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EVOLUTION OF AGRICULTURAL EXTENSION MODELS IN SUB-SAHARAN AFRICA: A CRITICAL REVIEW

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ABSTRACT: *This is a paper review of the work presented at the Royal Agricultural University, Cirencester, United Kingdom. Using library research and reflection, document, journal papers and content analysis were used to generate data. The Sub Saharan African region covered in the paper is that of seven countries. The paper describes the role of agricultural extension models in Sub-Saharan Africa, as well traces the various extension models currently being developed or implement in Sub-Saharan Africa, namely; the top down approaches; from international institutions/ national governments and participatory approaches/bottom-up that engage farmers in decision making. Currently, there are six basic extension approaches/models in diverse stages of development and implementation in developing countries. These models have been structured in a more analytical way around key themes; top down; participatory; demand-led; group versus individual targeting; private sector and free/paid extension services. The reality is that pluralism of models has been employed in various forms in most countries in Sub-Sahara Africa. The paper critically examined seven models, including National Public Extension Model, Training and Visit (T&V) Extension Model, Private Sector Model, Fee-For-Service Extension Models, Farmer Field School Model, Non-Governmental Organization Extension Model, Commodity Extension and Research Model.*

KEY WORDS: Sub-Saharan Africa, evolution, top down, participatory, model, extension services

INTRODUCTION

The genesis of agricultural education could be traced to the era when a movement of early researchers started to relate education to the needs and desires of human beings and the application of science to practical issues. Hence, this became apparent in the establishment of schools which gives prominence to teaching and application of science to agriculture, founding of agricultural societies and publication of agricultural literature in the 17th and 18th century (Ayansina 2011). The first agricultural society was founded in the United Kingdom in 1826 by Lord Henry Brougham, named the Society for the diffusion of useful knowledge, aimed to provide information to all classes of society. In 1843, Rothamsted Agricultural Research Station was established, and

in 1845, Royal Agricultural College was founded (Jones and Garforth 1998). Coincidentally, between 1845 and 1851 the Irish potato crop was destroyed by blight, a fungal disease, and extension services were used to assist farmers during outbreaks across Europe.

The term "*extension"* originated in England in 1867 when a system of university extension was taken up by the Universities of Cambridge, London and Oxford and subsequently by other educational institution in England and other countries. The actual use of the term *"University extension"* was first used in 1873 by Cambridge University to describe this particular innovation. The core objective of university extension was to take the educational advantages of the University to common people.

Evolution of Agricultural Extension in Africa

Africa is the only continent in the world where agricultural productivity is largely stagnant whilst populations grow rapidly, resulting in food insecurity and malnutrition among the populace (Veeman 2014; Madhusudan 2015; FAO 2015). Agricultural production has been limited by various constraints, which include lack of adequate research in science and technology; lack of dissemination of research; ineffective utilization of soil resources; low commodity prices and unstable markets for agricultural products; and storage and marketing issues (Okuneye,*et al.* 2003; Awoyinka,2009; Saingbe,*et al.* 2015; Awerije, 2017).

All these constraints are frequently emphasized by the lack of capital which is fundamental for agricultural development (Kennedy 2005). According to Simpson and Owen (2012) there are six key challenges facing agricultural extension in Africa:

1. Relevance and responsiveness of research to local concerns.
2. Systems learning and the generation of new knowledge.
3. Information flow and farmer-to-farmer communication.
4. Institutionalization and Local Organizational Development.
5. Changes in relationships.
6. The integration of the Farmer Field School into the existing program.

Experience from other parts of the world, particularly in the developing countries of Asia and Latin America, shows that agriculture has been rapidly transformed in recent years into a progressive commercial industry and treated as a full business (Thirtle and Piesse, 2003). Investment in the agricultural sector with adequate agricultural information technology has enabled farmers to intensify production and lead to sustainable development which enhances their standard of living as well as contributing significantly to national and rural prosperity within environmental constraints (Ali, 2011). This could also happen in Africa if smallholder farmers could be assisted with the necessary resources to intensify their farming activities through increased use/effectiveness of agricultural extension services delivery and information technology. However, agricultural extension is needed in order to help smallholder farmers increase their agricultural productivity and attain sustainable development. There is a general consensus that extension services, if successfully applied, should result in outcomes which include observable changes in attitudes and adoption of Good Agricultural Practice technologies and improve the quality of lives of farming households (Yegbemey, *et al.* 2014). Similarly, it has been recognized

that effective agricultural extension services could accelerate development in the presence of other important factors such as markets, agricultural improved technology, availability of supplies, production incentives (quality seeds, fertilizers and herbicides) and transport.

Over the years, a number of extension models have been adopted in developing countries to enhance the effectiveness of agricultural extension services and service delivery. According to Anandajayasekeram *et al.* (2008) a model may be defined as a schematic description of a system, or phenomenon that accounts for its known or inferred properties and may be utilized for the further study of its characteristics. Table 1.1 shows an illustrative review of various extension approaches around the world including government driven; private or supply driven; with several extension systems in Sub-Saharan Africa. This emphasizes the broad range of extension models that have been implemented in the past or are currently used, ranging from top-down to participatory approaches.

Table 1.1: Typologies of Extension by Various Scholars

Criteria	Rivera (1988)	Axinn (1998)	Gêmo, *et al.* (2005)
Top-down	Training and Visit (T&V)	Training and Visit (T&V)	Training and Visit (T&V)
	Conventional	Commodity	Commodity
	University	Educational institute approach	Farmer field schools (FFS)
	Technical innovation		NGO
	Integrated agricultural development program	Cost-sharing	Private sector
			NGO
Participatory	Farming system research-extension	Farming systems research and extension (FSR/E)	
	Farmer information dissemination system		
Contract farming	Commodity development	Project approach	Commodity
Rural development	Integrated development programs		
	Community development		

Source: Adapted from Davis 2008

Currently, there are six basic extension approaches/models in diverse stages of development and implementation in developing countries (Eicher 2007). These models have been structured in a more analytical way around key themes; top down; participatory; demand-led; group versus

individual targeting; private sector and free/paid extension services. It is, however, important to note that there is no superlative extension model for a particular country, as several countries are trying to identify the best extension model and as yet, there is no best practice (Davis 2008). The reality is that pluralism of models has been employed in various forms in most countries in Sub-Sahara Africa (Birner,*et al.* 2006; Davis, 2006; Birner and Anderson, 2007; Baig and Aldosari, 2013). Smallholder farmers in Sub-Saharan Africa now enjoy a mixture of extension delivery assistance from the public, NGOs and private firms (e.g. seeds and fertilizers dealers). However, the various extension models currently being developed or implement in Sub-Saharan Africa are summarized (Table 1.2) and can be divided into two main types:

- Top down approaches i.e. from international institutions or national governments.
- Participatory approaches that engage farmers.

Table 1.2: Top-down and Participatory Approaches

Top-down Approach	Participatory Approach
National Public Extension Model	Non-Governmental Organisation Extension Model
Training and Visit (T&V) Extension Model	Farmer Field School Model
Private Sector Model	Commodity Extension and Research Model
Fee-For-Service Extension Models	Agricultural Technology Management Agency (ATMA)
	National Agricultural Advisory Services (NAADS), Uganda
	Participatory Demonstration and Training Extension System (PADETES), Ethiopia
	National Agriculture and Livestock Extension Programme (NALEP), Kenya

Source: Author's own

Top-down Extension Approach

Top-down extension approach is a system whereby agricultural information from the Universities or ministry of agriculture is disseminated to farmers through extension agents and is directly related to the diffusion of innovation theory. This extension structure is known as Transfer of Technology (TOT) through extension workers who are also passive recipients of technology from the researchers to farmers. Top-down methods characterized the United States extension model, which was also instituted by many colonial governments in Africa (Anandajayasekeram *et al.* 2008). In Africa, the system helps promoting agricultural messages that have been designed and developed by research scientists, with limited input by the ultimate users (farmers) of the technologies. Technologies are spread vertically in the top-down approach (Anandajayasekeram *et al.* 2008).

In most cases, farmers are often persuaded through incentives or forced by authoritarian extension workers to adopt new agricultural technologies. Transfer of Technology models are robustly linked to the Diffusion of Innovations theory postulated by Rogers. This Diffusion of Innovations

theory says that technologies are communicated over time among the members of a social system, and adopted according to various characteristics of both the technology and the ultimate end users (farmers) (Rogers 2003, Anandajayasekeram *et al*. 2008). The Roger's Diffusion of Innovations model was focused on a very linear process of technology development. However, Roger's model has been criticized for employing linear technology transfer and for other inadequacies, such as the pro-innovation bias, blame of smallholder farmers for non-adoption and incorrect implementation of technologies, lack of recognition of farmers' vast indigenous knowledge and innovation, and too much emphasises on change agents (extension workers) instead of the users (farmers) of the technologies (Anandajayasekeram *et al.* 2008). Generally, the results of top-down approach to innovation development and diffusion are:

- The adoption rates of technologies remain low on the whole. The technology was not effective and the success in most cases not sustainable.
- The cultural, societal, organizational and power structure at the rural community level is mistreated and neglected.

The National Public Extension Model

This model was introduced by the US Land Grant system and works on three interconnected processes; agricultural research, extension, and agricultural higher education. However, in developing countries, agricultural extension services have been the exclusive domain of the public sector and government responsibility, while in most developed countries, extension services are mainly privatized (Swanson and Samy 2002) as agriculture becomes more commercial. Public extension deals with a broadrange of policy issues, including: responsiveness; relevance; cost-effectiveness and accountability (Swanson and Samy 2002). The overall objective has constantly been to contribute to the increase of agricultural production and productivity of the rural population (Shinn *et al.* 2009), utilizing mainly a top-down approach, through the Transfer of Technology (TOT). As mentioned previously, this model is strongly linked to the diffusion of innovation theory proposed by Rogers. This theory is known for the linear technology transfer which tends to work better only in the developed nations. Rogers himself moves away from linear technology process with the convergent model in the latest version of his theory (Roger 1995, Rogers 2003, Anandajayasekeram *et al.* 2008). In this model, technologies are generated at research stations and diffused to extension agents who in turn disseminate them to the farmers (Davis and Place 2003); in other word a one way transfer of information.

The information flow from the Ministry of Agriculture is absolutely supply-driven and not area-specific (Raabe 2008), meaning that in most cases the technical knowledge transferred into the field is distorted, outdated and often wrong for the specific situation. Thus, farmers see the quality of the information provided by the public extension staff as a major shortcoming (NSSO 2005), where a top-down approach continues to hinder the full potential of the extension service delivery system (Hall *et al*. 2000; Raabe 2008). Under the Ministry-based extension model, smallholder farmers' access to extension is also an issue, because of the low level of outreach by public extension services. The public extension model often has little to offer in terms of messages to a large section of the rural population. In fact, there is no specific answer to farmers' problems because it has not been a research concern to reach the farming community (Eicher 2007).

As a result, public extension came under attack in the 1980s because of the cost of financing it coupled with condemnations of insignificance, inefficiency, ineptness and lack of equity (Rivera 2001). In addition, the current ratio of extension agents to farm families is extremely low in most developing countries and this has been a continual threat to efforts in achieving food sufficiency. In Nigeria, for example, the current ratio is 1 to 3000 farmers (Oladele 2015). However, in Lagos state, Nigeria, Ogundele (2016) reported that the ratio is 1 extensions: 10,000 farm families. These ratio are far higher than the ratio of 1:500 recommended by the World Bank. Ideally, the ratio should be 1:200 farmers within a cluster so that they can make a meaningful impact by effectively teaching and monitoring the farmers' progress (Ogundele 2016).

Since the mid-1980s, agricultural extension has become a "pluralistic" method (Birner and Anderson 2007); public extension leaders have recognized the interdependent economic and social roles of NGO and private sector extension models in agricultural and rural development projects. The new ideas include decentralization; cost-recovery; outsourcing and involvement of other key stakeholders (Ferroni and Zhou 2012). According to Swanson and Samy (2002), collaboration among the three key stakeholders to effectively work together in partnership for the development of the agricultural sector and rural community (Figure 1.1).

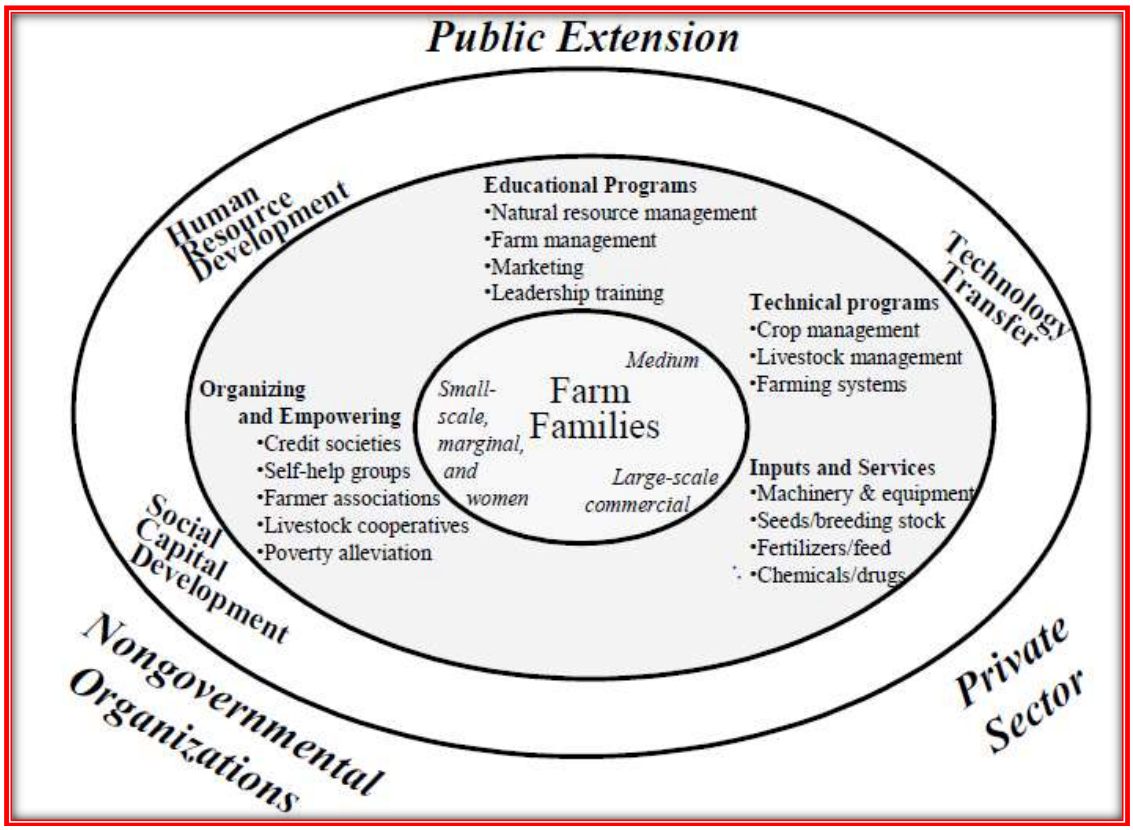


Figure 1.1: Conceptual framework depicting a Public, Private and NGO Partnership Adapted from Swanson and Samy 2002

This model also describes the partnership between the key players in agricultural extension and advisory services for sustainable agricultural development. The major responsibility of public extension is typically human resource development, technology transfer and educational programs in order to complement the social capital development of NGOs and the role of private sector extension model (Swanson and Samy 2002; Figure 1.1). In developing countries, there is a lot of collaboration between private sector, government, non-governmental organization and international donors to address food security issues and sustainable development.

Many Public extension models employed the Training and Visit (T&V) delivery system to perform its activities. The T&V system has been adopted by more than 70 countries around the globe (Umali and Schwartz 1994). The system employed a traditional approach in which research findings are transmitted to farmers through extension workers after training. The predominant one-way paradigm of technology transfer which is insufficient for addressing complex agricultural problems has been widely criticized (Chambers and Jiggin 1986; Roling 1988; Mattock and Steele 1994). According to World Bank (2010), public extension is incapable of serving resource-poor farmers due to inadequate linkages between research and extension; inadequate finance support; and poor human resource and facilities. In addition, the system's designer stressed the following characteristics: a single line of command, with several tiers of management between the field and supervisor; in-house technical expertise, whereby subject matter specialists are to provide training; exclusive dedication to information dissemination; and, a seasonal workshop with research personnel among others (Anderson and Feder 2003). The T&V model has proven to be financially unstable in many cases (Anderson *et al.* 2006).

There are several criticisms against the public extension model due to its inefficiencies and poor formulation and implementation of extension programmes (Ayansina 2011). In the same vein, Richardson (2005) enumerated other problems of traditional extension model. These include:

1. Failure to meet the needs of smallholder farmers.
2. Poor funding and extremely weak government commitment.
3. Inadequate human resource capital.
4. Lack of continuity of most of the government projects, which resulted in non-sustainability of these projects (Benor *et al.* 1984).
5. Non-involvement of farmers in the planning and technology development. Indeed, the services are supply driven rather than demand-driven. Farmer are not allowed to participate in technology planning.

Following the above review of the past extension models and current thinking in extension, the extension models employed in some selected Sub-Sahara Africa are summarised.

The Training and Visit (T&V) Extension Model

The Training and Visit extension (T&V) system in agriculture extension was conceived for building a group of professional extension personnel that is capable of guiding farmers in agricultural production and raising their productivity and income through appropriate, effective and efficient planning. The principle of the model was to create a professional agricultural extension service which has the perspective of supporting farmers to increase production and

incomes and also deliver proper advice, assistance and support to the farmers for agricultural productivity and rural development (Naamwintome and Millar 2013). The T&V model of extension was promoted by the World Bank in the 1970s as a national public extension system (Umali and Schwartz 1994). The T&V model was implemented through field demonstrations, farm visits, group and individual meetings. The T&V model expended about three billion dollars of donor assistance over the 1975 to 1995 period (Anderson *et al.* 2006; Eicher 2007; Anandajayasekeram *et al.* 2008).

According to Ilevbaoje (2004) the T&V model was characterized to be a single line of command; supply-driven and top-down approach; promoting agricultural messages that had been planned and developed by research scientists, while farmers (technology users) were usually not involved. Recommendations were sent down to farmers for adoption; it focused on effective training and visiting the contact farmers; time-bound work; field and farmers' orientation; consistent and regular training and strong linkages with agricultural research institutions and devotion primarily to extension work. The T&V model is centralised in a manner that the subject matter specialist would visit a group of "contact farmers" from surrounding villages on a fortnightly training session schedule (later every month) to train them and provide the most up-to-date information (Davis 2008; Ashraf *et al*. 2009).

The T&V extension model forbids front line extension officers from selling seeds and fertilizers, and instead places the emphasis on professionalism. Extension agents are required to concentrate on introducing improved technologies and innovations and training is provided regularly and continuously at all levels and field and farmers' orientation should be maintained (Ashraf *et al*. 2009). The T&V system was found to very effective in disseminating Green Revolution technologies, particularly irrigated areas in Asia (Davis 2008). However, the T&V extension model was criticized for being top-down; too rigid; labour intensive, and too expensive as it involves high levels of recurrent expenditure; many countries saddled with huge debts; autocratic in appearances and the one-way flow of innovation and information; thus, the system was irrelevant, unproductive and lacked equity (Reijntjes *et al.* 1995; Rivera 2001; Mengal *et al.* 2014). It is often referred to as "training and vanish" (Anderson 2007). Additionally, the withdrawal of the World Bank support from the T&V extension model confirmed that the model was financially unsustainable (Anderson *et al*. 2006).

In Kenya and Somalia, T&V was perceived slightly satisfactory (Gautam 2000) meanwhile in Rwanda and Cote d'Ivoire, T&V was considered unsatisfactory. However, it was successful Kenya because the government put enabling environment in place such as provision of infrastructure, most notably improved roads. Better roads can reduce transaction cost associated with agricultural activities including travel for extension officers. Also, public investment can play several roles in creating the enabling environment necessary to stimulate agricultural growth. For instance, by providing agricultural extension services, advise them on best farming practices, and assist them in dealing with adverse shock such as insect infestation and plant disease.

Similarly, in a study conducted in Ethiopia, Dejene (1989) found out that in the Training and Visit (T&V) extension model communication system from contact farmers to the non-contact farmers

in the villages did not work as effectively as anticipated; the author reported further that about 25% of contact farmers did not have the essential knowledge, skills and ability to disseminate the information acquired to the wider farming community (Dejene 1989). Likewise, in Cameroon evidence from a pilot study confirmed that merely 20% of respondents had contact with the extension workers, and even they found it extremely challenging to apply the knowledge acquired (Davis 2008).

In Nigeria, Asiabaka and Bamisile (1992) argued that a lack of communication skills, transportation issues, extension to farmers ration and cultural barriers contributed significantly to the failure of the T&V extension model. Historically, Nigeria adopted the World Bank assisted T&V system as the major approach for agricultural extension delivery to increase agricultural production and spread the benefits of improved farming techniques more widely to farmers nationwide. Undoubtedly, during that era T&V was comprehensively tested, monitored and evaluated in the country (Adejo *et al*. 2011). The central objective of T&V extension approach was based on transforming and improving upon the efficiency of the traditional agricultural extension system in the country. In Nigeria, the T&V extension model was implemented typically by the public-sector agency namely; the Agricultural Development Project (ADP) which was directly responsible for the dissemination of extension and advisory messages to farmers. ADP is the last chain of command, possibly the most significant element in the T&V management system of an extension in Nigeria (Fabusoro *et al.* 2008). The ADP adopted the T&V system though with modification after a while. The T&V is combined with the Unified Agricultural Extension System where extension workers are trained for necessary skills and knowledge in all enterprises of agriculture. The in-service training was organized by the ADP on a fortnightly basis to equip village extension agents with skills to prudently impart information to the farmers (Issa 2008; Fabusoro *et al.* 2008).

The Private Sector Model

The private sector assists in providing input and transfer technology to farmers and develops a sustainable and profitable business, selling extension services which go beyond the traditional mission of providing production technology to include market services and linkages (Ferroni and Zhou 2012). The private sector employed a marketing strategy of selling their products and extension services as one efficient package. Agro-dealers and input suppliers frequently provided vested advice and delivered extension services to farmers for productivity growth and improved links to markets (Ferroni and Zhou 2012). These relationships will sustain in the long run and give benefits to both parties. The private sector also provides extension as part of sales or stewardship schemes to ensure appropriate use of their inputs. Moreover, the private sector strategically maintain farmers' profiles and records centrally and provided solution packages targeted to the farmers according to their profiles. They maintain records of activities for each contact farmer. However, in the context of public extension services such practices are not available due to a large number of farmers serviced (Gemo *et al.* 2005). The private sector model is sturdily correlated to the top-down, transfer-of-technology model of technology dissemination, many following the theory of Diffusion of Innovation.

Adebayo (2004) identified three main advantages of private sector extension models from fund providers' and farmers' perspectives. These are:
a. Efficiency, that is the competition and decrease in public funding, leading to substantial reduction in costs which the private sector paid for.
b. Flexibility: the government and clients have a choice of service providers.
c. Accountability: the relationships provide transparent and levels of service.

In the same vein, the key issues in private sector participation in agricultural extension services have been identified by Adebayo (2004) including confusion due to a multiplicity of services providers, primarily due to the array of knowledge and information system; credibility of information sources and conflict of interests. Furthermore, sustainability is a crucial factor and the sustainability of the private sector in extension service delivery requires a completely new orientation among staff members who will deliver the service.

This model has been spreading around the globe especially in the very industrial countries like the Netherlands, New Zealand, and the United States, and more recently in some middle-income countries such as Chile and unindustrialized countries such as Uganda (Eicher 2007). Under this model, the farmer is anticipated to pay some of the cost of extension delivery services acquired with the expectation that public expenditures on the extension could be reduced (Anderson and Crowder 2000; Eicher 2007; Anandajayasekeram *et al.* 2008). However, there is no concrete evidence from the literature that smallholder farmers could pay for the extension advice which perhaps could help them alleviate extreme poverty (Anderson 2007).

Fee-For-Service Extension Models

Fee-for-service extension is provided by both public and private initiatives whereby farmers pay for extension services in an approach that makes services more affordable while minimizing long-term risks inherent in the credit model (Anderson and Feder 2005; Aker 2011). In this model, a small group of farmers normally contract extension workers with specific information and service requests. The fundamental goal of this extension model is to deliver the most up-to-date and appropriate information to the right farmer or a group of farmers via the formation of a demand driven extension service system which is cost effective, efficient and of high quality (Umali and Schwartz 2000, Foti *et al.* 2007). This model originated from New Zealand in 1986 where it was totally privatized. The UK's advisory services, ADAS, initiated a system of charge in 1987 and became full private sector company in 1997 and began cost recovery efforts (Garforth and Jones 2008). The Fee-For-Service (FFS) model does not only provide feedback to farmers but also makes available additional sources of profits to a public extension. However, charging for extension services will obviously ensure that the service is getting to those farmers or the groups of farmers that are actually interested in the information and would also implement the practice (Foti *et al.* 2007).

In an empirical study conducted in Zimbabwe, Mitei (2001) found that when farmers pay for the services rendered to them, the attendance and application rates was greater than 70%. Additionally, some scholars have argued that globally paid extension services is not in the public interest, nevertheless, there is a perfect combination of public, private and paid extension services (Hanson

and Just 2001; Davis 2011). The challenge envisaged with this type of model was that subsistence farmers especially the poor-resource farmers may not be able to purchase services (Anderson and Feder 2005). It was suggested that farmers should be categorized, thus permitting the commercial farmers to purchase services while the resource poor farmers be given adequate service by public extension agents. This is certainly related to the diffusion of innovation approach (Davis 2011).

Participatory Extension Approach

Participatory extension is basically a combination of technology transfer, advisory services and human resources development and involves two main elements. The first element addresses how extension systems are organized and emphasizes the fact that smallholder play significant role in shaping extension programmes, and also take ownership of the extension programme and operations. The second core element includes more participatory extension such as farmers-to-farmers exchange and experiential learning. It highlights that knowledge is acquired through interactive processes that include extension agents and progressive smallholder farmers.

In the same vein, the term participatory extension approach could be defined as involving the ultimate users and rural communities in all stages of the development process (Narayan 2016). Participatory projects contribute to empowerment of the individuals and communities involved in the project. Cummings (1995) defines a participatory project as one initiated and owned by the beneficiaries. On the other hand, the reputation of participatory extension models is based on the presumption that they eradicate the weaknesses of the traditional "top-down approach" to research and development (Anandajayasekeram 2008). The input of the ultimate users and beneficiary are highly valued in participatory approach and are related with increasing the respect for and incorporation of farmers indigenous knowledge in every aspect of the development project.

The significant features of the participatory approach include putting emphasis on people rather than things, it is also a decentralized system which ensure involvement of the key stakeholder in problem solving and implementation, empower the participants, to value and work on what matter to the beneficiary (subjective perspective), and also learn from the recipient rather than to teach them (Anandajayasekeram 2008). Similarly, farmers facilitated by outsiders where extension agents encourages farmers to share knowledge and experiences. This approach is distinctively related to TAM3 model, a modified version of the TAM proposed by Venkatesh and Bala (2008). The participants (farmers) also involved in the problem identification, decision making, implementation, monitoring and evaluation. The following extension models are examples of participatory approaches:

The Farmer Field School Model

The Farmer Field School (FSS) extension model emerged in 1989 and originated from Indonesia and the Philippines during the rice mono-cropping farming era when extension agents offered advice to a group of farmers on a strategy to control pest in irrigated rice farming using Integrated Pest Management (IPM). The FFS extension model is a participatory methodology of technology development and dissemination, which gives the farmers an opportunity to learn practical field activities. The members of the group fund the school and the group tends to show high levels of ownership. FFS was remarkably active in reducing insecticide use in Indonesia and Philippines (Feder *et al.* 2004). Around 70 developing countries are currently using the model and found it

very effective and efficient for extension delivery services (Eicher 2007). The FFS model had successfully produced about 4 million competent graduated farmers by mid-2000s according to Braun (2006). FFS is strongly correlated with Technology Acceptance Model (TAM) theory with long-term development achievement.

The FFS model has intensive training activities which utilize participatory methods to assist farmers to develop their analytical knowledge and skills, critical thinking and creativity and; as a result, help them learn how to make healthier and better decisions, not only in their farming operations but also in their daily activities (Kenmore 2002; Anandajayasekeram *et al.* 2008, at least once a week on the farmland of a member. There are usually between 20 and 2). FFS is an informal school within the farmers' location, a school without a wall, community-based learning where alike-minded group of neighboring farmers gather together periodically 5 farmers in attendance with facilitators during the crops and animal cycle.

However, Anandajayasekeram *et al.* (2008) outlined some challenges encountered in implementing FFS in the developing countries including; inadequate exposure of research and extension personnel to the concepts and procedures of FFS; competition and conflict of interest between different donor agencies; sharing of proceeds from the school approach; lack of coordination of FFS activities at the national level in Kenya, gender inequalities and low level of participation and the involvement of policy makers. In Nigeria, the FFS approach gained acceptance and became the foundation of field based food security programmes (Dimelu and Okoro 2011). Various FFS's are established in many states in Nigeria, although, the attributes, prospects and implementation and constraining factors have not been evaluated (Dimelu and Okoro 2011).

The Non-Governmental Organization Extension Model

NGOs are recognized for being relatively well endowed with financial resources for their programs and their crucial role in agricultural and rural development has been largely acknowledged by experts (Swanson and Samy 2002; Davis and Place 2003; Swanson and Rajalaht 2010). Giving the dwindling public extension services, a number of national governments and international donors view NGOs as more effective and efficient in rural community mobilization (Swanson and Rajalaht 2010). Moreover, NGOs have great mobility and drive for bottom-up approaches and play an increasingly significant role in agricultural research and extension in less developed countries especially in localities where the institutional infrastructure is weak (Mattock and Steele 1994). In addition, NGOs are filling a critical gap and offer considerable services in the area of agricultural development and rural community development. NGOs often utilize a "Farmer First" extension service approach; a participatory, demand-driven and client-centred approach, which perhaps explains why they have been more effective and efficient than a top-down approach to the Transfer of Technology (Davis and Place 2003). The opposing approaches of farmer first and Transfer of Technology are summarized (Table 2.4). The participatory approach of NGOs explicitly aims to enable smallholder farmers to become self-teaching experimenters and to train peers (Anderson 2007; Ferroni and Zhou 2012).

Table 1.3: Philosophy of TOT and Farmer First by NGOs

Factor	Transfer of Technology	Farmer First
Diffusion of technology	Top down	Bottom up
Farmer's role	Beneficiary	Client; colleague
Scientist's role	Technology generator	Consultant; collaborator
Extensionists' role	Deliver technology & demonstrate	Facilitate and network
Determination of research priorities	Perceptions of scientists	Perception and needs of farmers
Main research location	Research station	Farmers' fields
Explanation of non-adoption	Failure of farmer to learn, farmer's constraints	Failure of technology and of scientists

Adapted from Davis and Place (2003)

The Farmer First (bottom-up approach) is a unique model in the view of farmers and agricultural development experts. It is a participatory approach that sees smallholder farmers as part of the technology generation process, using their farmland as a central location to the model, providing essential resources and inputs and evaluation of new technologies. The Farmer First approach has been utilized heavily by NGOs to meet the needs of smallholder farmers and enhance rural development. Davis and Place (2003) reported that NGOs have numerous advantages over other extension providers, for example; NGO staff members tend to be better motivated with improved salaries; the organization is often ready in assisting the resource poor farmers through community organization and poverty alleviation programs; and there is often there was the availability of funds and access to facilities. In addition, NGOs tend to use a unique method of identifying the needs of farming families and then assist the poor families in bringing to more sustainable development (Swanson and Samy 2002). However, critics stated that often NGOs fail to develop procedures for monitoring and evaluating their performance, accountability and conducting strategic planning (Davis and Place 2003).

The Commodity Extension and Research Model

This model was initiated among smallholders' farmers producing cotton in Mali, Malaysia and other Francophone countries by the colonial powers (Eicher 2007; Anandajayasekeram *et al.* 2008). It is a type of farmer organization at village-level dealing with inputs needed by the members (the resource owners), to increase the productivity and livelihoods of the rural community. The focus is generally on a single crop or one aspect of farming. Extension delivery tends to be effective and focus on only a single commodity and the organization is generally small and predominately concerned about inputs (Kenmore 2002). This type of association generates income from the sale of inputs and outputs. The model is participatory, democratic, responsive and community-based.

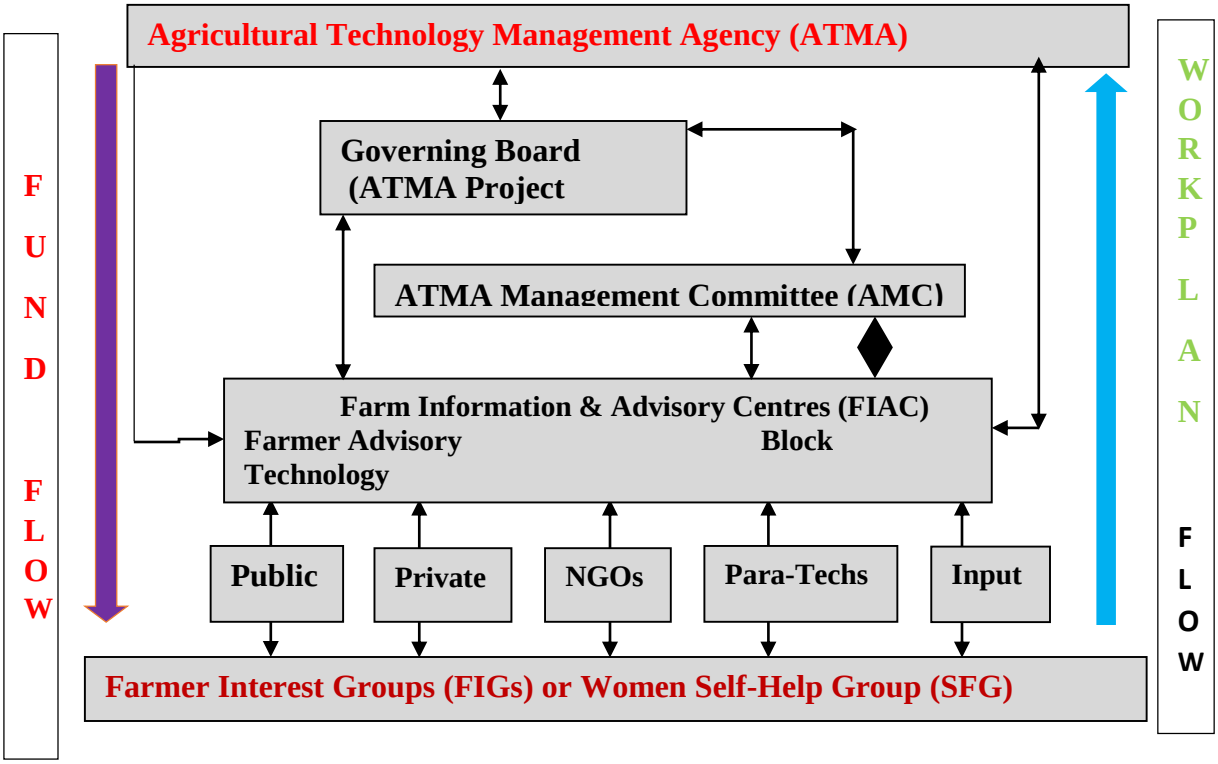
In this model, the interest of the association supersedes farmers' interest. Research, extension and production are effective and closely interconnected. Similarly, all the functions related to the

commodity are combined together such as research, extension, input supply, output marketing and prices. However, the model is not without some disadvantages including less priority for farmers' interests, conflict arising among members if not properly handled, the needs of or the whole farmers may not be considered, and extension services are usually determined by the agents not farmers.

The Agricultural Technology Management Agency (ATMA)

The Agricultural Technology Management Agency (ATMA) is an Indian self-governing decentralized participatory and market-driven extension approach which symbolizes a transformation from transferring technologies to better coordination of research and extension activities (Singh *et al*. 2006). The primary objective is to increase significantly farm income and rural development; integrate extension services across departments; link research and extension and the involvement of farmer organizations to enhance productivity (Swanson *et al*. 2008; Birner *et al.* 2009). The ATMA is primarily a government extension initiative to support the state extension reform which aims to assist the states to revitalize its extension system (Gupta and Shinde 2013). The ATMA extension model employs a bottom-up planning technique which combines decentralization with the continuous use of public sector extension agents, to encourage agricultural modification and the improvement of rural livelihoods (Eicher 2007; Birner *et al.* 2009). Interestingly, the ATMA approach has been considered as the most successful agricultural extension reform in India because within five years of establishment the model had spread out rapidly and been adopted in all 600 districts in the country (Anderson 2007; Davis 2008).

ATMA was formed as a registered society outside of the customary government organization as an autonomous group who can receive, apportion and even authorize to expend government funds (Figure 2.5). The ATMA Governing Board, which is composed of a cross-section of stakeholder representatives, determines priorities and can also take decisions on extension activities (Swanson 2006; Ferroni and Zhou 2012). However, the ATMA started experiencing challenges of which the notable ones are a lack of qualified local manpower; delivery mechanism issues; technical and financial support and a clear framework for partnerships (Kapoor 2010; Ferroni and Zhou 2012).



Adapted from Singh and Swanson (2006)
Figure 1.2. Organizational Structure of Agricultural Technology Management Agency (ATMA)

National Agricultural Advisory Services (NAADS), Uganda

NAADS is an innovative farmer-driven extension service initiated in 2001 by the government of Uganda, and constituted a promising new approach with the goal of improving the productivity and livelihood of farmers through the adoption of profitable agricultural enterprises and improved technologies (Benin *et al.* 2012; Swanson and Rajalaht 2010). Moreover, as part of a wide-ranging Plan for the Modernization of Agriculture (PMA), whose priority included; promoting agricultural research and technology; improved access to quality agricultural advisory services; promoting agricultural skills and knowledge through formal and informal education; improving access to available rural finance; promoting agro-processing and improving access to markets; promoting the sustainable use and management of natural resources and improving supportive social amenities (Larsen *et al.* 2009; Kasirye 2013). The NAADS is sponsored by donors, which creates a decentralized and operating through product-based farmer groups. It is usually considered as a farmer-owned private sector delivery which addresses all the needs generated by grassroots farmers. Technology development was an integral success element of NAAD, which was provided inthe form of revolving credit and provided the opportunity for direct farmer involvement in learning new skills and new technology adoption, productivity and per capita income. The features of NAADS were further enumerated by Anderson (2007) including decentralization; outsourcing; subcontracting; farmers' empowerment; market orientation and increasing cost recovery.

Furthermore, apart from availing up-to-date information to farmers, the programme also significantly enhances farmer access to productivity via technologies, and empowers farmers with skills and knowledge in order to shift from subsistence to commercial farming (Kasirye 2013). NAADS, provides an interesting example for other African countries to emulate in their effort to enhance rural communities and ensure sustainable agricultural development (Anderson 2007, Benin *et al.* 2012).

Participatory Demonstration and Training Extension System (PADETES), Ethiopia

PADETES was initiated in Ethiopia based on the experience and publicized success story of Sasakawa Global programme (SG-2000) as an extension approach which promoted cereals production using on-farm demonstration plots and links technologies to inputs through a package deal (Kiptot *et al.* 2013). PADETES aimed at increasing productivity of smallholder farmers; improve incomes through enhancing productivity; empowering farmers to actively participate in the development process; ensure self-sufficiency in food production; establish farmer organizations; increase production of export crops; conserve natural resources; and encourage farmer organizations and women's participation in development (Davis *et al.* 2010). The model promoted cereals production via the Extension Management and Training Plot (EMTP), usually half hectare on-farm demonstration plots which were managed by farmers and used to train other farmers and extension workers on good agronomic and farm management practices (Egziabher *et al.* 2010).

The beneficiaries were mostly those smallholder farmers who reside in high rainfall areas of the country, though, the yields on the upscale plots were not as high as those on the original demonstration plots, perhaps because of lack of sufficient supervision by the extension staff (Davis *et al.* 2010; Egziabher *et al.* 2010). The programme focused primarily on increasing the productivity of smallholders through better access to improved production technology such as improved seeds; fertilizer; pesticides and other improved production practices (Wubneh 2007). Extension agents saw their role typically as distributors of fertilizers rather than technical advisors (Davis 2008). However, other studies found that extension workers and rural services contributed significantly to the massive increase in agricultural production (Ayele *et al.* 2005).

According to Davis *et al.* (2010) PADETES employed a related extension system to Sasakawa Global programme (SG-2000), in conjunction with a modified T&V extension model. Several studies (Swanson and Rajalaht 2010, Kiptot *et al.* 2013, Lucky and Achebe 2013) have been conducted to review and evaluate PADETES' programme, notable among them was EFA/EEPRI 2006. The results of the study revealed the following significant achievements of the model:

- Reach several smallholder farmers equitably
- Quick increase in productivity
- Increased production of cereals
- Rapid use of fertilizer and improved seeds
- Increased numbers of participating households in extension packages.

Weaknesses

- The majority of extension packages are on crop production and extension is supply-driven and limited training for extension workers.
- Extension packages are formulated at the federal level and there is lack of regional strategies
- Limited focus on cereals crops, cash crops and animals
- Limitations in infrastructure, marketing and inputs affected implemented
- Limited participation of women farmers (Lucky and Achebe 2013)

National Agriculture and Livestock Extension Programme (NALEP), Kenya

The current Kenya extension program, National Agriculture and Livestock Extension Programme was established in the year 2000 which encourages common interest groups (CIGs) among farmers. Groups are generally believed to extend technologies faster than individual farmers (Anandajayasekeram *et al*. 2008). The NALEP approach supported in part by Swedish International Development Cooperation Agency (SIDA) focuses on supporting demand-driven, pluralistic and farmer-led extension system involving all stakeholders which facilitate a gradual transition from predominantly public extension to private provision of agricultural extension services (Anandajayasekeram *et al*. 2008). The NALEP mission was to transform agriculture and livestock to a sustainable system to achieve food security, wealth creation and national economic growth through science-based market-oriented, competitive and profitable agricultural systems (Chhettri 2011).

The main objectives of NALEP was to guide the establishment and implementation of the programme of pluralistic extension systems through national agricultural and livestock goals; significantly contribute to poverty reduction; develop and improving the efficiency of sustainable agriculture as well as livestock, water, forestry and rangeland resource (Cueller *et al.* 2006). These objectives will be achieved via diverse strategies including; organizing farmers into viable rural organizations; empowerment of farmers to adequately respond to food security through the transfer of adapted research technologies; inclusion of other stakeholders in the activities; bottom-up planning system; involving the farmers at all levels in the project; ensuring farmers participate fully in the decision-making processes and group-based approaches in focal areas (Chhettri 2011; Ngugi *et al.* 2014).

However, it is imperative to acknowledge that NALEP is not without its own challenges including; lack of financial strength to support farmers, a declining attendance of the farmers in training, field days and seminars; too short time framework for NALEP officials to implement the programme and lack of demonstration materials (Chhettri 2011). The training and retraining of the extension personnel on issues of marketing, packaging and emerging crops and animals to ensure they meet the expectations of farmers also came up as a challenge to be noted (Ngugi *et al.* 2014).

CONCLUSION AND RECOMMENDATION

The section has highlighted the various agricultural extension approaches in SSA and put forward the evolution of extension in Africa. The section further considers various extension models

currently implemented in the developing countries and their correlation with different extension theories and models, particularly Diffusion of Innovation Theory and Technology Acceptance Model. In addition, a review of top-down and participatory extension approaches has been presented which shows that all the paradigm of participatory extension were considered to be most beneficial to smallholder farmers. This section has so far, put into context the way in which extension models operates in Africa and the underlying theories previously discussed.

References

Adebayo, K. (2004). Private sector participation in agricultural extension services in Nigeria. Paper prepared for presentation at the Farm Management Association of Nigeria Conference, held on Oct. 19-21, 2004, Abuja, Nigeria https://core.ac.uk/download/pdf/6499396.pdf

Adejo, P.E., Okwu, O.J. and Ibrahim, M.K. (2012). Challenges and prospects of privatization of agricultural extension service delivery in Nigeria. *Journal of Agricultural Extension and Rural Development,* 4(3), 63-68

Aker, J.C. (2011). Dial 'A' for agriculture: a review of information and communication technologies for agricultural extension in developing countries. *Agricultural Economics*,42 (6), 631-647.

Ali, J. (2011). Factors Affecting the Adoption of Information and Communication Technologies (ICTs) for Farming Decisions, *Journal of Agricultural & Food Information*, 13(1), 78-96.

Anandajayasekeram P, Puskur R, Sindu, W. and Hoekstra D. (2008). Concepts and practices in agricultural extension in developing countries: A source book. IFPRI (International Food Policy Research Institute), Washington, DC, USA, and ILRI (International Livestock Research Institute), Nairobi, Kenya. 275 pp

Anderson, J. and Crowder. L.V. (2000). The Present and Future of Public Sector Extension in Africa: Contracting-out or Contracting-in? *Public Administration and Development*.

Anderson, J.R. and Feder, G. (2003). Agricultural extension: Good intentions and hard realities. The World Bank, *Research Observer,* 19(1), 41–60.

Anderson, J.R., Feder, G. and Ganguly, S. (2006). The rise and fall of training and visit extension: An Asian mini-drama with an African epilogue. Policy Research Working Paper 3928, The World Bank, Washington, DC.

Ashraf, I., Muhammad, S., Mahmood, K., Idrees, M. and Shah, N. (2009). Strength and weakness of extension system as perceived extension field staff. *Sarhad Journal of Agriculture*, 25(1), 131-134.

Asiabaka, C.C., and Bamisile, A.I. (1992). Evaluation of constraints affecting the performance of extension agents in the Lagos State Agricultural Development Project in Nigeria. *Tropical Science,* 32, 421-428.

Awerije, B. (2014). Exploring the Potential of Cassava for Agricultural Growth and Economic Development in Nigeria, Unpublished PhD. Thesis, University of Plymouth, UK.

Awoyinka, Y.A. (2009). Cassava Marketing: Option for Sustainable Agricultural Development in Nigeria. *Ozean Journal of Applied Science* 2(2), 175-183.

Axinn, G. H. (1988). *Guide on alternative extension approaches.* Rome: FAOAxinn, G.H. (1988). T&V (Tragic and Vain) extension? *Interpaks Interchange,* 5(3), 6-14.

Ayansina, S.O. (2011). Farmers' Perception of Public and Private Extension Services in South Western Nigeria, Unpublished PhD Thesis, University of Ilorin.

Ayele, G., Alemu, D. and Kelemework, F. (2005). The provisions of rural services in Ethiopia: Characterization, impacts, and farmers' priorities. Unpublished manuscript, International Food Policy Research Institute, Washington, DC

Baig, M.B. and Aldosari, F. (2013). Agricultural Extension in Asia: Constraints and Options for Improvement. *Journal of Animal and Plant Sciences* 23, 619–632.

Benin, S., Nkonya, E., Okecho, G., Randriamamonjy, J., Kato, E., Lubade, G., Kyotalimye, M. and Byekwaso, F. (2010). Impacts of and returns to public investment in agricultural extension: the Case of the National Agricultural Advisory Services (NAADS) Program of Uganda. IFPRI mimeo. (Accessed 13 June 2020)

Benor, D. (1984). *Agricultural Extension: The Training and Visit System*. Back to basics. World Bank, Washington, D.C.

Birner, R. and Anderson, J.R. (2007). How to make agricultural extension demand-driven? The case of India's agricultural extension policy. IFPRI Discussion Paper 00729, Development Strategy and Governance Division, IFPRI.

Birner, R., Davis, K., Pender, J., Nkonya, E., Anandajayasekeram, P., Ekboir, J., Mbabu, A., Spielman, D. J., Horna, D., Benin, S., and Kisamba-Mugerwa, W. (2006). *From best practice to best fit: A framework for designing and analyzing agricultural advisory services*. ISNAR Discussion Paper No. 5. Washington, D.C.: IFPRI.

Birner, R., Davis, K., Pender, J., Nkonya, E., Anandajayasekeram, P., Ekboir, J., Mbabu, A., Spielman, D., Horna, D., Benin, S. and Cohen, M. (2009). From best practice to best fit. A framework for analyzing pluralistic agricultural advisory services worldwide. *Journal of Agricultural Education and Extension*, 15(4), 341-355.

Braun, V. and Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology,* 3(2), 77-101.

Chambers, R. and Jiggins, J. (1986). Agricultural Research for Resource-Poor Farmers Part I: Transfer-of-Technology and Farming Systems Research Agric. *Admin.* and *Extension*. 27, 35-52

Chhettri, J. (2011). Agriculture and Livestock Task Force (2011). Government of South Sudan (GOSS) National Agriculture and Livestock Extension Policy (NALEP).

Cueller, M., Hedland, H., Mbai, J. and Mwangi, J. (2006). The National Agriculture and Livestock Extension Programme (NALEP) Phase I impact assessment. Sida Evaluation 06/31. Stockholm: Swedish International Development Cooperation Agency.

Cummings, F.H. (1995). Role of participation in the evaluation of and implementation of development projects. Paper presented at the International Evaluation Conference, Vancouver, Canada, 1–5 November 1995.

Davis, K. and Place, N. (2003). Non-governmental organizations as an important actor in agricultural extension in semiarid East Africa. *Journal of International Agricultural and Extension Education* 10(1), 31–36.

Davis, K.E. (2008). Extension in Sub-Saharan Africa: Overview and Assessment of Past and Current Models, and Future Prospects, *Journal of International Agricultural and Extension Education*, 15(3), 15-28.

Dejene, A. (1989). The training and visit agricultural extension in rainfed agriculture: Lessons from Ethiopia. *World Development*, 17(10), 674- 659.

Dimelu, M.U. and Okoro, C.P. (2011). Prospects of Farmer Field School Extension Approach in Enugu State, *Journal of International Agricultural and Extension Education*, 15(2), 79-89.

Egziabher, G.K., Mathijs, E., Maertens, M., Deckers, J. and Bauer, H. (2010). Extension Participation, Household Income and Income Diversification: A System Equations Approach. Proceedings of the CSAE 25th Anniversary Conference 2011: Economic Development in Africa, 20th-22nd March, 2011

Eicher, C.K. (2007). Agricultural extension in Africa and Asia. Literature review prepared for the World AgInfo Project. Cornell University, Ithaca, New York, USA.

Fabusoro, E., Awotunde, J.A., Sodiay, C.I. and Alarima, C.I. (2008). Status of Job Motivation and Job performance of field level Extension Agents in Ogun State: Implications for Agricultural Development. *Journal of Agricultural Extension*, 11(1), 1-8.

FAO, (2015). Achieving Zero Hunger. The critical role of investments in social protection and agriculture. Rome, FAO.

Ferroni, M. and Zhou, Y. (2012). Achievements and Challenges in Agricultural Extension in India. *Global Journal of Emerging Market Economies*, 4(3), 319-346

Foti, R., Nyakudya, I., Moyo, M., Chikuvire, J. and Mlambo, N. (2007). "Determinants of Farmer Demand for "Fee-for-Service" Extension in Zimbabwe: The Case of Mashonaland Central Province*." Journal of International Agricultural and Extension Education,* 14(1), 95–104.

Garforth, C. and Jones, S. (2008). United Kingdom: ADAS and the Privatization of Advisory services in England and Wales.

Gautam, M. (2000). *Agricultural extension: The Kenya experience: An impact evaluation.* World Bank, Operations Evaluation Department, Washington, DC, USA.

Gemo, H., Eicher, C.K. and Teclemariam, S. (2005). *Mozambique's experience in building a national extension system.* Michigan State University Press, East Lansing, USA.

Gupta, H. and Shinde, S. (2013). Agricultural Extension in India, *International Journal of Management and Social Sciences Research,* 2(11), 25-38,

Hall, J. and Pretty, J. (2008). Then and now: Norfolk farmers' changing Relationships and linkages with government Agencies during transformations in land Management, *Journal of Farm Management,* 13(6), 393-418.

Hanson, J.C. and Just, R.E. (2001). The Potential for Transition to Paid Extension: Some Guiding Economic Principles. *American Journal of Agricultural Economics,* 83(3), 77-88.

Ilevbaoje, I.E. (2008). Training and Visit Extension System Flourishes in Nigeria. BeraterInnen News.

Issa, F.O. (2008). Evaluation of Job Performance of Village Extension Agents in Lagos State, Nigeria. *Journal of Agricultural Extension,* 11(1), 28-44.

Jones, G.E. and Garforth, C. (1998). The history, development, and future of agricultural extension in Swanson, B. "Improving Agricultural Extension: A Reference Manual (3rd Edition)" FAO.

Kapoor, R. (2010). Financially sustainable models key to agricultural extension system. Business Line (The HINDU), Monday, June 21, 2016. Retrieved from http://www.thehindubusinessline.com/todays-paper/tp-agri-biz-and-commodity/article994780.ece

Kasirye, I. (2013). Constraints to agriculture technology adoption in Uganda. Evidence from 2005/06-2009/10 Uganda National Panel Survey. Economic Policy Research Centre (EPRC) Series No. 102. http://ageconsearch.umn.edu/bitstream/160629/2/Chapter%204.pdf (accessed 13 September 2020).

Kenmore, P. (2002). Integrated Pest Management. *International Journal of Occupational & Environmental Health*, 8(3), 173-174.

Kennedy, K. (2005). The 2005 TRIPS Extension for the Least-Developed Countries: A Failure of the Single Undertaking Approach? 40 International Law. 683

Kiptot, E., Lukuyu, B. and Franzel, S. (2014). "Voluntarism as an Investment in Human, Social and Financial Capital: Evidence from a Farmer-to-farmer Extension Program in Kenya." *Agriculture and Human*, 31(2), 231–243.

Larsen, K., Kim, R., and Theus, F. (2009). Agribusiness and Innovation Systems in Africa. The World Bank, Washington.

Lucky, O. and Achebe, F. (2013). Information Communication Technology and Agricultural Information Dissemination: A Case Study of Institute of Agricultural Research (IAR) Ahmadu Bello University, Zaria, Kaduna State, *Research Journal of Information Technology* 5(1), 11-17.

Madhusudan, M.D. (2005). The Global Village: Linkages between International coffee Markets and Grazing by livestock in a South Indian Wildlife Reserve, *Conservation Biology,* 19(2), 411-420.

Mattocks, D.M. and Steele, R.E. (1994). Non-Governmental Paradigms in agricultural development: A relationship of competition of collaboration? *Journal of International Agricultural and Extension Education,* 54-62.

Mitei, R. (2001). Improving extension systems in tropical agriculture. Washington, D.C.: The World Bank.

Naamwintome, B.A. and Millar, D. (2013). Change Trends in Agricultural Extension Strategies: Who Dictates? *Scottish Journal of Arts, Social Sciences and Scientific Studies,* 16(1), 3-12.

National Sample Survey Organization (NSSO) (2005). Situation assessment survey of farmers: Access to modern technology for farming, 59th round (January–December 2003).

Ngugi, J.,Muigai, S. and Muhoro, F. (2014). Transforming Agriculture Through Contracted Extension Service Delivery Systems: The Case of Kenya's Agricultural Productivity and Agribusiness Project, *African Crop Science Journal*, 22(4), 905-915.

Ogundele (2016). The Guardian Newspaper, Nigeria.

Okuneye, P.A., Fabusoro, E., Adebayo, K. and Ayinde, I.A. (2003). The Nigerian Agriculture and Poverty Incidence: The Need For Private Sector Empowerment, Paper prepared for presentation at the Farm Management Association of Nigeria Conference, Abuja, Nigeria Oct. 19-21

Raabe, K. (2008). *Reforming the agricultural extension system in India: What do we know about what works where and why?* IFPRI Discussion Paper 00775. Washington, D.C.: International Food Policy Research Institute

Reijntes, C., Harvertkort, B. and Water-Bayer, A. (1995). Agriculture and sustainability in: Farming for the future an introduction to low-external-input and sustainable agriculture. Micmillan, Netherlands, 11-28

Rivera, W.M. (1988). The 'Business' of the Public Sector: Extension in Transition and the Balance of Powers, *Journal of International Agricultural and Extension Education,* 15(2), 19-31.

Rivera, W.M. (2001). Agricultural extension into the next decade, *European Journal of Agricultural Education and Extension,* 4(1), 29-38.

Rogers, E.M. (1995). Diffusion of Innovations, New York Free Press.

Rogers, E.M. (2003). Diffusion of innovations (5th ed.). New York: Free Press.

Saingbe, N.D., Ibrahim, H.Y. and Ibrahim, H.I. (2015). An evaluation of groundnut processing by women in a rural area of North Central Nigeria. *Journal of Agricultural Science,* 2(1), 206-212.

Shinn, G.C., Wingenbach, G.J., Lindner, J.R., Briders, G.E. and Baker, M. (2009). Redefining Agricultural and Extension Education as a field of Study: Consensus of Fifteen Engaged International Scholars. *Journal of International Agricultural and Extension Education,* 16(1), 73-88.

Simpson, B.M, and Owens, M. (2012). Farmer field schools and the future of agricultural extension in Africa. *Journal of International Agricultural and Extension Education,* 9(2), 29-36

Singh, J. P., Swanson, B. E. and Singh. K. M. (2006). Developing a decentralized, market-driven extension system in India: The ATMA model, pp. 203–223. In A. W. van den Ban and R. K. Samanta, eds., *Changing Roles of Agricultural Extension in Asian Nations*. Delhi, India: B. R. Publishing.

Swanson, B.E and Rajalahti, R. (2010). Strengthening Agricultural Extension and Advisory Systems: Procedures for Assessing, Transforming, and Evaluating Extension Systems. Agriculture and Rural Development Discussion Paper 45. The World Bank.

Swanson, E. B. and Samy, M. (2002). Asset Mapping: A useful methodology to plan systematically extension programs for sustainable rural economic development 'Paper presented at the 18th annual meeting of the association for international agricultural and extension education, Durban, South Africa

Thirtle, C. and Piesse, J. (2003). The Impact of Research-Led Agricultural Productivity Growth on Poverty Reduction in Africa, Asia and Latin America, *World Development*, 31, (12), 1959–1975.

Veeman, M. (2014). Labelling policy for GM food. *Current Agriculture, Food & Resource Issues*, 4, 107-115.

Venkatesh, V. and Bala, H. (2008), "Technology Acceptance Model 3 and a Research Agenda on Interventions", *Decision Sciences*, 39(2), 273–315.

World Bank (2010). World Development Report: Agriculture for Development. Washington DC, World Bank.

Wubneh, F.K. (2007). Realizing the dream: Agricultural extension for rural livelihoods development in Ethiopia. Institute of Social Studies (ISS) Graduate School of Development Studies. The Hague, The Netherlands: ISS.

Yegbemey, R.N., Yabi, J.A., Heubach, K., Bauer, S. and Nuppenau, E.A. (2014). Willingness to be informed and to pay for agricultural extension services in times of climate change: the

case of maize farming in northern Benin, West Africa, *Climate and Development,* 6(2), 132-143.