

## Different Agricultural Extension Systems Implemented in Africa: A Review

Tsion T. Kidane\* and Steven H. Worth

*Agricultural Extension and Rural Resource Management, School of Agricultural,  
Earth and Environmental Sciences, University of KwaZulu-Natal, Private Bag X01,  
Scottsville, 3209 South Africa*  
*Telephone: +27 (0)33 3559304, \*Fax: +27 (0)33 3305946*

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**ABSTRACT** The aim of this review was to summarize some selected Agricultural Extension Systems (AES) that have been implemented in Africa. The review revealed that, many AES were implemented before assessing the existing indigenous knowledge systems, social and economic situations. Extension transformations are happening in the African continent in line with agriculture sector and industry development. Reviewing and evaluating the suitability of the planned and implemented AES were found to be crucial to identify the success and shortcomings associated to their implementations. It is important to develop an appropriate agricultural extension system suitable for Africa by considering ecological, social, economic, cultural diversification and indigenous knowledge systems. In order to fulfil the desired objective that will maximise the effectiveness of AES in terms of their productivity, sustainability and change in life standards, agricultural development projects should be based on research findings and farmers' needs.

### INTRODUCTION

One aspect of agricultural extension constitutes the transfer of information and knowledge scientifically developed through research to farmers. In this process farmers need to be educated to identify and think critically about the proposed alternatives and to do this context of achieving agricultural development goals that may extend beyond the goals of individual farmers (Van den ben 1996; Bah and Fang 2015; MASHAV 2016). In developing countries, investing in providing extension to farmers is crucial to increase agricultural productivity and farmers' incomes, as well as for effective sustainable development, food self-sufficiency and poverty reduction (Anderson and Feder 2004; Ragkosa 2015). However, it has been long established that developing agricultural technologies without considering the end users' needs and their situations are ineffective in achieving the desired agricultural development (Adesina and Baidu-Forsonb 1995; Röling 2009). Most Agricultural Extension Systems (AES) were funded either by government, non-governmental organizations, the private sector, or by combinations thereof with varying objectives and strategies without thorough consideration of the existing reality of farmers the AES is meant to help.

Further, basic research conducted does not help smallholder farmers progress as expected except when the research is integrated with the practicalities experienced by the farmers (Adato and Meinzen-Dick 2002; Röling 2009). To tackle smallholders' problems, especially in the African context, requires problem-based research which is entirely grounded in the needs of the farmers that have been ascertained and identified as a part of the research process (Röling 2009).

Over the past decades, agricultural extension has been expressed using different approaches and implementation strategies. Most, however, have focused on the technology and not on the farmer and his unique situation. Methods that integrate farmer needs with wider developmental objectives are more effective in terms of achieving the expected goals (Anderson 2004) and "are most effective when they engage the farmers in a program of experiential-based learning" (Masere and Worth 2015). Moreover, AES should focus on agricultural diversification, rural income creation, increasing access to information, access to market and new biotechnology beyond transferring new agricultural inputs (Pingali 2006) while simultaneously building farmer capacity to engage with scientific enquiry (Worth 2002, 2006). In Africa, the most dominant extension and research systems have experi-

enced shortcomings which are probably created in the process of looking for cost effectiveness and more pluralistic extension systems (Anderson and Feder 2004; Babu et al. 2015).

Given that different extension systems have been implemented in different regions of Africa (Anderson et al. 2006; Davis 2008; Röling 2009), reviewing the experiences gained thus far and learning from the results they have achieved will create new perspectives and facilitate the selection and implementation of more effective AES on the African context.

### Objectives

The aim of this paper is to present a review of the different types of AES that have been implemented in different parts of Africa. Specifically, farmers' field schools, the training and visit model, the paid private extension model, the commodity and research extension model, and the decentralisation extension model will be explored. This will be in the context of a general review of African farmers, and measurement issues for extension systems, is also presented.

## METHODOLOGY

Systematic data about the impact of extension systems that have been implemented in Africa has been limited (Van den Berg and Jiggins 2007; Davis et al. 2012). Thus, this review discusses the implementation of AES, their strengths and weaknesses in the context of Africa. This document seeks to shed some light on when, where and how extension systems should be applied. The paper will first review different extension approaches and models implemented on the continent including selected articles with evaluative contents on African agricultural extension systems that were assessed. Finally, the indigenous points of view of farmers on the various agricultural extension systems were reviewed. This document gives information for agricultural extension policymakers, program designers and implementers to choose the right agricultural extension strategies for the many and varying African conditions. The following AES were identified; the Training and Visit extension system, Paid Private Extension System, Public Extension system, the commodity extension system, Decentralisation extension system

(DES) and the Farmer Field School (FFS). The review of each system is presented in the following section. They will be evaluated through a simple framework posited by Abdu Raheem and Worth (in press) which focuses on three elements: mission and goals, approach and functions, and clientele. Mission and goals looks at the overall orientation of the approach, effectively whether the focus is on the farm or on the farmer. Approaches and functions looks essentially at the locus of service provision – central vs decentralised; public vs private. Clientele looks at where attention is being focused, that is, who is the primary focus of extension delivery.

Further, ideally, extension approaches should address, in the first instance, building farmer capacity to manage his/her farming enterprise, manage the sustainability context in which that enterprise operates, and building farmer capacity to learn (Worth 2015). Thus each of the systems will be examined on that basis as well- with a general focus on learning and building farmer capacity.

## OBSERVATIONS AND DISCUSSION

### The Training and Visit Extension System

Training and Visit Extension system (T&VES) was propounded by Daniel Benor (Rogers 1988; Röling 2009; Tugendhat and Alemu 2016). Most Asian and African countries have been practicing this extension system since 1984 (Anderson et al. 2006). The system was first launched in Turkey (Eicher 2007; Tugendhat and Alemu 2016). The system was implemented by many developing countries. It was ineffective for those who entirely are dependent on rain fed agriculture for farm production. The system was sponsored by World Bank and costed more than three billion USD from 1975-1998 (Anderson et al. 2006; Anderson and Feder 2007; Eicher 2007). The targeted change in the extension system was to transform the extension administration (Gustafson 1990). The system guides the farmers to adopt locally existing agricultural technologies (Eicher 2007; Tugendhat and Alemu 2016). The subject matter specialists and extension workers make frequent visits to a group of selected farmers from nearby communities and train them in order to acquire sufficient knowledge and skill in the area of improved agricultural practices (Bindlish and Evenson 1997).

The T&V extension system has strengths and weaknesses in Africa (Anderson et al. 2006). The experience in Burkina Faso and Kenya showed that training and visit extension approach was effective in terms of improved system management, agricultural productivity and high return on investments, although at a later stage it seemed to be criticised for the errors in data collection (Bindlish and Evenson 1997; Gautam 2000). On the other hand, in Zimbabwe midlands and Mashonaland West province, the T&V extension system contributed positively to increase smallholder farmers' cash crop production (Hanyani-Mlambo 2002; Tugendhat and Alemu 2016). Also the experience in Kenya and Nigeria shows that, the system had benefited towards staff training, increased geographical coverage, improved linkage with research but it was financially unsustainable (Gautam 2000; Musa et al. 2013). On the other hand, the training and visit system that has been exercised in Rwanda and Cote d'Ivoire was believed to be unsatisfactory in terms of its agricultural productivity and incentives for extension staff (Davis 2008). Similarly, in South Africa the pilot extension program in Ciskei based on T&V system was ineffective due to poor selection of contact farmers and inadequate extension and institutional support (Williams and Bembridge 1990). In Ethiopia, the Training and Visit Extension System was effective in terms of increasing yield among contact farmers, staff training and giving base line information for extension systems in the country. However, it has limitation on its rapid diffusion of innovation to the masses. The system has limited application in the resource poor and drought-prone region of the country (Dejene 1989; Eicher 2007; Tugendhat and Alemu 2016). Likewise, Mullen (1989) indicated that the T&V extension system in Somalia showed higher initial success in irrigated agricultural practices than rain-fed agriculture. Similarly, the system provided an excellent management system in irrigation projects in Zimbabwe, Egypt, Sudan and Yemen (Hanyani-Mlambo 2002). While in Cameroon weak communication between the contact farmers and extension workers resulted in difficulty to apply the recommended technologies properly (Tchouamo and Steele 1997). Ntifo-Siaw and Agunga (1994) noted that Ghana had been exercising the T&V extension system since 1978, however, the T&V approach had not improved extension performance compared to

the previous general extension system. The T&V extension system has low extension performance, lower farmers' participation, weak extension research linkage, poor management and communication skill (Ntifo-Siaw and Agunga 1994). The experience in Tanzania showed that T&V extension system was not based on farmers' participation and need, but was a top down technology transfer system which failed to achieve its objective (van den Ban and Mkwawa 2007). Currently, in Zambia and Mali a modified training and visit extension program has been implemented (Eicher 2007). Overall, the Training and Visit (T&V) Extension System has been implemented in over 50 developing countries in the period 1975-1998. The system has limitations on the issues such as, inadequate research system interaction, weak accountability, lack of political support, budget constraint, and financial unsustainability (Anderson 2006; Tugendhat and Alemu 2016).

The T&V Extension System has been described as a hard system with a single line of command and several levels of field and supervisory staff (Anderson and Feder 2004). The system is implemented on formally selected farmers within an identifiable farming group. Bias in the selection of contact farmers resulted in reduced diffusion in the system (Anderson and Feder 2004). The system improved the interaction though little influence was gained over research priorities. The system was started and promoted by funding organisations and therefore has a financial sustainability problem when operated outside of NGO's funding support. The financial stability problem seems to jeopardize the system effectiveness and continuation after the limited fund extent and left many countries burdened with huge debts (Anderson and Feder 2004). The T&V extension system attempted to incorporate the linear system throughout Africa. In the continent, most of the T&V extension system implementers have been applying the system although there is no evidence of success after continuous implementation in situations where it is not relevant to specific local farming environments. Usually, most of the farmers in the continent do not operate in well-developed commodity market-oriented production (Röling 2009). The small scale farmers do not have sufficient access to the relevant information, agricultural inputs and capital that are required to make use of the benefits that may come

from the introduced new extension system and technologies (Röling 2009). Agricultural technology adoption, selection and implementation to benefit smallholder farmers have been conducted mainly by funding agencies. Newly introduced projects should require initial trial for their cost effectiveness, farmers need, and sustainability for the existing local condition. This is the main reason why unsustainable well-funded and short lived agricultural development programs and systems are often implemented in Africa.

There is no embedded learning programme in the T&V system. Similarly, building farmer capacity is not on the agenda. As argued by Masere and Worth (2015), if there is no process that “deliberately engages farmers with experimentation and scientific enquiry...farmers are unlikely to adopt what is offered.”

While outwardly the T&V system documentation suggests the focus of mission and goal of the T&V system is on the farmer, it appears (through the dominance of technology adoption) that the focus is on the farm and its productivity. This understanding is strengthened by the fact that, in terms of clientele, the focus is on smallholder, less productive farmers. Finally, in terms of its approaches and functions, the T&V system is highly centralised and public sector driven. Its cost and monolithic administration are unlikely to be adopted by the private or NGO sectors.

### **The Farmer Field School (FFS)**

Farmer Field School (FFS) started in Indonesia in 1989, and was since established in many sub-Saharan countries (Braun et al. 2006; Davis et al. 2012). The FFS was developed to address the major food security threat in Asia associated with rice yield losses due to plant hopper (Pontius et al. 2002).

Basically, the FFS is a learner-centred approach (Andre et al. 2009). It is participatory learning based on adult-learning principles. It helps farmers to develop investigative skills, critical thinking, and creativity, to make good decisions (Asiabaka 2002; Bello-Bravo et al. 2011; Davis et al. 2012). In the process 20 to 25 neighbouring farmers meet weekly with a facilitator in their farming environment. In the FFS, the trainer is a facilitator rather than an instructor. In this system farmers are the main actors to conduct

their own research based on the identified problem and come up with possible solutions (Asiabaka 2002). In the FFS farmers are supported by outsiders such as extension workers, researchers and non-governmental organisations (NGOs), who serve as the facilitators or source of information from field experimentations (Andre et al. 2009; Davis 2008; Röling 2009; Kraaijvanger et al. 2016). However, there have been limitations on the availability of systematic data about the impact of FFS. There is confusion regarding unanswered questions, such as when, where and how FFS should be applied (Davis et al. 2012).

According to the explanation by Braun et al. (2006), FFS is a group-based participatory practical learning that enhances technology development and dissemination based on experiential learning. It is believed that, empowering of farmers is determined by the level of farmers' involvement in the identification, adoption and evaluation of a certain agricultural technology package (Davis 2008).

The FFS was found to be more expensive than the traditional extension model. The financial unattainability made the system unable to sustain after a certain project or fund existence (Feder et al. 2001). However, the FFS system was implemented by many developing countries. Over the years, the FFS approach has been extending to include other issues in agriculture and rural development, such as natural resources management, animal husbandry, conservation agriculture, HIV/AIDS, food security and nutrition (FAO 1998; CIP-UPWARD 2003). Building farmers organisations and farmers' countervailing power is crucial to establish a firm basis. In Sudan, the alumni started complaining about the implementation typology (Khalid 2002). Farmer Field School has been implemented through different typology in many countries in Africa including Angola, Benin, Burkina Faso, Cameroon, DR Congo, Ethiopia, Sudan, Gambia, Ghana, Ivory Coast, Madagascar, Mozambique, Namibia, Niger, Mali, Malawi, Kenya, Zambia, Uganda, Tanzania, Senegal, Rwanda, Sierra Leone, South Africa, Zimbabwe, Tanzania, Togo, Uganda, Nigeria, Yemen, Algeria, Egypt and Zanzibar for the period 1993-2005 (Davis 2008; Braun and Duveskog 2008; Braun et al. 2005). However, in several other African countries a planned and developed FFS curriculum was forced instantly into a technology push program



by powerful managers (Youdeoeqi 2003). Unfortunately, those powerful managers in the planning and implementation system were unable to understand the FFS central instruction method that is participatory processes. They used FFS as a tool to control farmers to transfer their message and to implement their plan (Röling 2009).

Higher-level policy makers' impression after FFS visit directed them to the intention for rapid scaling up (Youdeoeqi 2003). Rapid scaling-up in the system caused poor quality because of limitation on available relevant resources and conditions such as finance and time to train the facilitators and required facilities. However, many African countries still used FFS as an instant means for technology transfer which led to a poor quality system in attempting to achieve the targeted objective (Röling 2009).

The FFS experience empowers farmers to organise training for other farmers, to speak in public and to undertake development projects (Davis 2008; Röling 2009; Dolinska and d'Aquino 2016). In some African countries FFS has become a policy system without adopting the FFS to specific conditions and need. Rapid scaling up results in shortcomings in the implemented system and program objective. Therefore, FFSs requires careful research and testing to develop applicable curricula that are appropriate under African conditions (Röling 2009).

FFS have shown significant effect on decrease in insecticide use, increase in output, knowledge improvement among farmers, and empowerment (Davis 2008; Kraaijvanger et al. 2016; Dolinska and d'Aquino 2016). However, some studies do show that FFS has an insignificant effect on economy, environment, human health performance and weak farmer-to-farmer knowledge and technology transfer (Davis 2008). Kraaijvanger et al. (2016) reported that farmers' involvement in experimentation facilitates the transfer of knowledge and skills to farmers and there by enhance their farm productivity. In Kenya, Tanzania and Uganda FFS was found to be beneficial to women-headed households and also to increase household agricultural productivity and income (Davis et al. 2010; Davis et al. 2012). In contrast, Bello-Bravo (2011) reported that in West Africa FFS female participants lagged far behind compared to male involvement. Davis et al. (2012) indicated that the impact of FFS varies significantly across gender, land resource endowment, and level of education. Their findings

indicate that FFS is suitable for farmers with limited education (Davis et al. 2012). Other reviews show that FFS has considerable instant and sustainable developmental impact on the participants (Asiabaka 2002; van den Berg and Jiggins 2007). Furthermore, FFS approach such as demonstration sites, experiential learning, group approach and other factors have impact on low literacy people to participate and benefit (Davis et al. 2012; Kraaijvanger et al. 2016). FFS focuses on improving experience to address the issue of financial unsustainability through self-financed technique (Khisra 2007). Experience in East Africa indicated that FFS groups and associations were able to avoid the financial unsustainability of the system by creating their own financial source to alleviate the system financial limitation (Braun et al. 2006). In developing countries, agricultural extension system sustainability depends on strategized and developed relevant financial system that can alleviate the limitation. In this condition the useful and relevant implemented extension system and developed programs can sustain longer than the project span based on the implementer's plan.

It would appear that the mission and goal of FFS is building farmer capacity, with a clientele focus on smallholder farmers who are struggling with productivity issues, particularly those related to pest management. FFS is clearly farmer-centred. It clearly also focuses on building farmer capacity albeit, as noted earlier, primarily on production; there is little evidence to show that it builds farmer capacity in other areas relevant to managing the farm enterprise or its environmental or social sustainability context. As with the T&V system, cost and management keep FFS in the public sector – perhaps with links to the private sector.

### **Decentralised Extension System**

In the 1980 and 1990s, a decentralisation extension system was tried in Latin America, Uganda and other African countries (Anderson and Crowder 2002). Many developing countries have been implementing the system through redistributing extension programs to local communities (Anderson and Feder 2004).

DES transfers responsibility for delivery to local governments. This extension system is planned to improve accountability by moving services closer to the people who use them to get better feedback, for better services and

achievement (Anderson and Feder 2004). Experience in Kenya indicated that the system was successful by improving access to extension services (Nambiro et al. 2006). The system creates partnership among service providers and synergy for effective implementation. Having information and means of modern communication, literacy and income have significant impact on farmers' options and access to extension service (Nambiro et al. 2006).

Success in the decentralisation extension system is based on grassroots local participation and citizens' behavioural change which means that people began to mobilise their own resources instead of counting solely on the state. In addition, success in the development project depends on the type of support structure, available capacity development through relevant training, potential financial sources and the level of participation implemented in the system. Extension projects need identification, objectives and plan transparency, which are directed by the level of participation allowed in the extension system. Effective extension system planning and implementation depends on the level of participation and involvement of all stakeholders in the system (Tossou and Zinnah 2005; Okorley 2011).

In developing countries, the DES planning process can be complex due to complex agro-ecological, socio-cultural, environmental politics and socio-economic environment. The system demands that project planning process should incorporate both formal and informal meetings with farmers, extension staff and stakeholders. Similarly, other literature also confirms that the identification of farmers and all stakeholders could help the system to experience an effective extension project planning and implementation (Okorley 2011). In general, the system allows for the decision making process to be at grassroots level. The grassroots level decision making could help the system to respond to the grassroots need, to mobilize public and donor funds, and to transfer technical and financial responsibilities to decentralized entities (Tossou and Zinnah 2005). However, experience in Benin, Sri Lanka and Nepal indicated that the decision making processes are still highly influenced by public administrators and politicians at national and regional level (Dusseldorp 1995; Tossou and Zinnah 2005). However, in Ghana, district de-

centralised agricultural extension system and organisation was found to be relatively successful (Okorley 2009).

The decentralised agricultural extension organisation performance can be determined by external and organisational factor. Okorley (2009) provided and explained the list of external factors that could have impact on the decentralised agricultural extension organizational system such as the political will, level of decentralization at relevant government departments, availability of transparent framework, level of cooperation with support giving organization, stakeholders willingness to support, clients, that is, communities social, economic and cultural condition.

The organisational cost of operation of DES is lower in smaller geographical areas than larger geographic coverage area. However, during the implementation process, the decentralised funding agencies usually face multitude problems such as political interference, using extension agents for other political purposes and difficulty to organise the extension-research link (Anderson and Feder 2004). In Benin and Malawi, DES is applied by coordinating and synchronising the system with other extension system (Davis 2008). In several West African countries, the devolution of the extension function has some notable successes towards the desired achievement to its goal such as strong financial sustainability and accountability between the service provider and clientele (Anderson and Feder 2004).

Another caveat for DES is the extension methods and approaches being decentralised. The frequent reference to planning projects suggests that the mission and goal of decentralisation is still technology transfer. While there is a clear intention to devolve decision-making downward, there is no clear statement that building farmer capacity to participate effectively in such processes. An extension system which is based on the end user need by considering the existing social, environmental, economic and cultural reality could be effective to achieve the desired agricultural extension goal – provided it is clearly grounded in building farmer capacity.

### **The Commodity Extension System**

The commodity based extension system was defined as the extension approach that groups different activities that function for promoting

production including technology extension, research, provision of input, producing marketing and pricing under one organisation structure or administration. In Africa, Mali and other countries were exporting cotton and palm. In those countries, the system was using the commodity extension system (CES) (Ruttan 1982; Eiche 1989). Currently, commodity extension system has been implemented by many African countries. The system is organised based on a self-financed research and extension system structure by coordinating with the public extension system. Moreover, the system has been organised in most cases by private firms who engage in production and marketing of very important industrial cash crops. The commodity based extension system research has been receiving strong support from private firms and hence led to the establishment of some successful produce grower schemes in some countries in Africa such as in Zimbabwe (FAO 2016).

Commodity extension is clearly designed around marketing and therefore around production quantities and quality. As determined by Ndlela (2015), in the case where extension was provided to smallholder cane growers in South Africa – the agenda of the commodity agency hidden behind the professed farmer development was, in reality, to increase production of raw material for the sugar mill. It was found that this increase was attained at the expense of the farming families' food and nutritional security.

This extension system might have a good potential for several African countries where private agricultural business has started to flourish – provided again, the interests of the farmers are ensured, and their capacity to engage with the extension provided is built.

### **Public Extension System**

Public extension system (PES) has been the main agricultural extension system all-over the world (Eicher 2007). This extension system is inadequately funded and known to have high extension costs. The system effectiveness is limited due to administrative and design incapability. The problem of effectiveness was caused due to its coverage area and operation complexity, poor research–extension linkage, lack of accountability, weak political support, management incapability, financial unsustainability, weak assessment and evaluation (Anderson et al. 2006;

Davis 2008; Röling 2009). In developing countries, the existing public extension organisations are under increasing pressure to deal with a range of policy issues, including accountability, relevance, responsiveness, and cost-effectiveness (Davis 2008). In the system, many NGOs are required to undergo institutional transformation to participate in the development activities (Swanson and Samy 2002). During the early part of the 21<sup>st</sup> century, the concerned organization had to engage the required system adjustment and transformation in order to determine the role and effectiveness of agricultural extension system and to look at new opportunity and resource in the development program and implementation (Swanson and Samy 2002).

As with DES and commodity, housing of extension does not reveal its mission or goal. Public extension has clearly a role to play in the overall provision of extension. However, there is an increasing tendency towards pluralistic systems where there is a mix of public-, private and NGO-sector extension available to farmers (FAO 2016; Hanyani-Mlambo 2002). Within this mix of services, the mission and goals will vary depending on the agency offering the service.

### **Paid Private Extension System**

Paid private extension system (PPES) extension system is working in developed and developing countries. For example, Uganda has seen the introduction of paid private extension system. This extension system targets the reduction of public outlays on extension by motivating farmers to pay some costs associated with knowledge and technology extension (Anderson and Van Crowder 2000; Babu et al. 2015). However, there is no visible evidence that small scale farms can access the service by sharing the costs associated with agricultural extension advice. Anderson and Feder (2007) and Babu et al. (2015) reported that privatisation of agricultural extension services in some countries, such as in Uganda, where private extension has been implemented is dependent on the financial sustainability of the particular service. To be 'paid for' requires farmers to have disposable income which suggests that this system is suitable for commercially-based farmers with substantial turnover, who operate as market competitors, with exportable products. This suggests that its mission is to support commercial farming.

This is evident where fee-for-service extension systems (called private paid extension) have been provided by private sector (Hanson and Just 2001). Developed countries like New Zealand privatized their extension system and seem to have solved the financial sustainability in the system (Davis 2008). A common approach to this is where a small group of farmers typically contract for extension services to address their specific needs (Anderson and Feder 2004; Babu et al. 2015). Such paid private extension systems encourage farmers to identify their problems and search for an appropriate solution from service providers (Lindner 1993). PPES have been assisted by the on-going withdrawal of public sector (Dinar and Keynan 2001; Holloway and Ehui 2001; Babu et al. 2015).

While within its own space, private paid extension is financially sustainable, its main shortcoming is lack of access to this service for the majority poor smallholder farmers. Within developing economies, 'paid for' extension services can reduce the financial burden of public extension service. However, in such economies, there is inevitably a mix of 'free' public extension and 'paid for' private extension (Keynan et al. 1997; Babu et al. 2015).

### Measurement Impacts of Extension Systems

The main challenge for Governmental Organisations (GOs) and Non-Governmental Organisations (NGOs) is in how to measure, and cultivate a capacity to measure, the performance of the various extension systems that are being implemented in Africa. One way is to measure the impact of AES in terms of farmers' knowledge, technology and farm practice (adoption), productivity, efficiency supply and demand (Birkhaeuser et al. 1991). There are no clear procedures on how to select and implement a suitable technique to measure the performance of different types of extension systems that have been applied in developing countries. Lack of baseline information, absence of suitable control groups and the systemic biases in extension placement and contracts contribute towards the complexity, mainly the reaction to the impact of extension systems (Birkhaeuser et al. 1991; Feder et al. 2001).

The major characteristics that affect the impact of extension system performance include scale and complexity, policy environment, research extension link, management efficiency,

accountability and transparency, political support and financial sustainability (Anderson et al. 2006; Feder et al. 2001; Birkhaeuser et al. 1991; Jones 2016). Anderson et al. (2006) and Feder et al. (2001) also introduced that the scale and intensity is one of the important factors to be considered in measurement. Higher running cost, limited communication and diverse farming environment in reality affect more smallholder farmers. On the other hand, the policy environment is one of the most important basic factors for effective outcome of extension system implementation because it determines the actual provision of extension on the ground. Similarly, creating incentives for extension staff to interact with researchers will improve the success of extension system by reinforcing collaboration around agricultural knowledge systems (creation and interaction) (Anderson et al. 2006; Feder et al. 2001). Weak accountability relates to the incompetence to characterise the impact, low-quality and tiresome guidance given to small scale farmers, and lower effort to interact with farmers have remarkable effect on the success and practicality of the implemented extension system.

In developing countries politicians are more attracted to investing in visible development projects and activities than extension expenses. As a result, much lower budget is allocated for the extension activity compared to other (Anderson et al. 2006). In many African countries extension workers are participating in public duties other than extension activities which is actually public activity other than extension by nature (Anderson et al. 2006; Anderson and Feder 2004). Usually, at the end of fund/donors' based extension programs, financial unsustainability is faced due to weak political support and high project running cost. Many African countries were unable to sustain such a program and are left in huge debts which is a financial factor responsible for the unsustainability of the extension program (Feder et al. 2001; Anderson and Feder 2004; Anderson et al. 2006).

Table 1 displays the advantages, limitations as well as applications of the most popular implemented AES in Africa. The summary briefly shows that both advantages and disadvantages of agricultural extension system in relation to the situations and environment in which the system has been implemented.

Worth (2006, 2015) argues that impact of AES, regardless of the system employed, should be



**Table 1: Implemented AES, their advantages, limitations and areas of their use in Africa**

<i>S. No.</i>	<i>Systems</i>	<i>Advantages</i>	<i>Limitations</i>	<i>For whom does it work?</i>
1.	<ul style="list-style-type: none"> <li>The Farmer Field School</li> </ul>	<ul style="list-style-type: none"> <li>Could answer food self-sufficiency (Röling 2009).</li> <li>Encourages technology development and dissemination</li> <li>Empowers farmers (Röling 2009).</li> </ul>	<ul style="list-style-type: none"> <li>Financially unsustainable</li> <li>Needs enough time and money for the quality of facilitation and carefully trained facilitator (Gallagher 2003)</li> <li>Need carefully design curriculum (Röling 2009).</li> </ul>	<ul style="list-style-type: none"> <li>Interrelated and cooperative society. Very good basis to build farmers organisation (Röling 2009).</li> <li>Useful for farmers with limited education (Davis et al. 2010; Davis et al. 2012)</li> <li>beneficial to women farmers (Davis et al. 2010; Davis et al. 2012)</li> </ul>
2.	<ul style="list-style-type: none"> <li>The Private (Fee-for-Service) Extension Model,</li> </ul>	<ul style="list-style-type: none"> <li>Financially sustainable.</li> <li>Solve the accountability problem</li> <li>Accessible service depends on the ability to pay</li> </ul>	<ul style="list-style-type: none"> <li>Inaccessible for majority poor farmers</li> </ul>	<ul style="list-style-type: none"> <li>Implemented in developed farming environment.</li> <li>For commercial and large scale farmers</li> </ul>
3.	<ul style="list-style-type: none"> <li>The NGO Extension model</li> </ul>	<ul style="list-style-type: none"> <li>Effective for the condition of emergency need.</li> </ul>	<ul style="list-style-type: none"> <li>Financial unsustainable and donor based</li> </ul>	<ul style="list-style-type: none"> <li>In the condition of natural disaster and emergency.</li> </ul>
4.	<ul style="list-style-type: none"> <li>The Training and Visit Extension Model</li> </ul>	<ul style="list-style-type: none"> <li>Effective in dissemination of very specific package and new technology and practice</li> <li>in controlled environment the system could Support agricultural growth and produce returns on investment</li> </ul>	<ul style="list-style-type: none"> <li>Financially unsustainable</li> <li>Ineffective in rain fed agriculture</li> <li>Weak accountability and lack of political support</li> </ul>	<ul style="list-style-type: none"> <li>In homogenous society</li> <li>In identical area.</li> </ul>
5.	<ul style="list-style-type: none"> <li>The Commodity Extension and Research Model</li> </ul>	<ul style="list-style-type: none"> <li>The system combines research and extension system</li> </ul>	<ul style="list-style-type: none"> <li>Based on companies' interest</li> </ul>	<ul style="list-style-type: none"> <li>Organised and row material producers</li> </ul>
6.	<ul style="list-style-type: none"> <li>Decentralisation</li> </ul>	<ul style="list-style-type: none"> <li>It has financial sustainability and improved accountability</li> <li>Move service closer to the people.</li> </ul>	<ul style="list-style-type: none"> <li>It has high political interference</li> <li>Difficulty farmers research linkage</li> </ul>	<ul style="list-style-type: none"> <li>In democratic community environment(to mobilise internal and external resources in the system)</li> <li>For small scale to large scale organised farmers</li> </ul>
7.	<ul style="list-style-type: none"> <li>Public Extension Model</li> </ul>	<ul style="list-style-type: none"> <li>Accessible for small scale resource poor farmers</li> </ul>	<ul style="list-style-type: none"> <li>Financial sustainability and effectiveness problem</li> </ul>	<ul style="list-style-type: none"> <li>In centralised and organised system</li> </ul>

measured in terms of building capacity of farmers on three fronts: capacity to manage the farm enterprise; capacity to manage the sustainability context within which that farm enterprise operates; and capacity to learn and engage with scientific enquiry. Assessment of impact should cover improvements in the structures and systems in place governing these three spheres, the opportunity for farmers to genuinely command those structures and systems, and the

knowledge and skills to command them. This, the researcher posits, cuts across all other assessments as it focuses on the farmer, who is the primary actor in the sector.

### **Unleashing Farmers Innovation Capacity in Africa**

In many African countries, the majority of farmers do not have the opportunity to operate

in well-developed community markets and there is lack of access to the information, inputs and capital (Röling 2009; Poulton et al. 2010). These and many infrastructural limitations should be considered and supported by the introduced and transferred extension systems and technologies. The exclusion of farmers need, required infrastructures and relevant research findings in the designed process of extension programs or during developing technology have resulted in the fall of technology supply push in Africa (Röling 2009; Hounkonnou et al. 2012).

Developing and transferring agricultural technologies to small scale farmers' has not generally been effective in Africa. Moreover, the influence of agricultural research on smallholders has been remarkably inadequate (Gabremadhin and Haggblade 2004), although African agriculture is extraordinarily active. In fact, small scale farmers are continuously innovating local technologies and adapting them all the time in order to handle the changing circumstances (Reij and Waters-Bayer 2001; Röling 2009). African farmers are not traditional nor backward, but they have few and small opportunities available for their growth in agricultural sector. This indicates that the implication that African agriculture is stagnant as associated with limited advances in agricultural productivity is wrong (Reij and Waters-Bayer 2001; Röling 2009). Rather, African small scale farmers are innovating not only in terms of component technology, but also in terms of using complex farming systems that have been scientifically proven by agricultural research. African farmer's innate tendency to innovate, in search for ways to improve their lives is a huge asset that research and development projects could utilize in the process of learning and to mobilize for agricultural development in the continent. Röling (2009) also clearly indicated that experience across Africa displays that growers are fast to hold onto opportunities. However, despite their innovative capacity and activity, many African small scale farmers remain disenfranchised from mainstream agricultural economies and struggle to expand their farming operations beyond provision for the table with small surpluses. Worth (2002) would argue that this is a result of over-emphasis on technology to the exclusion of building capacity in many other areas related to managing the farm enterprise and its sustainability context. This, therefore, is fertile ground to plant the right development ex-

ension programs based on relevant research findings and farmer's needs, and ground in sound extension theory.

## CONCLUSION

Six AES were reviewed and presented in this report. Sustainable agricultural development can be achieved by adopting and applying an appropriate agricultural system which can easily fit into the existing reality. Analyzing and understanding farmers' capacities, problems and needs were found to be important to develop and implement integrated cost effective and relevant AES. African heterogeneous social, economic, cultural, political and environmental conditions demand for integrated research and development that could provide solutions for the existing farmers' needs and problems with particular focus on addressing their capacities relative to their farming operations, sustainability and learning. It is, therefore, essential to review and study different experiences as well as the existing farmers' capacities, needs and limitations in order to create appropriate AES that fit well in to existing economic situations and future needs of the farmers and farming systems in the continent. Experience clearly shows that there is no 'best' or magical system which can fit simultaneously into differing economic, social and political situations. Perhaps greater attention should be given less to the system than to the aim of whatever system or collection of systems are devised and employed.

## RECOMMENDATIONS

Generally, prior to adopting any AES, an appropriate strategy and development system that accommodates the varying agro-ecological, social, cultural, political and economic farming environments to be found on the African Continent should be developed or identified through research. Moreover, policy-makers, and project and research directors should make agricultural extension development decisions based on research findings in the context of farmers' capacities, needs and unique circumstances. It is also essential to consider the impact of the proposed AES. While there will be broad goals to enhance agricultural development on an aggregate basis, impact of AES must also address building farmer capacity to run the farm enterprise, man-

age its sustainability context and to learn as a part of engaging with scientific enquiry. Assessment must also consider the short-, medium- and long-term impacts and financial sustainability.

The preconditions to the eventual AES include an open and willing government system, identified and prioritized needs determined through research, mobilized physical and human resources, and coordinated stakeholders cooperation and allowing conditions, that is, political, social, economic and cultural, and a clear understanding of the possibility for pluralistic systems including 'free' and 'paid for' extension service. These findings show that deciding on AES structures cannot be arbitrary. Designing AES and resulting extension programmes and projects must be based on research which has sought to understand the capacities, needs and circumstances of farmers in specific regions rather than funders' interests and desires or even exclusively government political objectives.

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