



# The contribution of Agricultural Education and Extension on the growth of the Rural Agricultural Economy

Evans Moturi Mamboleo

Department of Agriculture, Education and Extension, Kisii University.

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## ABSTRACT

The current global challenges of ensuring the availability of and access to food, in both quantity and quality, require deliberate and far-reaching solutions. Historically, research for development in agriculture and extension services has been a strong driving force for meeting food supply around the world. Agriculture is changing, and with it, a revised set of skills is needed to address new challenges in agriculture. As attitudes, expectations and employment in agriculture have changed, there is evidence that the skills and competencies of graduates do not meet the needs of today's agricultural sector. Industrial development is not possible without agricultural development so, maximum people must live in the villages and help in the agricultural development, there is vast difference between rural and urban life and this should be lessened. The standard of living of rural people can be uplifted permanently only when they themselves make an effort in this direction and encourage people to take initiative; it is prerequisite that the change in the field of knowledge, understanding, skill and attitude should be brought about. Extension Education is primarily for the rural development. Its main objective is to bring necessary change in the beliefs or views of people. Extension education is an educational process by which capabilities among people are developed to understand their problems and resources. It is utilized to make scientific methods available to the rural people, so that they can raise their agricultural production and their standard of living. The aim of extension education is community development, which is possible only by bringing change in the behaviour complex of rural people. Extension education plays major role in bringing desirable change in rural people.

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## Introduction

Agriculture is the main occupation for livelihood of the people and raw material for industries. Agriculture has grown up gradually and helped the human being to enjoy the settled life from nomadic life. At the beginning, human being has developed the method of hunting the animals in search of food and further to collecting grass, seeds, fruits, roots and nuts from places where they grew in abundance. Thus, human being started to cultivate useful plants for his needs. Davis, (2008) observes that Later explosion of population and the increased need for food and goods created an urge to increase the food production from land. Several scientific studies have been reported in the agriculture literature which can be considered as major studies in the agriculture field (Ellis,2009)

Chambers, (2004) argues that in its broadest sense, extension is an educational process with communication being its core component. Anderson, (2007) define the term extension as the conscious use of communication of information to help people form sound opinions and make good decisions. As a system, extension facilitates the access of farmers, their organizations and other market actors to knowledge, information and technologies; facilitates their interaction with partners in research, education, agribusiness, and other relevant institutions; and assists them to develop their own technical, organizational and managerial skills and practices (Christoplos, 2010).

In relation to its role in rural livelihoods, agricultural extension encompasses the entire set of organizations that support and facilitate people engaged in agricultural production to solve problems and to obtain information, skills, and technologies to improve their livelihoods and well-being (Birner et al., 2006). Since a livelihood comprises the capabilities, assets and activities required for a means of living, it appears that agricultural extension intends not only to increase productivity and income (Anderson and Feder, 2007; Waddington et al., 2010), but also to improve multifaceted aspects of rural life.

Often times, extension impacts have been associated with improvements in productivity and household income. A worldwide review of extension services shows that the impact of extension services on rural livelihoods is mixed: very high rates of return in some cases and negligible achievements in other cases (Rivera, Qamar and Crowder, 2001; Anderson and Feder, 2007). It is also widely acknowledged that estimation of extension impact on rural livelihoods is challenging in terms of dealing with attribution issues and linking cause and effect quantitatively (Anderson and Feder, 2007). The use of Sustainable Livelihood Approach (Ellis, 2009; Allison and Ellis, 2001; Niehof, 2004; Morse, McNamara and Acholo, 2009) to analyze the impact of extension services on rural livelihoods is uncommon in many developing countries. In fact, while there is a large literature dealing with issues related to agricultural extension in developing countries, rigorous

Tele:

E-mail address: [evansmamboleo@yahoo.com](mailto:evansmamboleo@yahoo.com)

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impact evaluations of this kind are less common (Waddington et al., 2010).

Chapman and Slaymaker, (2002) observes that in the United Kingdom (UK), agricultural research and education was coordinated by the number of firms and statutory bodies engaged in the agricultural research. The chief among these was Rothamsted Experimental station which was founded in 1843 at Harpenden in Hertfordshire. This institute is the first pioneer institute which had made several landmarks in the development of agricultural research in the UK. In order to carry out agricultural research, the first agricultural college was established in England at Cirencester in 1845.

Davis, (2008) In the United States of America (USA), some institutions had shown their interest in agricultural education. Those were the American Philosophical Society (1743), Philadelphia Society for Promotion of Agriculture (1785), and State Agricultural College (1853). The Act of the Congress (Morrill Act) signed by Abraham Lincoln on July 2, 1862 was a historic document in the evolution of agricultural education. It contained a provision for grants of land in the public domain to all the States and the union for the establishment of colleges to teach agriculture, mechanic arts and military training without excluding humanities or classics. The Land Grant College known as first college later became the Federal State Extension System. The first Director General of FAO of United Nations Norris E. Dodd formulated and designed agricultural education in the world. Presently, 15 international organizations imparting research under the umbrella of FAO. These institutions are provide training and research in the field of agriculture and allied subjects like tropical agriculture, cereals, food policy, improvement of maize and wheat, biodiversity, dry land, water management, forestry research, agro-forestry, fisheries and crop research (rice, potato) followed by the livestock research. The spread of agricultural education was furthered by the establishment of agricultural schools in the early twentieth century

The world's population in the underdeveloped countries is living the life of poverty. This area encompasses South-east Asia, Africa and Middle-east. These countries were for many years/centuries under foreign rule and subjected to exploitation. During the past several decades, millions of people across the Asia and Pacific region have benefited from dramatic improvements in agricultural productivity, reduction of poverty, and higher per capita incomes. The region was on track to achieve the United Nations Millennium Development Goal of halving the prevalence of extreme poverty by 2015. However, the recent dramatic fluctuations in the prices of rice and other staples indicated the sensitivity of these gains to rapid price increases, and showed that the region's food supply system is more fragile and imbalanced than what was previously believed (Solesbury, 2000).

Niehof, (2004) concluded that improving the productivity, profitability, and sustainability of smallholder farming using "agriculture for development" is the main pathway out of poverty, with innovation through science and technology being one of the key instruments (Adhikanya, 2004). Agriculture is the critical sector that can improve the life of the population despite the Natural calamities such as famine, crop failure and problems like soil degradation and economic crises can also result in immediate and this can be done through agriculture extension and education. According to Allison and Ellis, (2001), agricultural extension is important because it gives people information about good or new

agricultural practices in a particular environment from research station or farmers experience can be assembled synthesized and made available to use and further investigate it or to disseminate knowledge. This results in creation of organizational and administrative setup which can make dissemination of technologies easier.

Anderson and Feder, (2007) Agriculture in the United States and many other developed countries has evolved into a specialized industry with knowledge widely distributed across different types of stakeholders. This transformation has been driven by three trends: increased concentration and specialization, increased education and expertise, and the expansion of communication technologies. Furthermore, individual agricultural operations are growing many different types of crops in varying agro-ecological contexts, making it important to adapt information to specific cases. At the same time, the decline in financial resources experienced by many extension programs constrains traditional outreach strategies. Communication technology and other "network-smart" strategies provide new opportunities for overcoming these barriers.

Belay and Abebaw, (2004) notes that the Asia and Pacific region is the largest supplier as well as consumer of the world's food and agricultural products. This region, where agriculture is one of the key economic sectors, houses about 58% of the world's population in 39 countries, but has only 38% of the world's agricultural land. Despite the wide range of natural resources in the region, some countries more than others face major challenges of food insecurity, poverty, and malnutrition. The huge diversity in the size, population, and agricultural and economic development of the countries reflect the large differences in their agricultural production systems, agroclimatic potential, population density, and infrastructure (Belay, 2003).

Agricultural and extension education professionals continue to play an important role in agricultural and rural development. Proper education and training, as reflected in higher education curricula, are essential to the success of these professionals. However, due to demographic changes in society and the fast-changing fields of agriculture and rural development, there is a significant challenge in keeping agricultural and extension education curricula relevant. For example, Chambers, (2004) examined the case of India and found there is a need to revise the agricultural extension curricula to keep pace with changes in the agriculture sector. Colderin (2000) identified several current issues related to agricultural extension including the role of the state, reductions in public spending, financial viability, partnership, privatization, institutional structures, decentralization, participation, gender, local knowledge, pluralism, and sustainability.

#### **Purpose of the Study**

Agriculture is the most important sector in the country's economy, Kenya has experienced food shortages since the 1970s and millions of people have been suffering from hunger. For the last three decades, information on the performance of Kenyan agriculture indicates that there is a gap between food supply and demand and the sector is unable to produce adequate amounts of food to meet the growing human population in the country (Belay and Abebaw, 2004). As a response to the large gap between food supply and demand, a collaborative agricultural project that follows extension approach was initiated to curb Bad agricultural practices like cultivation of marginal land, widespread use of chemicals and

pesticides, over cultivation and overgrazing, use of chemical fertilizers rather than organic fertilizer result in degradation of soils and vegetation (Davis, 2008) Extension mission by itself is challenging as it deals with uneducated rural poor with the aim of changing their behavior positively. Past extension approaches have been planned and implemented in top down approach without the involvement of the people for whom they have been designed (Belay, 2003). While in many parts of the country the number of extension workers is very small, the existing ones lack qualification and communication skills. Extension programmes can also have a profound implication on the livelihood of the community and may create wealth differences among individual households as those who are close to the extension workers and those who can afford the cost can be better-off while the others are the losers.

## Literature Review

### Theoretical Framework

The theoretical framework of this study is rooted historically in a social Reconstructionist perspective of agriculture development (Ellis, 2009), highlighting the relevance of Agriculture to socio-economic development. Gastam (2000) frames the study through recognition of the needs of society and the structure and nature of knowledge the agricultural and extension education has been produced in recent years. In some cases, agriculture development processes focus heavily on stakeholder input (Niehof, 2004).

### Agricultural Education and Extension

Agricultural education refers to the process of education applied to the body of knowledge which includes such subjects as: needs assessment, formal and informal teaching methods, curriculum and program development, and instructional program delivery approaches (Adhirkanya, 2004). Anderson, (2007) stated that over the past decade (prior to 1996), a new commitment to quality instruction and student learning emerged in the educational community. Belay, (2003) described Cooperative Extension as a major educational provider in adult and continuing education, particularly for agricultural audiences.

Cooperative Extension is America's first (and only) national system in adult education (Solebury, 2000). Extension and its clientele base continue to evolve with continual program fluctuation. Education, and more specifically agricultural education, is not immune to the effects of change (Witte, 2004). Changes in the profession, clientele, and recent technological advances require Extension educators to re-think traditional programing delivery methods and formats (Davis, 2006).

A continual dilemma experienced by agricultural educators is how to respond to the changing face of society and stay abreast of the possible impacts that technology could have in the teaching-learning context (Colderin, 2000). In 1998, Trede and Whitaker described that future Extension program planning and delivery was expected to place more emphasis on the educational outcomes of its clientele and continue as a facilitator in the teaching/ learning process. As part of that community, agricultural educators are reassessing past educational practices in an effort to determine the effectiveness and validity of methods which have for years been practiced and proclaimed with almost religious fervor (Anderson and Feder, 2007). Emphasis on continuing education and the trend toward life-long learning necessitates that adjustments be made in educational programs for adults in agriculture.

Anderson, (2007) described that the cause of the limited adoption of sustainable agricultural practices is the lack of dissemination of clear and reliable information.

Belay, (2003) stated that information acquired in both formal and informal educational settings quickly become outdated as new knowledge is generated. As researchers expand their knowledge about adult learning, Extension staff can communicate information in more meaningful ways (Ansoms and McKay, 2010). Chambers, (2004) stated that charges had been leveled against the Cooperative Extension Service, other change agents, and research centers, that much useful technology had been left sitting idle in research centers for lack of appropriate information dissemination strategies.

Chapman and Slaymaker, (2002) proposed that selection of a teaching method is critical to the learning style of those being served by the instruction. In earlier years, Gustam, (2000) stated the contention is that the communication gap lies not in language or cultural differences as in the methods employed for the dissemination of agricultural information. Davis (2008) noted that because we tend to teach the way we learn best when instructional style matches our preferred style of learning, understanding how people prefer to gather and react to information, or learn, is a critical component in the development and delivery of effective educational programming. Strong, Adhikanya, (2004) addressed that Extension agents should reflect upon the teaching strategies they employ and evaluate those most effective for their adult audiences.

Agricultural extension is considered as: a function that can be applied to different areas in the society; a knowledge system whereby research and agricultural education are operating in association within a broader knowledge system; an extended concept in which rural people who depend on primary production, remittances, petty trade and casual works should covered under agricultural and rural extension; and it is also an alternative among different approaches to best suit to the existing social, environmental and economic conditions (Rivera, et al 2001)

It is difficult to assess the impact of extension services as the indicators e.g., adoption of technology and farm productivity is also influenced by many other factors that have compounding effects. An analysis of 512 estimated rates of return for agricultural research combined with extension, 18 of which were from extension-only investments, showed an average rate of return of 47% for research and extension investments, while for extension-only investments, this was 80% (Anderson, 2007). As with other reviews, the quality of the studies included in the analysis is varied, and only a few followed high-quality impact evaluation methodologies. To fill this gap in rigorous methodology, a review is underway by the International Initiative for Impact Evaluation to synthesize both quantitative and qualitative information relating to the effectiveness of agricultural extension.

### Models of Agricultural Education

Recent studies on models of teaching consumers and informing policymakers have varied. An educational model is a human-constructed system that explains interactions in the world; thus, educational models can be very diverse. Models in agricultural education can and have emerged from theoretical research. Allison and Ellis, (2001) developed a conceptual model for agricultural literacy exemplifying this type of research. While the message of the model is more pragmatic, the model itself is built partially around the outcomes of the theory of cognitive constructive functions.

Likewise, some models can be philosophical in nature. Belay, (2003) philosophical article reviewed roles of context and content in secondary agricultural science education. The model which emerged provided a conceptual view of how secondary agricultural science education can develop a skilled agricultural workforce and agriculturally literate citizens. Conversely, some models in agricultural education have been developed by incorporating best practices and evaluations. Anderson and Feder, (2007) developed a model of teaching agri-food entrepreneurs by incorporating service learning principles and feedback from alumni on the topic. The resulting conceptual model formed the nucleus of a possible class which focused on engaging students in community-based entrepreneurship education. Finally, some models have been developed by incorporating existing models into programming. The review of the Extension program Grandparents Raising Grandchildren is one such example of the application of the community mobilizing model (Chambers, 2004).

### **Methods of Agricultural Education**

Generally, educational methods can be described as instructional practices, principles, and strategies that are utilized in educational settings. Methods of educational effectiveness have been the focus of many research studies in school-based agricultural education (Anderson, 2007), extension education (Ellis, 2009) and literacy programs (Witte, 2004). The general consensus drawn from these studies is that different audiences may maximize learning through specific methods. Across all types of programs effective methods are typically varied, personal, relationship-based, well-planned, targeted, interactive, skill-based, or experiential in nature and enhanced through inquiry (Brown et. al, 2002). Facilitator- or instructor- led programs were the focus of these studies; however, understanding how the public seeks and values educational programs in self-guided and self-motivated methods of learning is critical. In such instances (news media, magazines, periodicals, or social media, for example) trustworthiness, validity of sources, and context related to the content is of primary importance (Rivera, et al. 2001).

### **Agriculture Extension Methods**

In agricultural extension, the local and national context is crucial to understanding and improving the system. Surveys indicate that a key general source of information for farmers is other farmers, but for more complicated technical matters, farmers prefer firsthand or specialized sources of information, such as extension experts (Solebury, 2000). Among the different methods of extension that have been tested, the Farmer Field School model has been accepted as a good methodology because it is participatory. For example, a participatory seed selection and multiplication project in Nepal using new varieties of crops increased yields by about 45% and improved stability in household food access. A special feature of this project was that it reached poor and female-headed households and lower-caste households much better than the regular extension services (Witte, 2004). Likewise, farmers in PRC, India, and Pakistan were reported to have used less pesticides and better practices after a training program on the integrated pest management of cotton. A surprising observation was the lack of diffusion effect from trained farmers to their neighbors (Davis, 2008). A similar insignificant diffusion of knowledge to other farmers who reside in the same village as the trained farmers was reported in Indonesia (Chapman and Slaymaker, 2002). These results

imply that farmer-to-farmer approaches like the Farmer Field Schools approach, while potentially useful, are not a panacea.

It is also significant to note that irrespective of the merits of the technology or a solution, farmers' acceptance is critical to any extension method. An interesting comparison was made between a 6-year participatory seed selection and multiplication project in Nepal and a 3-year seed distribution relief program in Zimbabwe. The project in Nepal was successful in its scaling up and continuity because the new varieties were relevant to the needs and interests of farmers. In contrast, only 12% of the beneficiaries in Zimbabwe decided to reuse and plant the open pollinated maize varieties the following year because the new varieties were not appreciated and the farmers had not received sufficient information and training on seed selection (Purcell and Anderson, 1997). Other barriers to the adoption of sustainable agriculture practices include social barriers, land tenure, infrastructure, and the incompatibility of technology.

While some countries are struggling with new extension systems, those with well-established systems are also facing tremendous challenges. For example, the agriculture and technology extension system in the PRC has been facing great challenges with the general consensus that the system needs a thorough reform. During the 1990s, the PRC's extension system, one of the largest and most effective in the world, nearly collapsed. A study by the Center for Chinese Agricultural Policy and Chinese Academy of Science (Rivera et. al, 2001) identified the lack of innovative extension approaches as negatively affecting farmers' adoption of new technologies and suggested that much more effort is needed in terms of institutional and organizational reforms and human capacity building than policymakers have planned for.

### **Relationship between Agricultural Education and Research and Extension**

With few exceptions, the institutional relationships between agricultural teaching and research and extension services are inadequate. In many countries, this is the result of the deliberate separation of education, research and extension into different ministries and agencies and a lack of functional mechanisms to link them together to solve common problems. Agricultural research is usually conducted at government research stations and laboratories, the majority of which are not linked with universities. Research activities are often carried out as part of postgraduate programmes of higher agricultural education, but they are seldom directly related to national research priorities and programmes. There are some significant exceptions to this separation of education and research (Anderson, 2007)

In India, for example, agricultural universities carry out an important part of research activities and are integrated within the programmes of the Indian Council for Agricultural Research (ICAR). Some specialised centres of ICAR (called University Centres), in turn, offer postgraduate M.Sc. or Ph.D. training programmes. Another example is the Colegio de Postgraduados in Mexico, which was created specifically to balance research, postgraduate teaching and extension activities. The participation of higher education institutions in research activities needs to be planned as part of the regular activities of the teaching staff and their students. The credibility of these activities, and the possibility of obtaining the necessary research resources, depends on the activities being relevant to farmers and to national research priorities. For agricultural education institutions to participate more fully in research, the role of research should be clearly defined in

the institutional policies and in the responsibilities of faculty members (Witte, 2004)

As with research, close working relationships between agricultural education institutions and extension systems are indispensable in order to ensure the relevance and contribution of agricultural education. As with research, however, the involvement of agricultural education institutions in extension and community outreach is often limited. Even in those countries where extension and agricultural education are not separated into different ministries, the lack of resources and linking mechanisms greatly limits joint activities. Notable exceptions are those institutions which have been organized with outreach or extension responsibilities and are provided with the necessary means to carry them out. Looking again at the example of India, the responsibility for extension falls to a large extent on universities. They provide training and technical support to extension subject-matter specialists and have direct contacts with significant numbers of farmers. The universities often maintain their own units of extension and communication for this purpose (Noyes et. al, 2000)

In the case of Mexico, the Colegio de Postgraduados has established a Centre for Development Studies with four regional units, one in each ecological zone of the country. These units provide a link between academic programmes, extension activities, and rural producers. One way for universities and technical institutes to implement development outreach activities is by follow-up technical support to graduates working in agri-businesses or managing their own production enterprises. Also, short courses of continuing education can be designed to update extension officers' knowledge and to qualify extension staff for career advancement. Continuing education should, wherever possible, make use of farmers' associations, graduate associations, NGOs, commercial enterprises and research and extension centres. Agricultural education institutions, working with appropriate government agencies and non – governmental organizations (NGOs), need to develop research and demonstration plots that directly address farmers' needs. This requires that farmers be valued for their contribution to production through their innovations and sharing of local knowledge. For their part, farmers' organizations need to do a better job of communicating the needs of their members to agricultural education institutions. Farmer advisory boards are one way to improve communication between agricultural education institutions and local producers (Niehoff, 2004)

#### **Rural Agriculture Development**

Davis, (2008) argues that Agriculture will remain for many years a major contributor to the economies of most developing countries. In some countries, however, its share of gross domestic product (GDP) will progressively decline. The agricultural sector in developing countries is undergoing rapid changes as a consequence of both technological progress and economic forces which call for an increased market focus, competitiveness and higher productivity. Employment opportunities in the off-farm sector are expected to increase at a faster rate than in agriculture. This will further emphasize the present employment shift of agricultural graduates to related sectors, requiring a revision of existing curricula to better address educational needs.

Agricultural education curricula need to be redirected to address the labor demands of the private sector. Curricular reorientation will need to incorporate both the new role of market-oriented agriculture as well as issues of direct relevance to food security and rural poverty. Curricula also

will need to better reflect the importance of social and environmental issues for sustainable agricultural development. Meaningful curricular revisions will require a better understanding and incorporation of the underlying psychological processes that influence learning, with special attention to experiential learning and participatory learning strategies that focus on inductive reasoning skills. Agricultural colleges and universities need to determine their unique functions and the special attributes that they can offer students and the agricultural community. They will need to do a better job of communicating these attributes if they expect to remain financially sustainable, given current economic constraints. Moreover, agricultural institutions need to do a better job of carrying through with their unique ability to solve the agricultural problems of the communities they serve (Rivera et al. 2001)

Witte, (2004) observes that a holistic approach to teaching agricultural production through a multi-disciplinary systems perspective will increase the utility of both scientific and local knowledge. Inter-university alliances offer a means to capitalize on individual university strengths and to reduce costs reflected in the duplication of efforts. Regional collaborative strategies should be explored as a means to keep pace with accelerated scientific advancement. A commitment to developing communication infrastructure, especially with regard to the new computer-based communication technologies, should be a priority because of the potential to reduce the information gap.

Solebury, (2000) observes that the curricula of agricultural colleges and universities in developing countries need to adjust to the current and future employment needs of graduates. The emphasis in curricular revisions should be on process skills of problem solving and on skill sets that are transferable to a diverse employment sector. New options for programs of study should be based on enabling students to meet the expectations of agricultural employers, and increasingly the employment needs of the private sector (Gaustam, 2000) Given the severe restrictions on financial resources, governments in developing countries need to determine levels of continued support to higher education in agriculture based on the ability of colleges and universities to carry out curricular modifications that reflect employment markets. In some countries, there has been excessive growth in the number of diploma and degree granting agricultural education institutions. The challenge is to achieve a "better fit" between the supply and the demand for trained human resources in agriculture.

Educational programmes must be considered as an integral part of all rural development activities. In many instances, the success of development efforts depends on the availability of well-trained agriculture personnel. People who run the different rural development services such as agricultural extension, research, credit and co-operatives are usually those who were trained in agricultural schools and colleges. The key role being played by these institutions in providing preservice training cannot be overemphasized (Ferrington et al. 2009)

Development is a continuous process involving allocating and generating resources (Davis, 2009). This is mainly done to satisfy social and economic needs. Development in the rural area is also very important and endowed with abundant human and natural resources. Rural development involves a process by which a set of technical, social, cultural and institutional measures are implemented with and for the inhabitants of rural

areas with the aim of improving their socio-economic conditions, to achieve harmony and balance at the state, national and the regional levels (Chamber,2004).

Since there is no universal definition of rural development, different scholars view it from different perspectives. Witte, (2004) defined rural development as a process of creating and widening opportunities for individuals to realize full potential through education and share in decisions and action which affect their lives. Rivera, et al. (2001) defined rural development as a means of providing basic amenities, infrastructure, improved agricultural productivity, extension services and employment generation for the rural dwellers.

Wadding et al. (2010) defined rural development as a process whereby concerted efforts are made to facilitate significant increase in rural resources and productivity with the central objective of enhancing rural income and creating employment opportunities in rural communities for rural dwellers. Hence, it is an integrated approach to food production, provision of physical, social and institutional infrastructures with an ultimate goal of bringing about good healthcare delivery system, affordable and quality education, improved and sustainable agriculture. Brown et al. (2002) defined rural development as the far-reaching transformation of the social and economic structures, institutions, relationships and processes in the rural area. They viewed goals as agricultural and economic growth as well as social and economic development with equitable distribution and creation of benefits. UNECA (2004) defined rural development as a process by which a set of technical, social, cultural and institutional measures are implemented to improve the socio-economic conditions of the rural dwellers. Ellis, (2009) defined rural development as a cyclic process involving analysis of the current situation, policy, modeling and implementation of the measures to be used. He further opined that the programming of rural development is very essential for any agrarian economy. According to him, the greatest empowerment that could benefit rural folks is education and information. Extension education therefore will serve as an essential tool for the attainment of sustainable rural development.

Changes in agricultural management practices such as a change in planting dates, row spacing, planting density and cultivar choice, and other measures, which would counteract the effects of limited moisture, Irrigation is currently used to supplement low levels of precipitation but this could become very expensive and less effective, giving conditions of increasing aridity. This would require a phasing out of irrigation farming and a relocation of the production areas eastwards, if practicable. To reduce the risk of famine, marginal production areas could be kept economically viable by, for example, decreasing input costs or planting drought resistant crops, such as sorghum or millet. Alternatively, land use could be changed to grazing. Many current agricultural practices, such as conservation tilling, furrow dyking, terracing, contouring, and planting vegetation as windbreaks, protect fields from water and wind erosion and assist in retaining moisture by reducing evaporation and increasing water infiltration (Belay and Abebaw,2004)

Management practices that reduce dependence on irrigation would reduce water consumption without reducing crop yields, and would allow for greater resiliency in adapting to future climate changes. Such methods include water harvesting.

The reduced use of some pesticides could directly reduce greenhouse gas emissions and also reduce water pollution, thus contributing to both adaptation and mitigation. Agricultural management practices that recognise drought as part of a highly variable climate, rather than a natural disaster, should be encouraged. Farmers should be provided with information on climatic conditions, and incentives should be given to those farmers who adopt sound practices for drought management, and therefore do not rely on drought relief funds. Land use planning can be used to identify trends in land use that would be advantageous in the event of climate change (Ferrington et al. 2000)

#### **The constraints facing Agricultural Extension**

A good agricultural extension system accepts and incorporates farmers' traditional knowledge in research processes and sees farmers as partners during decision making. However, in most cases the problem with science in agriculture and extension is that it has a poor understanding of the knowledge from very poor, indigenous rural people. For many scientists, in order to develop those rural people, formal research and extension has to transform their knowledge into another knowledge system, because their knowledge is considered as unscientific and primitive (Röling and Pretty, 1997). This is true when it comes to the case of agricultural extension in Kenya. In most cases, the approach is top-down, whereby technologies are developed somewhere and the farmers are told what to do by the development agents (Belay, 2003).

Since the beginning, extension service coverage was not properly emphasized and certain groups were more favored than others. In spite of their large number, small holder farmers were not given attention until recent days. Development of big commercial farms and industries have got attention during the imperial regime while the focus was towards cooperatives and big commercial state farms, which consumed about 95 percent of agricultural inputs (fertilizers, pesticides, improved seeds and farm implements), during the military regime (EEA, 2006).

Another shortcoming is from the linkage of extension with research in the country. Under normal conditions, agricultural extension service serves as a farmer organization that expresses the concern and feeling of farmers to the public and conveys information from research institute to farmers and from the farmers back to research institutes (Birkhaeuser, et al 2001). Contrary to this fact, agricultural research in Kenya is poorly linked to extension (Belay, 2003) because of the fact that extension and research activities have been carried out under different institutions with zero or minimal coordination between them (Belay, 2003).

According to Birkhaeuser et al (2001), agricultural extension service needs agents for two main activities: in the first place to transfer required information to the farmers and secondly to report the problems faced by the farmers. However, agricultural extension agents in Kenya (named as Development Agents), are involved in different activities which are not necessarily related to their normal work such as collection of fertilizer credit, being government spokesmen, or agents for other government bureaus and this will highly affect their relation with the farmers (Belay, 2003). According to the same source extension coverage in the past followed main roads and only farmers on both sides of all-weather main roads benefited from extension.

Agricultural extension approaches in the past were renewed with no or weak evaluation and monitoring of the

systems. Moreover the extensions that were put in place used one-size-fits for all types of extension methods and there is no extension that suits for all categories of adopters (Chambers, 2004). To summarize, research process and agricultural extension services in Kenya lack preferences, criteria and conditions of the farmers (Anderson, 2007) and a well articulated national research and extension policy is not yet developed in the country (Davis, 2008). In general, all of the above mentioned programs came up with some inputs which are totally or partly external to the traditional farming system.

### Conclusion

Rural locations, in particular, need more economic development in order to match urban centric development. Poverty in rural areas has remained by and large, the main focal point of governments and development agencies. Sustainable rural development is the most effective way to eliminate this curse. To improve the standard of living, governments have allocated more financial muscle for the rural areas. Constant efforts are being taken to ensure development of infrastructure in such areas. Also, environment friendly growth stimulators have been provided to rural populations.

New methods have also been encouraged for farming in barren lands. Most of the farming land remains unused during no-crop season in underdeveloped countries. To improve that, cyclical production of different crops is encouraged so that land does not remain unused. Farmers are also being supported by launching numerous agro-environment schemes. Income generation and equal growth are likely resultants of such initiatives. These initiatives are being taken in not only developing countries but in developed countries as well. In the next century, agricultural education institutions in developing countries will need to address not only immediate production needs, but also long-term food security, sustainable agriculture and rural development needs. This will require moving from a single-disciplinary approach to an inter-disciplinary, systems approach which incorporates a wide range of new topics, including gender, environmental and population issues. A major challenge will be the transformation of agricultural education institutions into dynamic promoters of change within their environments. This will require that they abandon long-established traditions of academic isolation and become active contributors to sustainable agricultural and rural development through innovative teaching, research and extension.

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