Performance Rating of the AgroTech Smart Ex Model and Willingness to pay

	Are you willing to pay for e-extension services?	How do you rate the performance of the Agro-Tech Smart Ex Model in rendering e-extension services?
Are you willing to pay for e-extension services? Pearson Correlation Sig. (2-tailed) N	1 342	.141* .015 296
How do you rate the performance of the Agro-Tech Smart Ex Model in rendering e-extension services? Pearson Correlation Sig. (2-tailed) N	.141* .015 296	1 304

\*. Correlation is significant at the 0.05 level (2-tailed).

**Source:** Author's Estimation (2017)

From the experiences and viewpoints of the OBs interacted with, when there is a favourable weather and climatic conditions, this results in good yield and because some of the farmers have assured market with animal feed industries they tend to have good business and they are able to reap good returns on their investment in e-extension and services delivery as well as paying for Agents services charges.

On the average Outgrower Business (OB) gives the following assistance to farmers:

- Linkage to Financial institution sometimes through NGOs
- Linkages to micro-finance institution such as Village Savings and Loans Scheme
- Tractor services for some farmers
- Linkage to input suppliers such as Agricare

Table 5 shows the level of improvement in access to specific extension and services delivery experienced by respondents before and after the Agro-Tech Smart Ex Model.

**Table 5** Improvement in Access to Extension and services delivery

Access to Extension and Services	Before Ago-Tech Smart Ex Model	After Ago-Tech smart Ex Model
Improved seeds	4.01	2.32
Labour services	3.64	2.91
Improved agronomic practices	4.08	1.81
Inorganic Fertilizer	3.95	2.11
Tractor Services	4.32	3.20
Irrigation	4.47	4.17
Market outlet	4.02	2.82
Storage facilities	4.06	2.21

**Source:** Author's Estimation. 1=Extremely Accessible 5=Not Accessible

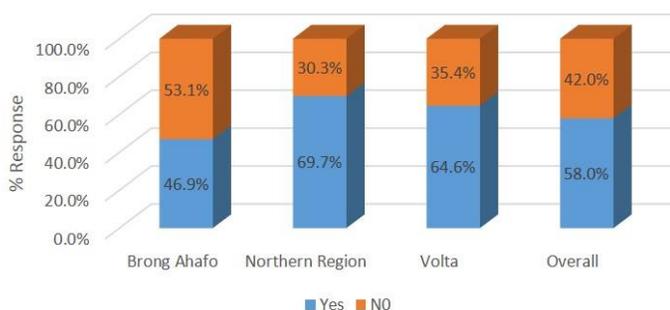
Respondents were asked to indicate on the scale of 1-5 the level of access to the following; 1=Extremely Accessible 5=Not Accessible. The results present the weighted averages of all the responses. The results show that the extension package does not cover irrigation services and access to tractor services. These services are limited making farming in the regions surveyed heavily dependent especially on rainfall which is risky.

### Willingness to pay for Extension Services

Willingness and capacity to pay for extension services delivery as in the AgroTech SmartEx model depend largely on the farmers and other value chain actors experiences regarding value addition and additional income realized as a result of being a beneficiary of the program.

Majority of the respondents were not paying direct fees for extension services delivery. Because the AgroTech Business model was led by business people involved in outgrower schemes (OBs as they are called). The payment mechanism for the extension services delivery was incorporated in the product buying prices. Indirectly, farmers who enjoyed the Agro-Tech Smart Ex paid for extension services through extra grain harvested given to the OBs or paid in-kind. That is making advisory services part of the cost of input-supply package. Primarily, farmers interviewed were willing to pay for extension services delivery as shown in Figure 8.

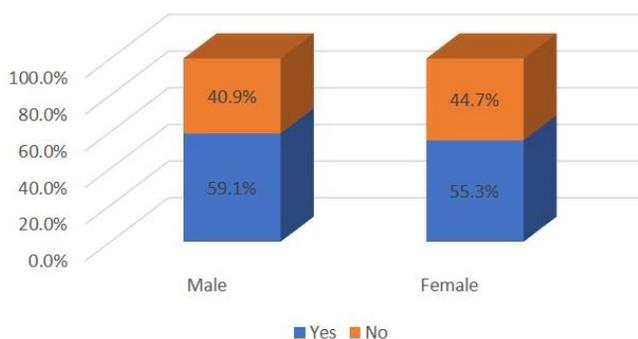
Fig 8 Willingness to pay for e-Extension Services Delivery



Source: Field Survey (2017)

Willingness to pay for extension services delivery was high in the Northern Region followed by Volta Region with the Brong Ahafo Region recording the lowest percentage of willingness to pay for extension and services delivery by farmers. Overall willingness to pay for extension services delivery was estimated at 58%. However as shown in figure 9, willingness to pay for extension services delivery was slightly higher among male farmers (59.1%) than female farmers (55.3%). Amount to be paid ranged from 5.00GHC (USD1.25) to GHC200.00 (USD50.00) per farmer per season depending on the crop productivity level in a particular season.

Figure 9 Willingness to pay for e-extension by Gender



Source: Field Survey (2017)

..... 'An OB indicated that payment is done indirectly. Instead of 50Kg of maize being the cost value of input supplied per acre of maize farm, at harvest I take the weight of maize of 55kg; the cost of e-extension and services delivered valued at 5kg of maize. Approximately I get 200GH/ season of 6months. This is very good if not for the risk involved in farming. For the past 4 years maize yields have not been encouraging hence difficult for farmers to pay for the extension and services delivery - very thorny issue'.....

..... 'Another OB said that I have encouraged my farmers to have a group farm. The produce from the group farm will be used to pay for extension and services delivery'.....  
 ..... 'Every week each member of the group pays GHC10.00. This is managed by a treasurer who is a woman. Both men and women cultivate the same crop if not a Moslem dominated community'.....

As discussed in the next section, the existing evidence from literature does not push for full-cost recovery of extension services delivery. The literature support public-private funding options for agricultural extension delivery and a gradual process of payment mechanism particularly for smallholder farmers.

## DISCUSSIONS

The Agro-Tech Model combines an ICT-Enable extension and advisory services delivery package through a mediated extension agent, and a direct to farmer interactive radio package that educate actors along the value chain on good agricultural extension practices. Selection criteria for beneficiary farmers are based on active membership in a group or farmer organization, credibility and trustworthy as a group member, willingness and ability to pay in-kind contribution for the services rendered. Success factors driving ICT-enabled extension and services delivery such as the Agro-Tech Smart Ex will ideally include adequate awareness, assured validity of information provided, allowance for interactions among users and service providers and a well-supported enabling environment.

There is a phenomenal change from supply driven extension and rural advisory services delivery to a demand driven and value chain approach (Elias *et al.* 2016; Singh, Shahi and Singh, (2016). Supply driven extension services approaches as witnessed in most public-sector approaches have been criticized as inefficient and being over-focused on production side issues with limited attention on marketing of agricultural produce (Manfre *et al.* 2013). With the gradual shift from supply to demand driven extension services delivery comes the issue of willingness to pay.

There is increasing debate on willingness to pay for extension delivery which is now shifting into the domain of private sector providers. Agricultural extension and advisory services which were traditionally funded, managed and delivered by the public sector are in transitory phase worldwide. Today, there is increased pressure to demand payment for extension services delivery. This has received mixed reactions but the willingness to pay in indirect ways are more acceptable among poor smallholder farmers than direct payment for extension and advisory services delivery in the agricultural value chains for some food crops. The chances are that willingness to pay for extension and advisory services delivery will be high among cash crop farmers than food crop farmers.

From the current study, response on willingness to pay for extension and advisory services among farmers interviewed was positive but farmers opted for an indirect payment option.

From the literature, willingness to pay for extension services and adoption of new technologies in the agricultural value chain is linked to improvement in yield, cost implications with regards to additional income, affordability and secured markets among others (Quaye *et al.* 2017, unpublished). A study by Falola, Kayode and Omonlumhen (2012) revealed that stock size, nature of production, level of education and age of the farmers are the significant factors affecting willingness-to-pay for extension services by fish farmers. Willingness to pay is more successful with production systems that are linked to secured markets. As discussed by Leeuwis (2006), in the case of the Agro-Tech Model, there could be a distribution channel whereby a commercial input provider or output buyer incorporates the cost of extension and advisory services in the selling/buying prices. Farmer groups can also subscribe to the Agro-Tech Model provision and pay from their membership dues.

Private processing companies that work with outgrower schemes can also adopt the Agro-Tech Model. For example, interactions with staff and Outgrower farmers of Blue skies in Ghana revealed that the company uses an indirect payment approach for the provision of extension and advisory services. In this approach Blue skies have experts who provide extension and advisory services directly to outgrower farmers on a regular basis to ensure quality supply of raw materials including mangoes, pineapples, pawpaw and passion fruits. Specific services rendered by the companies include training on Pest Management, Records keeping, personal hygiene and farm management. The companies generally would want to ensure a specific amount of production and often with a specific market quality requirement.

In connection with indirect payment for extension and advisory services (EAS) is the issue of Trust and relationship building. From the literature, effectiveness of

extension services requires strong building blocks in social trust. This implies that, as farmers' trust a system, they develop a positive attitude towards it. Also, the integrity and commitment of extension service providers significantly influence the perception that farmers develop on extension systems. Furthermore, trust positively correlates with the effectiveness of extension services (Turyahikayo and Kamagara, 2016).

Moreover, to build stronger relationships and foster Trust, indirect payment for EAS in this study is more pronounced with Identifying and operating through representative social networks (such as women's listeners clubs and farmers' groups). This study suggests that farmers' trust and willingness to pay for extension services is increased when local and traditional people from the community are integrated with the service delivery. This is relevant because such community groups have developed in a way that members over the years have built trust and feel free enough to speak about their deepest concerns. This is mostly evident in the case of vulnerable groups and people perceived to be of lower social status (FAO and GTZ, 2006). Research findings from Tall *et al.* (2014) studies also revealed similar results with the involvement of social networks and involvement of a trusted local NGO to build up trust with farmers to embrace EAS. Tall *et al.* (2014) further explained that where agricultural extension services are effective, service providers already have the knowledge and trust of farming communities.

The Agro-Tech Model can be fully integrated into the extension and advisory services delivery in Ghana. As indicated by Kidda *et al.* (2000) public and private sector led e-extension can co-exist since the role for the state in agricultural extension will continue to be important in many countries for both economic and social reasons. Where forms of privatization are useful, this will require tested strategies that are situation specific, multi-dimensional, gradual and flexible if resource-poorer farmers are to benefit.

## CONCLUSIONS AND RECOMMENDATIONS

This study concludes that:

*Agro-Tech Smart Ex Model has high performance rating.* More than one third of the farmers interviewed rated the performance of the Agro-Tech Smart Ex Model Excellent (above 70%) while 27% of the farmers sample interviewed rated the performance of the Agro-Tech Smart Ex Model Good (70 -50%). Interactions with farmers showed that factors such as timely supply of inputs, cost implications, improvement in crop yield and value addition that translates into additional income influence their decision on performance rating of the Agro-Tech Smart Ex Model.

Awareness of the Agro-Tech model in the communities surveyed was largely above average. Awareness level among males was higher than females.

The evaluation indicated a positive response to the overall performance of the Farm Radio International program content on improved practices and agriculture related issues, and time of airing particularly for women.

Men tune-in to listen and interact most often than their female counterparts. About 80% of the men were more comfortable with the airing time of Farm Radio Programs as compared to 54% of the female respondents.

Overall willingness to pay for extension and services delivery was estimated at 58%. Willingness to pay for extension and services delivery was slightly higher among male farmers (59.1%) than female farmers (55.3%). The amount farmers are willing to pay ranged from 5.00GHC to GHC200.00 (equivalent of US\$1.2 to US\$46 at the time of the survey in April 2017) per farmer per season depending on the crop productivity level in a particular season. However, an indirect mode of payment was more preferable to a direct payment.

## RECOMMENDATIONS

For scaling up of the AgroTech Model, there should be more focus on facilitating market access and/or guidance from the buyers on quality and quantity needs for farmers to respond appropriately. From the study, commercialization of the AgroTech model is feasible. However, payment indirectly or in-kind seems to be more preferable and therefore should be encouraged than direct payment which could be dependent on crop productivity. Possibilities for incorporating payment for Agro-tech Model utility in crop insurance schemes for commercial farmers should be explored. The study recommends future studies to consider the effect of ICT-Enabled extension services on crop yield and profitability. For policy considerations, the Ministry of Food and Agriculture (MOFA) should strongly promote the use of ICT enabled Extension and advisory Services delivery such as the Agro-Tech in Ghana.

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