Universal Journal of Agricultural Research 5(4): 219-225, 2017 http://www.hrpub.org
DOI: 10.13189/ujar.2017.050403

The Agricultural Extension Agents Influence on the Uptake of Improved Sorghum Technologies in Embu County, Kenya

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Abstract The agricultural extension agents play important role in facilitating and guiding farmers towards implementing various agricultural value chain technologies. However, despite the availability of extension agents and improved agricultural technologies, there is minimal corresponding uptake and output on the farmers' farms. The current study therefore assessed the influence of extension agents on the uptake of improved sorghum technologies in Embu County, Kenya. The study sampled 51 government and private extension agents from four villages. Data was collected on the agent's socio-economic characteristics and extension, techniques. The study revealed that 65% of the respondents were male and had acquired education up to tertiary level. Further, the agents had acquired over twelve years work experience in disseminating various agricultural technologies. The study findings indicated that majority 73% of the agents disseminated technologies through farm visits, demonstrations, and agricultural shows visits and through radio technologies. There was an association (x^2=96.7) between the extension agents and agents work experience with the work experience enhancing the uptake of improved sorghum technologies by farmers. Further, the work experience significantly ($p \leq 0.00$) influenced disseminating of the improved sorghum technologies among farmers. It was concluded that agents' gender, work experience, demonstrations techniques and farm visits, agricultural shows method complemented agents' work in disseminating the improved sorghum technologies among farmers.

Keywords Sorghum Improved Technologies, Socio-economic Factors, Institutional Factors

1. Introduction

Agricultural extension agents and progressive farmers play a complimentary role in influencing uptake and disseminating modern improved technologies between researchers, technical agents and other stakeholders Munyua and Stilwel [1]. In Kenya, the government extension services are provided by national and county government agencies and the Kenya Agricultural and Livestock Research Organisation (KALRO) Munyua and Stilwel [1]. According to Wanyama *et al,* [2] the private extension sector agents complement the government agencies. The private sector in Kenya include, Non-governmental organizations (NGOs), faith based organizations, progressive farmers, farm inputs and various cash crops agencies such as tea, coffee, sugar cane and wheat. However, Fisher and Vogel [3] asserted that majority of the extension agents both in private and government institutions in developing nations tend to restrict their contacts to the richer and large scale farmers willing to experiment with new technologies. Further, the study documented that large scale farmers use knowledge and skills acquired from extension agents to enhance their competence in production and accrue income from successful agricultural enterprises implementation Fisher and Vogel [3]. However, according to AGRA [4], agricultural extension service provision is crucial in disseminating information and technologies in the earnest to confronting food insecurity and poverty in Africa. Besides, the extension service provision acts as a pre-requisite for promoting technology uptake and its eventual use in increasing both livestock and crop productivity AGRA [4].

Related to this study, Kirimi *et al.,* [5] documented that agricultural extension service provision serves as a means of delivering information to farmers, besides disseminating new technologies aimed at increasing production in both crop and livestock products. In addition to service provision, extension models such as participatory and integrated computer technologies (ICT) play important role in guiding and styling up the action of an extension system or an organization to achieve its goals and objectives towards

effective adoption among the farming community Lavis *et al*., [6]. Further, extension model has been documented as a philosophy that informs, stimulates and guides agents on the system structure such as leadership, programmes, resource management and its linkages Okello, [7]. According to Aremu *et al.,*[8] extension agents convey or pass across new skills, technology, techniques or new methods of production in agriculture packaged in a model to ultimately improve the productivity and living standard of target farmer. Related to this study, Feder *et al* [9] asserted that, for successful modeled technology transfer, the extension agent must understand the farmers learning needs, challenges, priorities and opportunities as well as psychological process, semantic, physical and economic barriers to adoption of new technologies.

In addition to agents ability of agents to disseminate technologies across various value chains, Mukembo and Edwards, [10] asserted that extension models play complimentary roles in enhancing technology transfer. Moreover, Mukembo and Edwards, [10] documented that extension models include, educational institution based agricultural extension model, project based extension model, farming systems research extension model, the cost sharing extension model, information communication integrated and the participatory extension model. For instance in Kenya, the agricultural extension models guided by various techniques and avenues such as ASK shows in Kenya, farm demonstrations, government and private public field days, farmer to farmer chats, radio services, mobile phone technologies and computer based technologies enhance rapid adoption rates among farmers Mwadalu and Mwangi, [11].According to Doss, [12] the choice of extension model in Kenya by agents is dictated by factors such as availability of the of the farmer, availability of relevant institutional support and resources, suitability of methods or techniques, target and supportive, monitoring and evaluation of extension services. Besides, farmer's interest in various agricultural activities should be understood by extension agents' as guidance on the use and benefits of latest improved research technologies. In addition, Lavis *et al*., [6] documented that diffusion of knowledge and skills can achieve faster results outcome among farmers if research technologies are appropriately taken by agents during dissemination. Further, diffusion of research output can be also enhanced by qualified agents through simple documentary reviews, brochures and summaries of modern technologies to farmers.

Related to this study, Fisher [13] asserted that information transfer agents are important disseminators of relevant research, policy information and successful practices among farmers. Besides, agricultural extension agents translate research technologies into plain language that help farmers to acquire agricultural information and establishing a connection between research, producers and research users [Feder, *et al.,* 9]. In addition, Neubert [14] asserted that participatory extension services involving multi-agencies enhance sustainable uptake of improved technologies. Jurgen, *et al.,* [15] also asserted that the participatory research perspective is considered as the broader knowledge system in which farmers are embedded and evolved into the Agricultural Knowledge and Information System (AKIS) perspective. Jurgen, *et al*, [16] further documented multi-agencies and institutional support is very important in enhancing technology transfer through Agricultural Innovation Systems (AIS). According to Rivera and Sulaiman [17] information and technology transfer brokering by extension agents entails a broad range of tasks such as research, technologies and innovations development and goes beyond common knowledge a transfer. Related to this, Laurens *et al.,* [18] also stated that extension agents and researchers play key roles in systems complementary facilitation and support service provision to farmers.

Contrary to foresaid theories and philosophy, small-scale farmers in arid areas still face problems such as receiving minimal extension services, limited access to latest agricultural information and lack of training and knowledge on improved technologies Nambiro, *et al*, [19] and CGIAR, [20].Further, transfer of appropriate research technologies to promote food security is a major priority for many developing nations including Kenya Nambiro, *et al,* [19].It is against this back drop the current study examines the greatest challenges facing the agricultural technology transfer, the availability of approaches and models to the end users and sustainability and the use of technology to meet the future challenges by farmers. The current study was therefore evaluatedinfluence of extension agents on the uptake of improved sorghum technologies in marginal areas of Embu county Kenya.

2. Methodology

The study was conducted in arid Mbeere north Sub-County, Embu County, Kenya. The region's topography slopes from North West to South East direction and located on the East of Mount Kenya between coordinates 0°41' 18'N 37°55'E, Gachimbi, [21]. The study employed a descriptive survey design suitable for describing information, data, events, perceptions and issues Mugenda and Mugenda, [22]. Further, the study purposively selected 51 out of 101 agents fromnational and county government ministry of agriculture, lead farmers, farmers groups and non governmental organizations data from Mbeere north, Embu county engaged in improved sorghum value chain MoA, [23]. Data on the extension agent's gender, work station, education level, experience, telephone technologies, demonstrations, ASK shows and radio techniques was collected from lead farmers, private and extension agents located in Njura, Kangai, Njarange and Kiambungu villages. Purposive sampling technique was used to select extension agents working within Mbeere north Sub-County, Embu county (Table 1).

Table 1. Purposive sampling frame for extension agents

Institutions	Number of respondents
MoA, government frontline extension agents	19
MoA Sub county government agents	3
Progressive lead farmers	6
Contact farmers	21
EUCORD, N.G.O agent	1
CLUSA, N.G.O agent	1
Total	51

Key. MoA- Ministry of Agriculture, EUCORD-European Union Cooperative for Rural Development, CLUSA-Cooperative League of United States of America

N.G.O-Non Governmental organization

3. Data Sources, Collection Methods and Analysis

Primary data was collected on agents' gender, education level and occupational experience, telephone technologies, demonstrations, ASK shows and radio technique. A pre-tested Likert scale questionnaire containing varied items was used to collect data from extension agents' perception on the use of participatory and integrated computer technologies (ICT) models and techniques in promoting the production and marketing of improved sorghum products. The extension staffs were asked to express their opinion on a scale of 1 to 5, where 1 indicated a strong agreement with presented perception and **5** indicated strong disagreement with assertions on extension models and techniques enhancing production and marketing of sorghum value chain. Secondary data on the farmers' records, annual County agriculture reports, statistical abstracts, periodicals, journals, economic reviews and market reports were collected. The collected data was coded and analyzed using Statistical Package for Social Sciences (SPSS version 16). The descriptive study findings were presented through frequencies and percentages. Further Pearson's Chi-square test was further performed to determine the degree of association between variables.

4. Results

4.1. Extension Agents Characteristics

The study findings indicated that the majority 65% of extension agents' were male and 52% had acquired education up to tertiary level while 24% of the agents up to secondary level (Table 2). In addition, 75% of the agents had an experience of over twelve years conducting extension work to farmers disseminating various technologies among farmers (Table 2).

Table 2. The extension agents' characteristics

Agents characteristics	**Number of agents**	**Percentage (%)**
Male	33	65
Female	18	35
Educational levels		
Primary level	4	08
Secondary level	12	24
Tertiary level	27	52
Degree	07	14
Postgraduate	1	02
Agents work experience		
≤ 8yrs	07	14
≤10yrs	05	10
≤12yrs	38	75
≤15yrs	01	01

N=51

4.2. Technologies Disseminated by Extension Agents

The study findings also revealed that 77% of the agents were exclusively engaged in disseminating sorghum production technologies on the farmers' farms while 18% disseminated marketing technologies and 5% supported farmers in value chain technologies (Figure 1).

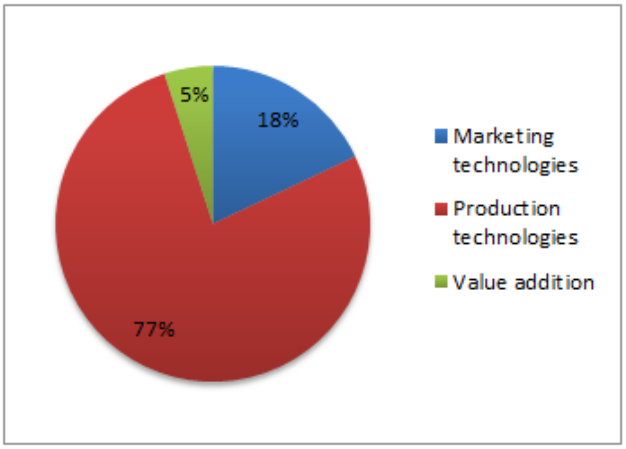

Figure 1. Disseminated technologies

4.3. Association between Agents' Characteristics and Disseminated Technologies

The results revealed an association between the agents' agents experience (χ^2=96.7) and agents disseminating production sorghum technologies which significantly ($p \leq 0.00$) contributed to dissemination of the improved sorghum technologies among farmers (Table 3).

Table 3. Association between agents' characteristics and disseminated production technologies

Agents characteristics	Chi-Square (χ^2)	P≤ Value
Gender	4.41	0.44
Education level	10.77	0.06
Agent's experience	96.74	0.00**

N=51 Statistical significance levels **p≤0.01, *p≤0.05

4.4. Techniques Used by Agents in Promoting Improved Sorghum Technologies

The study findings further showed that extension agents disseminated improved sorghum production technologies information through farm visits (73%), agricultural shows visits (80%), radio technologies (57%), tours and excursions (65%), farm group meetings (59%) and through farm demonstrations (75%) techniques (Table 4).

Table 4. Techniques used by agents in disseminating improved sorghum technologies

Techniques	Number of agents	Percentage %
Office visits	24	47
Telephone calls	37	73
Demonstrations	38	75
Farm meeting	30	59
Lead farmers	19	37
Tours and visits	33	65
Agricultural show visits	41	80
Radio programmes	29	57

N=51

4.5. The Association between Extension Techniques Used by Agents and Uptake of Improved Sorghum Technologies

Table 5. The association between agents' extension techniques and production value chain

Techniques	Chi-Square (χ^2) Association	P≤ Value Significance
Farm visits	42.8	0.00**
Telephone calls	4.2	0.38
Demonstrations	30.4	0.00**
Farm meetings	32.3	0.00**
Lead farmers	17.2	0.00**
Tours and visits	37.3	0.00**
Agricultural Shows	6.8	0.28
Radio programmes	14.8	0.01**

Statistical significance levels **p≤0.01, *p≤0.05

The techniques used by extension agents to disseminate production technologies were office visits, telephone calls, demonstrations, farm meetings, lead farmers, tours and visits, agricultural shows and radio programmes. The study revealed an association between farm visits (χ^2=42.8), demonstrations (χ^2=30.4) face to face chats (χ^2= 32.3), radio programmes (χ^2=21.6), tours and visits (χ^2=37.6) and the agents engaged in disseminating improved sorghum technologies which significantly (p=0.00) contributed to the agents disseminating production technologies of improved sorghum technologies (Table 5).

Further, the techniques used by extension agents to disseminate marketing technologies were office visits, telephone calls, farm meetings, lead farmers, tours and visits, agricultural shows and radio programmes. There was also a strong association between face to face chats (χ^2=60.8) approach, farm meetings (χ^2=28.9) ASK visits (χ^2= 41.8) radio programmes (χ^2=61.6) telephone calls (χ^2=21.2) and the agents engaged in disseminating improved sorghum marketing technologies which significantly (p=0.00) contributed to the agents disseminating marketing technologies of improved sorghum products (Table 6).

Table 6. The association between extension techniques disseminated by agents and uptake of marketing technologies+

Techniques	Chi-Square (χ^2) Association	P≤ Value Significance
Farm or home	7.9	0.10
Radio programmes	61.6	0.00**
Mobile phone and technologies	8.3	0.09
Telephone technologies	21.2	0.04
Face to face chat	60.8	0.00**
Farm meetings	28.9	0.00**
Community Leaders	10.1	0.02**
Agricultural show visits	41.8	0.00**

Statistically significance levels **p≤0.01, *p≤0.05

5. Discussion

The current study findings indicated that extension agents were engaged in disseminating improved sorghum technologies whereby 65% were male agents while 52% agents had acquired education up to tertiary level (Table 2). Gender of the extension agent and educational levels are key determining factors in enabling transfer of technology uptake and decision making among farmers. The current study results could be attributed to the fact that both female and male extension agents disseminate information on new technologies depending on their areas of specialization. Related to this study, Chiligati [24] asserted that education levels and literacy levels form the prerequisite to agricultural technology adoption potential of among small scale farmers. Moreover, Asomoah, [25] asserted educational status and age are assumed to influence the farmers' adoption of many technologies as a result of the farmer decision making on the technical and economical of potentiality of adoption new technology. Further, Adetumbi, [26] documented that education level contributes to the competency of an agent

in transforming information and knowledge into skills hence enhancing uptake of innovations in society to the farm. Besides, Piccoli *et al*., [27] established that the education level of an individual is a prerequisite to acquiring information and capacity to interpret and utilize the acquired information. In an argument that supports this view Adetumbi, [26] and Okello, [7] further argued that farmers who have spent less than ten years of schooling are less capable of acquiring and utilizing information sourced from the ICT/internet services among other modern technologies.

The current study findings revealed that 77% of the agents were exclusively involved in assisting farmers in disseminating improved sorghum technologies on farmers' farms (Fig 1). This could be attributed to the fact that majority of the agents were engaged directly with farmers as a result of funded promotion of *gadam* sorghum variety value chain in Mbeere. Related to these results, Andiema *et al,* [28] and Evenson and Mwabu [29] asserted that work experience and establishment of extension agents forms a strong association and formal and informal linkages between farmers, researchers, innovators and eventual adoption of new technologies.

Moreover, the current study findings indicated that agents had worked in their stations for twenty years twelve years disseminating improved sorghum technologies. Further, the findings could be attributed to the fact that private and government agents' experience and financial support acted as motivating factors contributing to enhanced need of the agents to disseminate various information and innovations on various value chains including sorghum technologies. The current the study findings also in tandem with Mburu [30] and Gachimbi [21] study which documented that rapid and significant uptake of sorghum technologies was facilitated by experienced extension agents among Siaya west sorghum farmers. In addition, Czapiewshi *et al.,* [31] documented that entrepreneurs are likely to embrace modern techniques in farming transactions when motivated and exposed to basic modern information and communication management by the experienced agents.

Further, there was a strong association between farm visits, office visits, demonstrations face to face chats, radio programmes, community leaders and agents were engaged in disseminating improved sorghum production technologies which significantly ($p=0.00$) contributed to disseminating of production technologies of improved sorghum varieties (Table 5). According to Okello [6], the effective uptake of information and technology requires harmonious synergy between agents and suitable extension model(s) for linking a farmer to relevant innovators, researchers, repository managers, agricultural extension policy formulators and extension agents. The association between mobile phone technologies, radio techniques and ICT extension model revealed significant relationships respectively contributing to dissemination and uptake of improved sorghum technologies. The results further showed extension agents rated television shows essential techniques in promoting production of sorghum products.

6. Conclusions

It was concluded that agents' work experience significantly contributed to the agents disseminating improved technologies among farmers. Further, demonstrations, farm visits, farm meetings, lead farmers, tour and visits and agricultural shows techniques complemented agents' disseminating the improved sorghum production technologies. Besides, radio programmes, face to face chats, farm meetings, community leaders and agricultural show visits complemented agents' disseminating the improved sorghum marketing technologies.

Acknowledgements

I appreciate the great financial support towards thesis writing from Association of African Universities, Ghana and the University of Nairobi, Kenya.

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