Factors Influencing Farmers' Adoption of Information and Communication Technologies in Accessing Agricultural Information: The Case of Nakuru District, Kenya

***Ombati, J. M.*[1], *Ngesa, F. U.*[1] *and Githeko, J. M.*[2]**

[1]*Department of Agricultural Education and Extension, Egerton University, P. O. Box 536, Egerton*

[2]*Department of Computer Science, Egerton University, P. O. Box 536, Egerton*

Abstract

There is a clear relationship between information, agriculture and progress. Progress in agriculture is based on information and information transfer. In the wake of the information age, national governments, international agencies, and research institutions are exploring ways by which the new communication technologies can contribute to transfer of agricultural information in an attempt to reduce the unit cost of extension services and to increase the level of coverage. Although the information and communication technologies (ICTs) are here with us, a significant number of farmers have made little use of this technology in accessing agricultural information. This translates into inadequate information transfer, considering that the extension agent/farmer ratio has continued to rise over time. In this study, factors influencing farmers' adoption of ICTs in accessing agricultural information were examined using survey data from 16 administrative divisions of Nakuru district. Results indicate that farmers are well aware of and willing to adopt ICTs to revolutionize their access to agricultural information, but lack of government initiative, lack of resources, poor infrastructure and lack of knowledge on computer use are major impediments on the utilization of this technology. Investment in science, technology, infrastructure development, and promotion of education are some of the measures that would enhance adoption of ICTs in accessing agricultural information for sustainable agricultural development.

Key Words: Agricultural information, Agricultural development, Communication, Extension contact, Technology

Eger. J. Spec. Issue (2007) 7(S):27-42

Introduction

Kenya's population currently stands at over 30 million and 70% of the people depend on agriculture for their livelihood (Government of Kenya, 2005). The agricultural sector is a source of employment, industrial raw materials, food security, foreign exchange earning and rural incomes. There is therefore need for the country to spur this sector forward owing to its strategic position in the nation's overall development process. Sustainable agriculture is essential for Kenya's economic development because it utilizes available physical and human resources better, leading to increased capacity of people and land to adapt to change while minimizing dependency on external and non-renewable inputs. The quality, capability and performance of farmers are fundamental indicators of the agricultural sector's efficiency, productivity, development and sustainability (Sigman and Swanson, 1982; Roling, 1988).

Despite the fact that smallholders constitute 80% of agricultural producers in the country, about 25% make little use of commercial inputs, lack managerial skills, and most labour for cultivation is provided by people working using simple hand tools (Mwangi, 1999). The poor performance of farmers is due to the use of traditional production methods, lack of adequate extension information, poor managerial skills and rampant illiteracy (Feder and Umali, 1993; Mwangi, 1999). Farmers must make efficient allocation decisions if they are to continue contributing to Kenya's economic growth (Government of Kenya, 2005). The country's agricultural future thus depends critically on raising the productivity of farmers.

Literature on agricultural development models indicates that the foundation of a modern and productive agricultural sector is the availability of appropriate and well-tested agricultural information (Rogers, 1983; Nagel, 1980; Mowlana and Wilson 1988). Agricultural information is knowledge that has been gathered, interpreted, and organised for use in decision-making (Ngesa, 1991). In many cases the information is in place and all that is needed is the recognition of its true value and utility before dissemination to its users. There are, however, cases where information may need to be generated and tested by researchers. In all these cases, the critical element is that for the information to have impact on agricultural production, it needs to reach the users in a form that is appropriate, useful and on a timely basis. The characteristics of good information are relevance, timeliness, accuracy, usability, exhaustiveness, cost-effectiveness, and reliability (Babu, et al., 1997). On this, agricultural development specialists increasingly emphasize

the need to integrate well-planned and effectively executed communication strategies in development efforts (Nagel, 1980; Mowlana and Wilson, 1988; Roling, 1988; Roling, 1990; Rogers, 1983; Van den Ban and Hawkins, 1996).

Factors that influence agricultural production have been studied using farm level data (Adenisa and Zinna, 1993; Ahmed and Hossain, 1990; Ngaje, 1990). Current debate postulates that the factors of production may include more than capital, land and labour, as is commonly assumed. It may include advanced innovations of material capital, managerial skills, and technical knowledge of farmers (Cassman et al., 1997). A farmer emerges as a key decision maker who allocates human and material resources and directs the operations of the farm. Debertin (1993) identifies key functions that are performed at this level to be selection of amount of output to be produced, determination of proper quantities of each input and allocation of inputs to the various outputs. The farmer has to oversee the general development of the enterprise and bear the risk associated with the production and marketing of products. Extension contact coupled with work experience, indigenous knowledge, and other forms of education can improve the managerial ability of farmers (Schultz, 1964; Swanson and Peterson, 1989). The contribution of extension contact to agricultural productivity is much higher in modern than traditional agricultural environment and also with farmers who have higher levels of formal education (Nelson and Phelps, 1979).

Many agricultural development specialists concur that extension contact introduces agricultural information and knowledge that influences important attitudes and other personal characteristics that raise human productivity (Lionberger and Gwin, 1982; McDermott, 1987; Swanson and Peterson 1989; Feder and Umali, 1993; Qamar, 2002; Ochieng', 2004; Kamau, 2006). It gives farmers information that promotes their adaptability to changes in agricultural development (Feder and Umali, 1993; Adhikarya et al. 1987; Quizon et al. 2001). Contact between agricultural extension agents and farmers is a measure of availability of information about new and improved inputs and prices to farmers and the utilization of such information is almost certainly dependent on its availability to farmers. Sustainability of agricultural production depends largely on actions of the farmers and their ability to make decisions given the level of knowledge and information available to them. Thus farmers with more extension contact would be more inclined and be in a better position to adopt new methods of production and apply modern inputs efficiently due to their informed background.

Continuing high rates of population growth have intensified pressure on natural resources. Less and poorer quality of land and water must provide food and income for more people. Inequality of access to land, water, government services and other resources tends to increase, and thus create a widening socio-economic benefits gap. The challenge to extension policy and decision –makers is that of large numbers of farmers needing extension services and limited public funds to provide needed extension help. As a consequence, large numbers of farmers cannot be reached by publicly supported extension services. Data from an FAO report indicate that hundreds of thousands of farmers are not yet being reached by agricultural extension services (FAO, 1990). Data analysis shows that in Africa, two out of every three farmers have no contact with public extension services (Wessler and Brinkman, 2002). In Kenya during the last 10 years, the staffing and facilitation of public sector extension has declined mainly as a result of public employment freeze and reduced funding for operations and maintenance. Currently, the ratio of frontline extension worker (FEW) to farmers is about 1:1000 compared to the desired level of 1:400 (Ministries of Agriculture, Livestock and Fisheries Development, 2004; Ochieng, 2004).

In the absence of effective private sector operations to fill the vacuum, the situation has led to reduced spatial coverage, targeting and effectiveness of service delivery reflected by clientele complaints (Kamau, 2006). Low agent/farmer ratios are necessary but fiscally unsustainable. Modern telecommunication technologies have reduced the cost of information dissemination and offer a number of options compared to the conventional systems. The inadequacy of trained staff, the high cost of such training and the sheer enormity of the target audiences make the use of modern communication technologies necessary to widen the reach of conventional information transfer and dissemination systems. Continuous advances in technology now give agricultural development specialists a wide range of options for improving communication with farmers. Linked to a central information bank by cable or telephone, a farmer can continuously receive available information, or interactively request specific information. By this process, farmers in remote areas can directly be connected with expertise and services of information in central locations ISNAR, 1989; Xu, 2001; Wessler and Brinkman, 2002; Kenya, 2004).

Given this backdrop, the present paper examines one of the least touched upon issues related to diffusion of modern agricultural information, specifically examination of farmers' awareness, willingness and ability to

adopt information and communication technologies (ICTs) in accessing agricultural information. The article argues for the need to increase investment in agricultural information and knowledge systems, which will include capacity building in ICT and establishing information points at appropriate locations. To realize this, there will be need to align policies and institutions to reflect the importance of science and innovation and harmonize standards for packaging of user-friendly extension messages.

Purpose and Objectives of the Study

The purpose of the study was to investigate factors that affect farmers' adoption of information and communication technologies (ICT) for accessing agricultural information. The objective was to determine their awareness, willingness and ability to adopt this technology and identify socio-economic factors determining such awareness and ability for improving their access to agricultural information. The results of the study would form a basis for improving the farmers' capacities to use ICT to access agricultural information.

Methodology

Agencies that offer extension services to farmers should ideally establish viable frameworks for the systematic gathering, interpreting, processing, storage, updating, retrieval, and dissemination of information needed by the farmers. They achieve this broad mission by:

- regularly determining the information needs of the farmers;
- promoting innovation as a tool for improving farm productivity;
- promoting linkages between the farmers and research and development organizations;
- setting up consultancy services for farmers; and
- establishing centres from which farmers may source information for use in their farming activities.

The selected research procedure was meant to enhance the efforts of the extension agencies to disseminate agricultural information to farmers by use of modern information and communication technologies (ICTs) that have shown to have a wide range of options for reaching the users by examining their awareness, willingness and ability to use these technologies.

Conceptual Framework

Literature on theories and practices of agricultural development provides basis for viewing communication in the agricultural sector as a syste consisting of five primary subsystems of agricultural research, extensio training institutions, farmers (users) and other stakeholders. The agricultu research, extension and training subsystems should engage in the generatio encoding, sending, receiving and decoding of knowledge and informatic during the communication process (Roling, 1988; Roling, 1990; Mowlar and Wilson, 1988; Nagel, 1980; Van den Ban and Hawkins, 1996). Oth agricultural development specialists also stress the need for effectiv interaction among the subsystems (Lionberger and Gwin, 1982; McDermot 1987; Swanson and Peterson 1989; Feder and Umali, 1993; Qamar, 200 Ochieng', 2004; Kamau, 2006. New developments in information an communication technology now mean that these subsystems can greatl improve the flow of information amongst them.

Contrary to the widely held belief that many farmers do not fanc communication technology for accessing agricultural information, experienc among rural poor farmers in India has proved that they readily adopt and us it to transform inefficient and corrupt marketing system for their produce. I his book, "The Profits at the Bottom of the Pyramid," Prahalad (2001), give the example of Information Technology · Centre (ITC), an Indian conglomerate which decided to connect farmers with personal computers i the villages. The ITC "*e-Choupal*" (literally meaning village meeting place allowed the farmers to access information on improved practices of soy bear production and finally check prices of soy bean futures at Chicago Board o Trade. The network thus allowed the farmers to access information or production as well as marketing thus improving their margins. Though the interventions used by other countries vary, the critical element of interacting research, extension and user subsystems permeate all the systems reviewed (Meyanathan, 1994). The theoretical model and the case from India provided the foundation by identifying the kind of networks that should be put in place using modern communication technologies. The resultant model is shown in Figure 1.

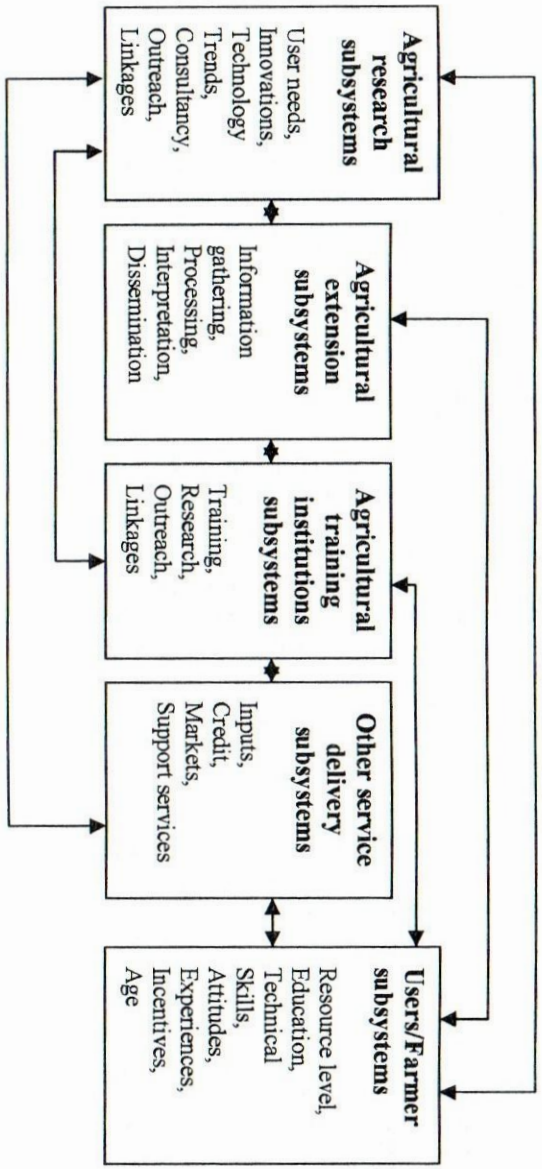

Figure 1: Agricultural information flow within the agricultural subsystems

The subsystems should interact on a continuous basis. The focus of this article is the farmer (user) subsystem whose capacity to use ICTs to access agricultural information is greatly influenced by their levels of education, experiences, technical skills, attitudes and resource endowment. This model provided the foundations for research procedures which focused on factors influencing farmers' adoption of information and communication technologies in accessing agricultural information. The larger study analyzed and documented: the level of ICT development in the country; ICT policy, training needs, level of awareness of farmers on ICT; and factors that had influence on ICT usage by farmers.

Research Design

A cross-sectional survey was conducted in 16 administrative divisions of Nakuru district. The district is typical of the farming situation in the country as represented by the small, medium and commercial farmers who are to be found engaged in a variety of farming enterprises. A multistage random sampling technique was employed to locate the locations, then the villages in each of the locations and finally the sampled households. A manageable total of 308 households formed the sample of the study. The sampled farmers included both large and small scale commercial farmers engaged in a variety of enterprises. Detailed data on ICT awareness and its application were collected from the sample using a pre-tested personally administered questionnaire. The instrument consisted of four parts. The first part elicited information on farmer profiles, while the second part sought information on ICT awareness and usage. The third part requested the respondents to reveal the relative importance of ICTs in accessing agricultural information on a five-point scale. The final part addressed suggestions for upgrading use of ICTs for accessing agricultural information by the respondents.

Data Analysis

The data were analyzed using quantitative methods. Summaries of the records of each respondent were generated. The summaries were then analysed for trends. The analyses were mostly descriptive. Percentages were used to describe the farmer profiles and their awareness and usage of ICTs in accessing agricultural information. Means and standard deviations were generated from the ratings on the relative importance of the ICTs from the farmers' perceptions for accessing agricultural information.

Results and Discussion

The findings presented here encapsulate quantitative information collected from the respondents who fell within the active years of 21-60. They were in their independent adulthood and for that matter formed the primary decision-makers in their households. The respondents highly valued agricultural information for making decisions in their farms. Only 31% of the respondents indicated that they had had extension contact within the last one year, but still classified this contact inadequate. They highly rated the usefulness of the help they got from this initial contact. Generally the respondents had average levels of formal education with 11% being illiterate and 59% having schooling up to the basic level (middle primary and junior secondary) 30% indicated they had post secondary education.

The unique qualities of ICT in availing information to farmers were included to find out whether farmers were aware of them. The ICT qualities included comprehensiveness, non-redundancy, speed and timeliness, appropriate database structure and ease of access to information. Usage of ICT-based means was included to test the level of involvement of farmers with this technology. Variables hypothesized to influence the ICT awareness and adoption by farmers included: availability of ICT facilities, its characteristics, technical capacity of farmers, socio-economic characteristics of farmers and even extension contact. Table 1 presents the description, measure, and hypothesized direction of the relationship between the explanatory variables with the dependent variable ICT awareness index (ICTAI).

Use of age and education level of farmers as explanatory variables in adoption–perception studies is fairly new. Extension contact can be singled out as one of the important sources of information dissemination directly relevant to making farm decisions.

This is reinforced by the fact that many studies have found a significant influence of extension education on agricultural productivity (Baidu-Forson, 1999; Adesina and Zinnah, 1993). Therefore, this variable was incorporated to account for its influence as well as to make a case for strengthening extension services and networks if proved useful. A high proportion of farmers (69%) who complained of poor extension coverage were willing to try out other means of accessing agricultural information including ICT-based systems.

Table1. Description, summary statistics and hypothesized direction of influence of the variables specified

Description	Measurement	Hypothesized direction of influence	Mean	Standard deviation
ICT Characteristics				
Adaptability	Number	+	4.52	3.32
Feasibility	Number	+	3.78	2.73
Costs	Percent	+	0.42	0.33
Level	Years	+	6.32	4.44
Incentives	Number	+	3.77	2.01
Policy	Number	+	2.98	1.86
Infrastructure	Number	+	4.31	2.21
Gov. initiative	Number	+	3.88	2.83
Socio-economic Characteristics				
Education level	Schooling yrs	+	8.67	6.27
ICT Skills	Number of yrs	+	2.43	2.01
Age of farmer	Value 1 if owner, 0 otherwise	±	45.27	14.31
Land tenure status	Value 1 if large, 0 otherwise	±	0.77	0.48
Land size	Value 1if commercial, 0 otherwise	±	0.37	0.28
Enterprise	Persons per household	±	0.54	0.22
Extension contact	Value 1 if had extension contact in the past 1 year	+	0.31	0.22
Subsistence pressure		+	6.02	2.50

± means direction of influence is indeterminate. + means positive influence

The Chayanovian theory of the peasant economy indicates that higher subsistence pressure increases the tendency to seek means to improve productivity (Ngaje, 1990). The findings of this study were consistent with this theory where farmers with higher subsistence pressure were found to be

keen to get means of enhancing their performance in their farms. The subsistence pressure variable, measured by family size per farm household was incorporated to account for its influence in raising awareness, if any, of how ICT would be used to avail agricultural information to the users with its attendant benefits. Farmers with higher subsistence pressure showed more willingness to try out other means to access agricultural information other than relying on the conventional extension system.

Land ownership in Kenya serves as a surrogate for a large number of factors as it is a major source of wealth and influences farm operations. Majority of the farmers owned their farms (77%). Partnerships and limited company status (23%) was mainly observed with large scale commercial farms. The impact of tenancy on the extent of awareness and willingness to seek agricultural information through ICT varied. The tenancy variable was incorporated to test whether there is any difference in the level of perception between landowners and tenant farmers. A positive coefficient for this variable implied that landowners are relatively more aware than the tenants.

The percentage of income earned off-farm was included to reflect the relative importance of non-agricultural work in these farm households. It was used as a proxy for measuring investment potential in ICT usage for accessing agricultural information. A high proportion of farmers (58%) who had off-farm income indicated willingness to invest in ICT based systems to improve their access to agricultural information.

The state of infrastructure and government policy affects availability and usage of ICT facilities. Government initiative was found to be necessary in creating awareness and enthusiasm among farmers on bringing services closer to where they live and work. Majority of the respondents (87%) were not aware of any government plans to deploy ICT based systems to improve their access to agricultural information.

The study also sought to determine if there were differences in ICTs awareness and usage between the small and large scale farmers. Close examination of the results indicated that a significant number of the large scale farmers (58%) indicated that they use the internet to get information related to their agricultural activities. Only a small percentage of the small scale farmers (11%) indicated that they used internet facilities for communication with a large number indicating that mobile telephony was a major leap forward in terms of their communication with the outside.

As high as 67% indicated their willingness to participate in programmes that would easily avail information to them. As many as 62% lamented slowness on the part of the government to initiate programmes that would use modern communication technologies to promptly cater for their agricultural information needs. Citing lack of resources and limited individual capacities they were keen to see the government set up information centres near their localities where they would easily get information on inputs, prices, markets and other developments. They were quick to draw comparisons with the private sector especially the mobile phones which had brought communication services right into their households.

Conclusions and Recommendations

The study focused on farmers' awareness and usage of ICTs in accessing agricultural information. Results reveal that farmers regularly need agricultural information for making decisions on their farm. Extension contact, the chief source of agricultural information to farmers is still low. Only 31% of the farmers indicated that they had extension contact at least once within the last year. However, they still acknowledged the service as being very important in providing them with agricultural information despite the sparse coverage.

Farmers were found to be aware of the advances in communication technology that would greatly enhance their access to agricultural information unlike the current situation which relies on the conventional methods. Most of this awareness had been prompted by developments in the private sector that had brought services closer to them using modern communication technology. Listed here were developments in the mobile telecommunications, banking, radio and even television.

The ICTs attributes directly influence its utility. The initial high cost and the technical skills associated with its usage have effectively ensured that farmers do not benefit from this technology. Government is yet to come up with a basic structure that incorporates ICTs in dissemination of agricultural information to farmers. This has profound implications for its usage by the farmers and perhaps partly explains stagnation of modernizing dissemination of agricultural information to farmers.

The policy implications are clear. Promotion of education and strengthening extension services both in terms of its quality and coverage would boost

farmers' productivity. Advances in technology now give the extension service an ever increasing range of options for improving communication. On this there will be need to increase investment in agricultural information and knowledge systems, which will include development of rural infrastructure, capacity building in ICT and establishing information points at appropriate locations where farmers can easily access them.

References

Adhikarya, R. (1978). Guideline proposal for a communication support component in trans-immigration projects. A consultancy report prepared for FAO/UN (project 6/INS/01/T), FAO, Rome, Italy.

Adenisa, A.A., Baidu Forson, J. (1995). Farmers' perception and adoption of new agricultural technology: Evidence from analysis in Burkina Faso and Guinea, West Africa. Agricultural Economics 13:1-9.

Adesina, A.A. and Zinnah, M.M. (1993). Technology characteristics, farmers' perceptions and adoption decisions: A tobit model application in Sierra Leone. Agricultural Economics 9:297–311.

Ahmed, R. and Hossain, M. (1990). Developmental impact of rural infrastructure in Bangladesh. Research Report No. 83: International Food Policy Research Institute, Washington, DC. USA.

Babu, A.R., Singh, Y.P. and Sachdeva, R.K. (1997). Establishing a management information system. In: B.E. Swanson and R. Bentz Bentz. (Eds.). Current Status of Agricultural Extension Worldwide. FAO, Rome. Italy.

Baidu-Forson, J. (1999). Factors influencing adoption of land-enhancing technology in the Sahel: Lessons from a case study in Niger. Agricultural Economics 20:231–239.

Cassma, K., Olk, D. and Dobermann, A. (1997). Scientific evidence of yield productivity declines in irrigated rice systems of tropical Asia. International Rice Committee Newsletter 46:7-18.

Derbertin, D.L. (1993). Agricutural Production Economics. 2nd Edition. New York: University of Kentucky. USA.

Feder, G. and Umali, D.L. (1993). Adoption of agricultural innovations: A review. Technology Forecasting and Social change 43(3&4):215-39.

Feder, G., Murgai, R. and Quizon, J.B. (2004). Sending farmers back to school. The impact of farmer field schools in Indonesia. Review of Agricultural Economics 26(1):45-62.

Food and Agriculture Organization. (1990). Report of the global consultation on agricultural extension. A Proceeding of an International Expert Meeting Held in Rome, 4-8 December 1989. UN, Rome, Italy.

Government of Kenya. (2005). Economic Survey. Ministry of Planning. CBS. Nairobi. Kenya.

ISNAR. (1989). Technology triangle: Linking farmers, technology transfer agents and agricultural researchers. Summary report of an international workshop held from 20–25 November 1989, ISNAR, The Hague.

Kenya, Republic of (2004). E-Government strategy: The strategic framework, administrative structure, training requirements and standardisation framework. Directorate of E-Government. Nairobi. Kenya.

Kamau, F.K. (2006). An overview of extension services in Kenya. A paper presented during the Animal Production Society of Kenya, Annual Conference Held in Isiolo from 8th to 10th March 2006.

Lionberger, H.F. and Gwin, P.H. (1982). Communication strategies: A guide for agricultural change agents. Danville, IL: Interstate.

Mbaga-Semgalawe, Z. and Folmer, H., 2000. Household adoption behaviour of improved soil conservation: The case of the north Pare and west Usambara mountains of Tanzania. Land Use Policy 17:321–336.

McDermott, J.K. (1987). Making extension effective: The role of extension/ research linkages, p. 89-103. In: W.M. Rivera and S.G. Schram (Eds.). Agricultural Extension Worldwide. London, Croom Helm.

Meyanathan, S.D. (1994). Industrial structures and the development of small and medium enterprise linkages: Examples from East Asia. The World Bank. Washington D.C., USA.

Ministry of Agriculture and Ministry of Livestock and Fisheries Development. (2004). Strategy for Revitalizing Agriculture 2004-2014.

Mowlana, H. and Wilson, L.J. (1988). Communication technology and development. UNESCO. Paris.

Mwangi, J.G. (1999). Policy milestones in Kenya that have supported or constrained sustainable agriculture and poverty alleviation. A research report prepared for the Director of Tegemeo Institute, Nairobi, Kenya.

Nagel, U.J. (1980). Institutionalisation of knowledge flows: An analysis of extension role in two universities in India. Quarterly Journal of International Agriculture, 30 Frankfurt: DLG Verlag.

Nelson, R. and Phelps, E.S. (1979). Investement in human, technological diffusion and economic growth. American Econ. Review 56:69-75.

Neupane, R.P., Sharma, K.R. and Thapa, G.B. (2002). Adoption of agroforestry in the hills of Nepal: A logistic regression analysis. Agricultural Systems 72:177–196.

Nganje, W.E. (1990). Productivity analysis of small-holder yam production in Fako Division: A case study in the Bonakandsa and Malende Zones. Memoir, Dschang University, Cameroon.

Ngesa, F.U. (1991). Agricultural information processing between agricultural research stations and frontline extension workers in Kenya. OSSREA. Addis Ababa, Ethiopia.

Ochieng' (2004). Kenyan initiatives to take science to its farmers. Scidev.Net (London). WWW: http://allafrica.com/200502150673.html. 12 February 2005.

Qamar, M.K. (2002). Global trends in agricultural extension: Challenges facing Asia and the Pacific region. FAO, Rome, Italy

Quizon, J. Feder, G. and Murgai, R. (2001). Fiscal sustainability of agricultural extension: The case of farmer field schools. International Journal of Agricultural Extension Education 8:13-24.

Rogers, E.M. (1983). Diffusion of innovations. New York: Free Press.

Roling, N. (1988). Extension Science: Information Systems in Agricultural Development. Cambridge University Press. UK.

Roling, N. (1990). The agricultural–research technology transfer interface: A knowledge systems perspective. In: D. Kamowitz (Ed.). Making the Link: Agricultural Research and Technology Transfer in Developing Countries. Boulder, Co: Westview Press.

Schultz, T.W. (1964). Transforming Traditional Agriculture. New Haven, CT: Yale University Press.

Sigman, V.A. and Swanson, B.E. (1982). Problems facing national agricultural extension managers in developing countries. Champaign. Urbana. IL. University of Illinois.

Swanson, B.E. and Peterson, W. (1989). A field manual for analyzing agricultural technology development and transfer systems. INTERPAKS Report. Urbana. University of Illinois. Interpaks.

Van den Ban, A.H. and Hawkins, H.S. (1996). Agricultural Extension. Blackwell Science, London, UK.

Wesseler, G. and Brinkman, W. (2002). Bridging information gaps between farmers, policy-makers, researchers and development agents. Paper Presented at the General Conference on Agroforestry Impacts on Livelihoods in Southern Africa: Putting Research into Practice. Aventura Warmbaths, South Africa, 20-24th May 2002.

Xu, J. (2001). The development and role of rural libraries in China. Rural Libraries 21(2):24–36.