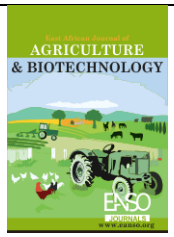


East African Journal of Agriculture and Biotechnology
eajab.eanso.org
Volume 7, Issue 1, 2024
p-ISSN: 2707-4293 | e-ISSN: 2707-4307
Title DOI: https://doi.org/10.37284/2707-4307

EAST AFRICAN NATURE & SCIENCE ORGANIZATION

Original Article

Perception and Adoption of Government Agricultural Technologies among Smallholder Farmers in Western Uganda

John Businge[1], *Ronald Kityo*[1,2*] *& Leonard Ninsheka*[1]

[1] Ndejje University, P. O. Box 7088, Kampala, Uganda.
[2] Makerere University, P. O. Box 7062, Kampala Uganda.
* Author for Correspondence ORCID ID: https://orcid.org/0000-0001-6585-1584; Email: ronaldkityo@gmail.com

Article DOI : https://doi.org/10.37284/eajab.7.1.1925

Date Published: *15 May 2024*

Keywords: *Extension, Training, Perception, Adoption, Uganda.*

ABSTRACT

Agriculture production and productivity remain key to feeding the growing population with agriculture extension being at the centre of the performance of the agricultural sector in Uganda. Research shows that improved technologies promoted through extension service provision could have an even greater impact on food production and on farmers' livelihoods in developing countries like Uganda. This study was conducted to investigate the perception and adoption of improved agriculture technologies under the government extension system among smallholder farmers in Kagadi District, mid-western Uganda. Data was collected using a questionnaire from 149 randomly selected households in three sub-counties. Results generated using Excel and SPSS revealed a high positive perception index of +0.63 for government extension services. The level of adoption of improved technology based on generalised partial adoption was 54.3% with farm size and training attendance being the significant factors affecting adoption of improved agricultural technologies in the study area. It is clear from the results that notable differences exist in terms of the perceptions of government extension services and the adoption of improved agricultural technologies. The general observation of farmers' perception is that government extension service is helpful to farmers and is the major source of agricultural information in the area. Efforts should be made to support access to arable land and intensification of agricultural training sessions coupled with appropriate mobilisation of farmers to attend such training. Further studies should be done to understand these aspects on a wider scope in the country since this study was only conducted in one district. There is also needed to study the factors individually as well as the relationships with other factors to determine the adoption processes of technological advancement.

APA CITATION

Businge, J., Kityo, R. & Ninsheka, L. (2024). Perception and Adoption of Government Agricultural Technologies among Smallholder Farmers in Western Uganda. *East African Journal of Agriculture and Biotechnology*, *7*(1), 236-245. https://doi.org/10.37284/eajab.7.1.1925

CHICAGO CITATION

Businge, John, Ronald Kityo and Leonard Ninsheka. 2024. "Perception and Adoption of Government Agricultural Technologies among Smallholder Farmers in Western Uganda.". *East African Journal of Agriculture and Biotechnology* 7 (1), 236-245. https://doi.org/10.37284/eajab.7.1.1925

HARVARD CITATION

Businge, J., Kityo, R. & Ninsheka, L. (2024) "Perception and Adoption of Government Agricultural Technologies among Smallholder Farmers in Western Uganda.", *East African Journal of Agriculture and Biotechnology*, 7(1), pp. 236-245. doi: 10.37284/eajab.7.1.1925.

Article DOI : https://doi.org/10.37284/eajab.7.1.1925

IEEE CITATION

J. Businge, R., Kityo & L. Ninsheka "Perception and Adoption of Government Agricultural Technologies among Smallholder Farmers in Western Uganda", *EAJAB*, vol. 7, no. 1, pp. 236-245, May. 2024.

MLA CITATION

Businge, John, Ronald Kityo & Leonard Ninsheka. "Perception and Adoption of Government Agricultural Technologies among Smallholder Farmers in Western Uganda". *East African Journal of Agriculture and Biotechnology*, Vol. 7, no. 1, May. 2024, pp. 236-245, doi:10.37284/eajab.6.1.1925.

INTRODUCTION

Agriculture production and productivity remain the keys to feeding the growing global population which is projected to reach 8.5 billion by 2030 (United Nations, 2015). In Uganda, the agricultural sector accounted for about 24% of gross domestic product (GDP) and 35% of export earnings in the financial year 2022/2023 (ITA, 2023). According to the UN's Food and Agriculture Organization (FAO, 2023), Uganda's fertile agricultural land has the potential to feed 200 million people. Eighty percent of Uganda's land is arable but only 35% is being cultivated. In FY 2022/23, agriculture accounted for about 24% of GDP and 35% of export earnings. The UBOS (2023) estimates that about 68% of Uganda's working population is employed in agriculture. One of the most important drivers of agricultural production and productivity is agricultural extension service delivery (Antwi-Agyei and Stringer, 2021). In fact, agriculture extension is at the centre of the performance of the agricultural sector in any country (Wambura et al., 2012) since it is responsible for delivering the required knowledge, skills and technologies to support increased production and productivity. On a global scale, agricultural extension is responsible for serving about one billion small-scale farmers (Hlophe-Ginindza and Mpandeli, 2020). The performance and effectiveness of agricultural extension services in the country have profound implications on the agriculture sector performance in Uganda (Danso-Abbeam et al., 2018).

One major issue in Uganda's agricultural extension is that research-extension linkages are critical to sustaining farmer agricultural production and productivity (Ssebaggala and Matovu, 2020). Farmer-centred and two-way communication that allows for a feedback mechanism from farmers to researchers and vice versa is necessary for the uptake of technologies and practices for improved production and productivity (Barungi et al., 2016). Furthermore, past agricultural extension-system reforms in Uganda did not solve critical challenges such as inadequate funding, a low extension worker-to-farmer ratio, use of inefficient service-delivery approaches, a weak research-extension-farmer linkage, and poor coordination of institutions (Ssebaggala and Matovu, 2020). The constraints for farmers to adopt improved agricultural technologies and practices make it imperative that the challenges with the adoption of these practices are explored (Ruzzante et al., 2021). In view of this, it is important to explore farmers' perceptions, the level of adoption and factors influencing the adoption of improved practices by smallholder farmers.to guide future interventions. The main objective is to investigate the perception and adoption of improved agriculture technologies under the government extension system among smallholder farmers in Kagadi District in western Uganda.

METHODOLOGY

Study Area and Population

The study was carried out in Kagadi district located within geographical coordinates of 0|*57"38*North, 30*47"48" East, mid-western Uganda. The household size for this area is 73,995 with a total population of 353,815, 171,960 males and 180,844 females (adopted from national households and population census 2014 and Kagadi district five-year financing plan for 2015/16 to 2019/20) (UBOS, 2021). The agricultural sector contributes more than 80% of the area's economy, and nearly 90% of the population earns its living from agricultural production and livestock keeping. Crops grown in the area mainly include tea, beans, tomatoes,

Article DOI : https://doi.org/10.37284/eajab.7.1.1925

fruits, tobacco, coffee, and vegetables as cash crops The food crops include maize, bananas, beans, cassava, sweet potatoes, Sweet Potatoes, peas, Paddy, Sorghum, Finger millet, and Groundnuts. (Mutekanga and Tusiime, 2018).

Study Sample

The population for this study consisted of farmers growing cash and food crops in Kagadi district. Proportional random sampling was used. A random sample of 150 household farmers was selected in three sub-counties purposefully selected based on accessibility and level of agricultural activity.

Data Collection

The data was collected in March 2022 using a structured questionnaire. Farmers were allowed to ask the researcher for any clarifications about the study. The data was collected using an online questionnaire with a smart phone, generated from the Kobo toolbox. Data for this study was largely quantitative supplemented with qualitative data. Each respondent was interviewed at his/her location in the study area by a trained research assistant.

Data Processing and Analysis

Data was analysed using the Statistical Package for the Social Sciences (SPSS, Version 16.0) computer program. Perception analysis was done according to Cloete et al. (2019). A perception index score is a composite index that ranks indicators based on how respondents perceive the aspect under study; in this case agriculture extension service provision. Farmers' perceptions of extension service have a binary nature the response and a respondent's choice lies on "agree" and "disagree" with the numbers of respondents and the agreed respondent assigned a positive value (+1) and the disagreed respondent assigned a negative value (−1). For the estimation of the perception index for each statement, categories were based on questions: "Do they agree or not agree with the specified statements (question)?" Responses were categorised as 0 = absolutely disagree; 1 = strongly disagree; 2 = disagree; 3 = agree; 4 = strongly agree; and 5 = absolutely agree (Table 1). In this study, a regression analysis model was used to estimate the significant determinants of the adoption of modern agricultural technologies for crop production in the study area under the government extension service.

Table 1: Calculation of farmers' perception index

	Disagree			Agree	
Score					
0	1	2	3	4	5
0	1	2	3	4	5

The mean score value is used as the perception index score and is expressed as:

$$\text{Mean score} = \sum \frac{No.of\ Agreed\ respondent - No.\ Disagree\ respondent}{Total\ number\ of\ respondent}$$

The closer the mean score is to -1, the greater the negative perception is, and vice versa.

Ethical Considerations

All participants verbally consented and participated voluntarily in the research process and all information collected ensured participants confidentiality and was kept secret with names removed.

RESULTS

Socio-Economic Characteristics of the Respondents

Effectively after data cleaning, responses from 149 households collected from three sub-counties were used for analysis. Based on the results, 61.2% of the participating households were male-headed while 38.8% were female-headed. Details

Article DOI : https://doi.org/10.37284/eajab.7.1.1925

of the characteristics in terms of marital status and education are provided in *Table 2* below.

Table 2: Descriptive characteristics of the sample households

Respondent characteristics	Cluster	Frequency	Percentage (%)
Gender	Female	57	38.8
	Male	90	61.2
Marital status	Single	36	24.5
	Married	99	67.3
	Divorced	7	4.8
	Widowed	5	3.4
Education	Never attended school	18	12.1
	Primary	71	47.7
	Secondary level	48	32.2
	Tertiary level	9	6.0
	Graduate	3	2.0

The average age of household head was 41 years. Other characteristics are presented in *Table 3* below.

Table 3: Household statistics for selected variables

Variable	Mean	Std. error
Age of household head	40.58	1.187
Years in school	7.8169	0.35696
Farming experience	15.7310	1.10620
Farm size	4.7755	0.51894

The level of understanding of agricultural extension services among smallholder households was also assessed and results are presented in *Table 4* below.

Table 4: Understanding of agricultural extension services

Category	Frequency	Percentage (%)
No idea what an extension is	21	14.1
Have some understanding of extension	99	66.4
Understand agricultural extension very well	29	19.5
Total	149	100

Sources of Agricultural Information

Results from the study revealed that the government agriculture extension system is the largest source of agricultural advice and information (73.7%) and the least is the farmer group (1.7%) among those assessed. The results further reveal that 19.5% of farmers have no access to any agricultural information at all and only rely on their own experiences and exposures.

Table 5: Sources of agricultural information

Source	Number	Percentage (%)
Input supplier	3	2.5
Extension officer	87	73.7
Farmer group	2	1.7
Radio	4	3.4
None	23	19.5

Article DOI : https://doi.org/10.37284/eajab.7.1.1925

Perception of Government Agricultural Extension System

In this study, respondents were assessed in terms of their perceptions of extension services using various aspects ranging from the usefulness of the information and ideas provided by the extension officers to whether the information provided helps in the improvement of yield. It was observed that the majority of farmers (86.6%) perceived the extension officers to offer helpful information to farmers, making a perception index of +0.78. Other aspects assessed are presented in Table 6 below. It is important to note that all aspects analysed had positive mean perception scores although these varied from low to high, and the overall perception index was +0.63.

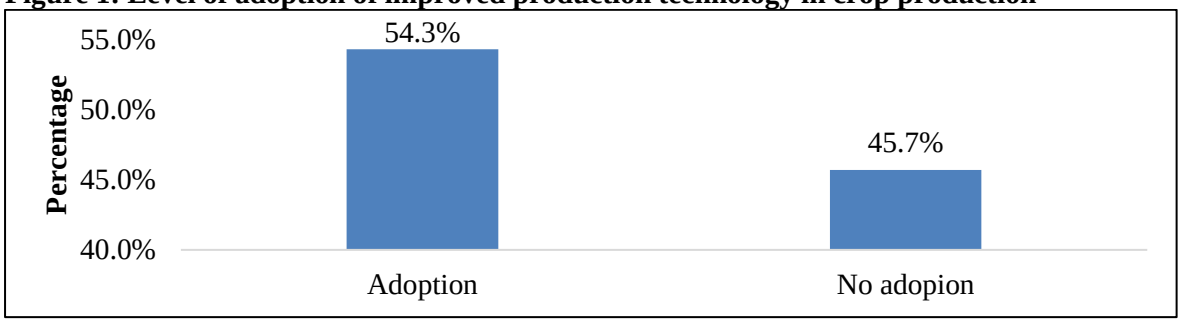
Table 6: Perception of the Government Extension System

Perception	Agree		Disagree		Mean score
	n	%	n	%	
The officer provides helpful ideas	129	86.6	20	13.4	0.78
The extension officer is readily available	112	75.2	37	24.8	0.59
We can apply advice field	117	78.5	32	21.5	0.64
Extension workers are usually well-prepared	112	75.2	37	24.8	0.59
Extension worker has training materials needed	97	65.1	15	34.9	0.42
Government plays an important role	117	78.5	52	21.5	0.64
Extension workers are friendly	119	79.9	30	20.1	0.66
The extension system offers what you really need	100	67.1	49	32.9	0.45
Participating in extension education programs helps in improving the way of farming/productivity.	127	85.2	22	14.8	0.75
Participating in an extension education program helps to increase my income from the farm.	125	83.9	24	16.1	0.73
Lessons taught can easily be applied to your daily field activities.	121	81.2	28	18.8	0.68
The extension workers provided continuous support to help me apply and implement the information that was taught.	108	72.5	41	17.5	0.54
Do you believe that extension workers help farmers to improve their production/yield?	129	86.6	20	13.4	0.78
Total mean score		78.1		21.9	8.24
Perception Index					0.63

Level of Adoption of Improved Agricultural Technology

Adoption was based on the fact that a household used at least one of the components of improved technology in crop production within the last 12 months. These components included; the use of improved seeds, timely planting, proper spacing, timely weeding, timely harvesting and use of fertilizers (organic or inorganic). Results revealed that 54.3% of the households sampled adopted and had used at least one of the practices within the improved technology package in crop production in the study location.

Figure 1: Level of adoption of improved production technology in crop production



Factors Affecting Adoption

Various factors were analysed for significance as far as the adoption of improved technology practices in crop production as delivered by government extension services in the Kagadi district. Results revealed that attendance of

Article DOI : https://doi.org/10.37284/eajab.7.1.1925

training and farm size were significant factors for adoption.

From the regression analysis (*Table 7*), results revealed two significant factors affecting the adoption of improved technology among smallholder households in the study area. These were attending trainings (p=0.003) conducted by extension workers, and farm size (p=0.033). The other factors analysed include gender of household head, age of household head, marital status, highest level of education, number of years spent in school, group membership, and farming experience. While these factors are also important for consideration as far as technology adoption is concerned, they were not significant in this study.

Table 7: Regression analysis of the factors for adoption of farming practices

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.988	.257		3.840	.000
	Gender	.035	.087	.034	.398	.691
	Age_hh	-.006	.003	-.154	-1.762	.080
	Marital status	-.076	.065	-.097	-1.169	.244
	Highest_edu	-.063	.085	-.104	-.742	.459
	Years_in_sch	-.002	.017	-.017	-.119	.906
	Attended training	.287	.094	.285	3.047	.003
	Group_membership	-.143	.097	-.134	-1.481	.141
	Farming_experience	-.002	.004	-.065	-.677	.500
	Farm size	-.018	.008	-.204	-2.160	.033

a. Dependent Variable: Adopted_tech

The correlation analysis (Table 8) revealed a weak, negative and insignificant correlation between technology adoption and farming experience (r= -0.124, p=0.138). Technology adoption had a negative low significant correlation with farm size (r=0.181*, p=0.028). There was a low positive significant correlation between technology and training attendance (r=0.198*, p=0.016).

Table 8: Correlation of the factors analysed factors potentially affecting technology adoption

	1	2	3	4	4	6	7	8	9	10
1. Gender	1									
2. Age_hh	-.062 .457	1								
3. Marital_status	-.065 .433	.121 .145	1							
4. Highest_edu	-.009 .911	-.190* .021	-.155 .062	1						
5. Years_in_sch	.000 .996	-.156 .064	-.073 .393	.807** .000	1					
6. Attended_training	.193* .018	-.090 .275	.062 .456	-.030 .713	.052 .541	1				
7. Group membership	-.006 .938	-.074 .374	.142 .087	-.130 .114	-.172* .040	.337** .000	1			
8. Adopted_tech	.108 .189	-.152 .065	-.084 .314	-.063 .443	-.026 .756	.198* .016	.000 .998	1		
9. Farming experience	.056 .505	.140 .093	-.054 .517	-.032 .704	.050 .563	.234** .005	-.022 .790	-.124 .138	1	
10. Farm size	-.065 .434	.054 .515	-.038 .648	-.130 .115	-.077 .367	.126 .128	.122 .140	-.181* .028	.472** .000	1

**. Correlation is significant at the 0.05 level (2-tailed).*
***. Correlation is significant at the 0.01 level (2-tailed).*

Article DOI : https://doi.org/10.37284/eajab.7.1.1925

DISCUSSION

In the current study, farmers' perception of extension service provision and adoption was anticipated to vary with different demographical characteristics regarding agriculture technologies. Randela (2005) asserts that demographic and socio-economic characteristics are important since they influence households' behaviour. Based on the results, 61.2% of the participating households were male-headed while 38.8% were female-headed (table 3). Contrastingly, the Uganda Population and Housing Census (UBOS, 2014) revealed that 76% of households are male-headed and 24% are female-headed in Uganda. The disparity in the current study could be due to a higher percentage of marriages (67.3% married) in the study area compared to the 2014 (65.1%) national score. Gender is generally viewed as an important factor in many agricultural development interventions. In fact, Obisesan (2014) reported a significant effect of the gender of household heads on the adoption of cassava cultivation techniques in Nigeria. However, Melesse (2018) indicated that gender is a highly biased characteristic based on the socio-cultural aspects of the local society. It affects the decision-making ability and the gender of the household head will play a main role in the adoption tendency for introduced technologies. Nevertheless, the current study found the gender of the household head is not a significant factor in the adoption of technologies ($p = 0.691$, $\alpha=0.05$). This result is similar to the findings of Morris and Doss (1999) who reported a non-significant effect of the gender of household head on adoption of a new maize variety in Ghana.

The average age of household head was 40.1 years and not significant towards adoption of improved technology ($p=0.08$, $\alpha=0.05$). Age is commonly discussed as an important factor in many development interventions. Older farmers are generally considered to have more experience and more accumulated resources than young farmers which is likely to facilitate their adoption of new technologies. The farming experience of 15.7 years implies that most of the farmers had long-standing experience with existing farming practices in the study area. When the farmers already have experience in cultivation in their lands for a longer time, they might have a better understanding of the impact of the problem that the technology is addressing (Dissanayake et al., 2022). In the current study, farming experience had a negative and non-significant effect on technology ($p=0.5$, $\alpha=0.05$). This could be due to the fact that experienced farmers are used to their traditional farming and slow to change to new technologies.

The average farm size of 4.77 acres reported in this study implies that farmers had an abundance of arable land higher than the national average household land size of 3.2 acres (UBOS, 2022). In this study, farm size significantly influenced the adoption ($p=0.033$, $\alpha=0.05$) of improved technologies in crop production. Similarly, a study conducted in the central highlands of Ethiopia to determine the factors affecting the adoption of an improved maize variety revealed a positive influence of farm size on the adoption behaviour (Dissanayake et al., 2022). Ogada et al., (2014) also reported a positive relationship between the farm size in the adoption of joint cultivation of inorganic and improved maize varieties. According to Melesse (2018), one of the main reasons for such a positive relationship is that most smallholder farmers grow different varieties of crops and at the same time it requires larger extents of land. One reason for this adoption among smallholder farmers is that they look at new technologies as something to try without entirely abandoning previous practices. The abundance of land allows them such flexibility to try out new technologies without much worry of failure. Farmers with limited land are unable to risk their limited land because they do not truly trust the new technology.

This study further revealed that the largest percentage of household heads had primary (47.7%) as the highest level of education and the average number of years spent in school in the area was 7.8 years. Education is very important in any agricultural development intervention. The lack of education is associated with marginalisation and poverty, and less educated

Article DOI : https://doi.org/10.37284/eajab.7.1.1925

farmers have a greater probability of lagging behind in terms of gaining access to information and technology (Bahta et al., 2016). However, in the current study, education was not a significant factor. This could be due to other confounding factors related to agricultural technology adoption in the study area.

Training attendance significantly affected adoption significantly ($p= 0.003$, $\alpha=0.05$). The results of the study revealed that the government agriculture extension system is the largest source of agricultural advice and information (73.7%) and the least is the farmer group (1.7%) among those assessed. The results further revealed that 19.5% of farmers have no access to any agricultural information at all and only rely on their own experiences and exposures. These results point out the contribution of the government extension system and the associated training being offered under the system.

In this study, respondents were assessed in terms of their perceptions of extension services using various aspects ranging from the usefulness of the information and ideas provided by the extension officers to whether the information provided helps in the improvement of yield (Table 6). It was observed that the majority of farmers (86.6%) perceived the extension officers to offer helpful information to farmers, making a perception index of +0.78. It is important to note that all aspects analysed had positive mean perception scores and the overall perception index was +0.63. This is consistent with the fact that overall adoption of improved technologies among farmers was above average at 54.3% as reported in this study. Faure et al. (2012) highlighted that agricultural extension services are perceived by many actors involved in rural development as important elements not only in improving farm performance but also in strengthening ties between farmers, research, agricultural education and other actors of society. Perception studies are oriented based on the scope of agricultural extension roles.

Adoption was based on the fact that a household used at least one of the components of improved technology in crop production within the last 12 months. These components included; the use of improved seeds, timely planting, proper spacing, timely weeding, timely harvesting and use of fertilizers (organic or inorganic). Results revealed that 54.3% of the households sampled adopted and had used at least one of the practices within improved technology in crop production in the study location. According to Fikire and Emeru (2022), the adoption of modern agricultural technologies offers a mass of potential benefits to increasing the productivity and income of smallholder farmers.

From the regression analysis, results revealed two significant factors affecting the adoption of improved technology among smallholder households in the study area. These were; attending trainings ($p=0.003$) conducted by extension workers, and farm size ($p=0.033$). The other factors analysed included gender of household head, age of household head, marital status, highest level of education, number of years spent in school, group membership, and farming experience. While these factors are also important for consideration as far as technology adoption is concerned, they were not significant in this study. The analysis revealed a weak, negative and insignificant correlation between technology adoption and farming experience ($r= -0.124$, $p=0.138$). Technology adoption had a negative low but significant correlation with farm size ($r=0.181^*$, $p=0.028$). There was a low positive significant correlation between technology and training attendance ($r=0.198^*$, $p=0.016$). The largest source of agricultural information was government (73.7%). This implies that the role of government extension services in this area cannot be understated. However, the large percentage of farmers with no access to agricultural information (19.5%) is worrisome implying that the government still has a big role to play in reaching out to farmers for dissemination of agricultural-related information on improved agricultural technologies and production practices.

CONCLUSION

It is clear from the results that notable differences exist in terms of the perceptions of government

Article DOI : https://doi.org/10.37284/eajab.7.1.1925

extension services and the adoption of improved agricultural technologies among farming households. The general perception is that government extension service is helpful to farmers and is the major source of agricultural information in the area. The generalised adoption of improved technology on the basis of partial adoption with farm size and training attendance being the most significant factors influencing the adoption of improved agricultural technologies in the area.

Recommendations

Efforts should be made to support access to arable land and intensification of agricultural training sessions coupled with appropriate mobilisation of farmers to attend such training. Further studies should be done to understand these aspects on a wider scope in the country since this study was only conducted in one district. There is also a need to study the factors individually as well as with the relationships with other factors to determine the adoption process of technological advancement. Therefore, it is recommended to further study and analyse the effect of these factors, for their influence on technology adoption individually as well as collectively in the agricultural sector.

CONFLICT OF INTEREST

Authors declare **NO** conflict of interest

REFERENCES

Antwi-Agyei, P., Stringer, L. C. 2021. Improving the effectiveness of agricultural extension services in supporting farmers to adapt to climate change: Insights from Northeastern Ghana. *Climate Risk Management 32 (2021) 100304.*

Barungi, M., Guloba, M. and Adong, A. 2016. Uganda's Agricultural Extension Systems: How Appropriate is the Single Spine Structure? *Economic Policy Research Centre, Research Report Number 16.*

Cloete, P., Bahta, Y. T., Marunga, M. and Lombard, W. A perception and understanding of agricultural extension: perspective of farmers and public agricultural extension in ThabaNchu. *South African Journal of Agriculture Extension. Vol. 47 No. 3, 2019: 14 – 31.*

Danso-Abbeam, G., Ehiakpor, D.S. &Aidoo, R. Agricultural extension and its effects on farm productivity and income: insight from Northern Ghana. Agric& Food Secur**7,** 74 (2018). https://doi.org/10.1186/s40066-018-0225-x

Dissanayake, C.A.K, Jayathilake, W., Wickramasuriya, H.V.A, Dissanayake, U. and Disseminating Agricultural Information to Farmers, International Journal of Basic & Applied Sciences IJBAS-IJENS Vol: 11 No: 02, April 2011.

Fikire, A. H. and Emeru, G. M. 2022. Determinants of Modern Agricultural Technology Adoption for Teff Production: The Case of Minjar Shenkora Woreda, North Shewa Zone, Amhara Region, Ethiopia. *Advances in Agriculture Volume 2022, Article ID 2384345, 12 pages https://doi.org/10.1155/2022/2384345.*

Hlophe-Ginindza S.N and N.S. Mpandeli N.S. 2020. The Role of Small-Scale Farmers in Ensuring Food Security in Africa. DOI: http://dx.doi.org/10.5772/intechopen.91694

International Trade Administration (ITA) 2023. Uganda – country commercial guide; agricultural sector. https://www.trade.gov/country- commercial- guides/uganda- agricultural-sector. Accessed on 24th December, 2023.

Melesse, B. (2018). A Review on Factors Affecting Adoption of Agricultural New Technologies in Ethiopia. *Journal of Agricultural Science and Food Research 2018, 9:3.*

Morris, M. and Doss, C. (1999). How does gender affect the adoption of agricultural innovations? The case of improved maize technology in Ghana: Paper Presented at the Annual Meeting, American Agricultural

Article DOI : https://doi.org/10.37284/eajab.7.1.1925

Economics Association (AAEA), Nashville, Tennessee, August 8-11.

Ogada, M.J., Mwabu, G. and Muchai, D. (2014) Farm technology adoption in Kenya: simultaneous estimation of inorganic fertilizer and improved maize variety adoption decisions. *Agricultural and Food Economics* 2: 12.

Ruzzante, S., Labarta, R., Bilton, A. 2021. Adoption of agricultural technology in the developing world: A meta-analysis of the empirical literature. *World Development 146 (2021) 105599*.

Ssebaggala, R. and Matovu, F. 2020. Effects of Agricultural Extension Services on Farm Productivity in Uganda. *AERC Research Paper 379*.

UBOS (2022). Annual Agricultural Survey 2019 Report. Uganda Bureau of Statistics (UBOS). Kampala, Uganda. https://www.ubos.org/wp-content/uploads/publications/04_2022AAS2019_Report.pdf.

Wambura, R., Acker, D., & Mwasyete, K. (2012). Extension systems in Tanzania: Identifying gaps in research (Background papers for collaborative research workshop). Retrieved from https://docs.google.com/file/d /0b0k_cmraulgqqxzhdkk3bezfntg/editPli=1.

Uganda Bureau of Statistics (UBOS), 2021. Uganda National Household Survey 2019/2020. Kampala, Uganda.

United Nations Development Programme. 2015. What are the Sustainable Development Goals? https://www.undp.org/sustainable-development-goals.

