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Farmers' Perceptions and Determinants of Using Varied Sources of Extension for Agricultural Information: Evidence from Eastern Cape and KwaZulu-Natal, South Africa

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ABSTRACT

In many developing countries, agricultural information is disseminated predominantly by government officials; however, the agricultural sector struggles to provide satisfactory services to smallholder farmers. In South Africa, a pressing need exists for more robust and nuanced empirical evidence concerning farmers' preferences regarding utilising various agricultural information sources. Utilising a simple random sampling method, data was collected from 265 respondents through in-person interviews employing a semi-structured questionnaire. The analysis incorporated descriptive statistics, the Perception Index, and Multivariate Probit Regression. The findings from the Multivariate Probit Regression indicated that farmers in the Eastern Cape and KwaZulu-Natal prefer pluralistic extension sources for agricultural information. Furthermore, variables such as farmers' satisfaction with the frequency of extension officer visits, the quality of technical advice, and the turnaround time for feedback significantly influenced the farmers' decisions to engage with pluralistic sources for agricultural information. Considering these findings, the study concludes that agricultural information delivery to smallholder farmers should be primarily managed by pluralistic sources of extension services, which acknowledge and embrace the inherent diversity among producers. Consequently, farmers will likely select an information mix that aligns with their specific farming enterprises.

Keywords: Agricultural Information, Extension Services, Multivariate Probit Regression, Various Sources.

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1. INTRODUCTION

The first known works of modern agricultural extension services emerged due to a disaster. The records indicate that the potato blight outbreak in 1845 in Ireland, now part of the United Kingdom, was pivotal (Swanson, 2008). The impact on the Irish peasantry was severe, as the population predominantly relied on potatoes in their daily diet. This prompted the Irish government to seek assistance across Europe, appointing lecturers to travel to the most distressed districts (Swanson, 2008). These educators were tasked with disseminating information and demonstrating to small farmers how to cultivate nutritious root crops apart from potatoes (Liebenberg, 2015). This initiative of extension and advisory services on the Irish island continued until 1851. Modern history notes that the term 'extension' was first employed to describe adult education programmes in England around 1857 (Schwartz, 1994). Programmes at Oxford and Cambridge Universities centred on teaching rural peasants (farmers) about literacy, social issues, and later agricultural subjects. In 1860, the two universities engaged in discussions focused on these educational programmes, aiming to extend their work beyond campus gates into the surrounding communities (Swanson, 2008).

It was not until 1867 when the first practical efforts were made, and these teachings and demonstrations proved successful, that the activities rapidly evolved into a well-established movement before the century's end (Anderson, 2007). Extension work began in the United States of America, as large groups collaborated to enhance agricultural techniques and disseminate information within private organisations and agricultural societies (Schwartz, 1994). This occurred around 1853, when many schools and colleges of agriculture started hosting farmers' institutes, public meetings, and lectures that presented and spread agricultural information (Swanson, 2008). The demonstration movement developed from these institutes, where instructors conducted public demonstrations of new practices in what became an outdoor classroom (Schwartz, 1994). The land-grant universities, established in 1890, were the first formal institutions funded by the United States government to recognise the importance of education for the nation. The objective was to provide a broader education for the American populace in the arts of peace, particularly in agriculture and mechanics (Swanson, 2008). This was followed by establishing and enacting the Smith-Lever Act of 1914, which created the cooperative extension system to benefit people from contemporary advancements in agriculture, home economics, and other fields (Schwartz, 1994). During this period, Britain transferred responsibility for extension activities from universities to the Ministry of

Agriculture, and the terminology for this new responsibility was revised to advisory services (Anderson, 2007).

Most European countries subsequently adopted this strategy as they developed similar advisory services within their respective Ministries of Agriculture. Travelling lecturers introduced the formal agricultural extension system from European countries and the United States to continents such as Africa, Asia, and the Caribbean. According to Daku (1997), donor agencies like the Agency for International Development (USAID) played a significant role in establishing agricultural universities and extension systems that we observe today in developing nations. Historically, historical, political, and socioeconomic factors have influenced the establishment and evolution of agricultural extension services in South Africa, particularly in the Eastern Cape and KwaZulu-Natal provinces. The formal inception of these services dates to 1925, when the South African government appointed Colonel Heinrich de Toit to lead the newly established extension service, initially comprising only six extension officers serving the entire country (Koch & Terblanché, 2013).

2. DEFINITION OF PROBLEM

The post-apartheid era, commencing in 1994, marked a significant shift in the approach to agricultural extension services. The newly elected democratic government sought to redress historical inequalities by integrating the previously segregated extension services into a unified system to serve all farmers, regardless of race. This integration was particularly pertinent for provinces like the Eastern Cape and KwaZulu-Natal, which have substantial populations of smallholder farmers. The reformed extension services aimed to transition smallholder farmers from subsistence to more sustainable and commercially viable agricultural practices (Koch & Terblanché, 2013). Despite these reforms, challenges persist. Studies indicate that black smallholder farmers' agricultural production and income levels have not significantly improved, suggesting that the extension services have not fully achieved their objectives in these regions (Sibanda, 2021). Factors contributing to this include inadequate resources, limited market access, and ongoing disparities in service delivery. In recent years, there has been a growing discourse on privatising extension services as a potential solution to these challenges. Research conducted in the Eastern Cape and KwaZulu-Natal provinces suggests that privatised extension services could offer farmers more tailored and efficient support. However, this approach necessitates careful consideration of the unique socioeconomic

contexts of smallholder farmers to ensure inclusivity and accessibility (Loki, 2022). This study assessed farmers' perceptions of using varied extension sources for agricultural information. The following research questions guided the study:

I. How do smallholder farmers perceive using various extension services for agricultural information?
II. What are the determinants for using various extension services for agricultural information?

2.1. Theoretical and Conceptual Framework

As mentioned earlier, many developing countries have their extension and advisory services as part of their Ministry of Agriculture structure. South Africa's agricultural extension sector is recognised as a national and provincial competency for delivering advisory and input supply services to farmers free of charge as social welfare (Koch & Terblanché, 2013). The sector incurs all costs associated with inputs and service delivery. It is increasingly under pressure to address various policy issues, including accountability, relevance, responsiveness, and cost-effectiveness (Swanson & Sammy, 2002). Additionally, many international and bilateral donors are demanding institutional modernisation within public extension services, considering trade liberalisation, the emerging role of the private sector, and governments with reduced resources (Swanson, 2008).

The public extension services appear unable to provide adequate support to farmers. This situation is exacerbated by the low extension worker-to-farmer ratio (1:1500), the laying off of skilled workers, poor essential support (e.g. transport), and the inadequate supply of inputs and information (Abdul & Eatzaz, 2007; World Bank, 2010; Ghosh, 2012; Hlatshwayo & Worth, 2016; Nkosi, 2017). The challenges above, coupled with climate change, declining soil health, and agriculture's contribution to the overall Gross Domestic Product (GDP), necessitate up-to-date extension services with technological advancements and sustainable practices (Lamm *et al*., 2021). Swanson and Sammy (2002) suggested that private sector involvement, farmer groups, and other non-governmental organisations could provide viable alternatives to the public sector. Nemaangani (2011), Koch and Terblanché (2013), and Liebenberg (2015) reiterated that the delivery of extension services by the private sector would be ideal for South Africa, given that these independent service providers have operated for at least 40 years. These firms, farmers, and factories have offered extension services to their clients under contractual

agreements and at specific fees (Chapman and Tripp, 2003). Numerous businesses supply various agricultural-related services, including technical production advice, marketing, infrastructure development (e.g. irrigation), business management, and research (Liebenberg, 2015). Moreover, since then, commercial farmers and some smallholders have withdrawn from public extension services and instead consulted these private sectors (DAFF, 2014).

Uddin *et al*. (2016) view the withdrawal of the state from service delivery as enabling farmers to share the responsibility of covering the costs associated with extension delivery. Oladele (2008) and Davis and Terblanché (2016) suggest that such an intervention could help recover the costs of providing extension services and ensure that extension officers are accountable to the government and the farmers contributing to these costs. Uddin *et al*. (2016) argued that the private sector offers various benefits that could alleviate pressure on the government, such as increased operational efficiency, cost-effectiveness, and greater accountability of extension officers to perform and deliver results. More importantly, private suppliers of extension services are considered profit-oriented, aligning well with the commercial aspirations of some smallholder farmers. Liebenberg (2015) supports this theory and notes that agricultural commercialisation is founded on the premise that smallholder farmers aim to transition from subsistence farming to profit-oriented production.

This shift towards self-sufficiency would necessitate moving away from traditional non-commercial methodologies towards scientifically enhanced farming techniques and farmers willing to invest in agricultural information (Uddin *et al*., 2016). The transition of farmers towards self-sufficiency and their willingness to pay for extension services has sparked a debate among researchers about the feasibility of privatising extension services in countries where the smallholder sector predominates (Agholor, 2012). According to Rivera (2011), the decision to privatise extension services poses a challenge for many developing countries, as considerable evidence exists in the literature supporting and opposing this change. Studies by Rivera & Alex (2004), Anderson (2007), Swanson (2008), Ramaila *et al*. (2011), Ghosh (2012), and Zwane (2016) seem to advocate for the privatisation of extension services. They argue that privatisation would significantly reduce wasteful expenditure arising from poor planning and vague strategies enacted by the government.

Furthermore, adopting profit-oriented farming practices could address various socioeconomic challenges, such as poverty, unemployment, and food insecurity (Oladele, 2008; Uddin *et al*.,

2016; Labarthe & Laurent, 2013). The study employed three theories: the Theory of Planned Behaviour (TPB), Diffusion of Innovations, and Scale Development. These theories are deemed appropriate for investigating perceptions and various sources of information, reinforcing information sharing; however, numerous barriers to adoption persist, including ineffective utilisation of these multiple sources, underestimating the capacity for innovation, and insufficient support and communication for implementing acquired knowledge from diverse sources. Ajzen's Theory of Planned Behaviour (Ajzen, 1991) was utilised in this study as it reflects the relationships between individuals (farmers) and the social and environmental aspects that influence consumer behaviour. Based on the Theory of Planned Behaviour, smallholder farmers' use of various extension sources for agricultural information is influenced by socioeconomic conditions, policy, research, and institutional factors.

The Diffusion theory, developed in the U.S. by rural sociologists, is a significant framework for understanding the change process. According to Padel (2001) and Lamm *et al*. (2021), this theory attempts to predict the behaviour of farmers and social groups in adopting innovations, considering their characteristics, social relations, timing, and attributes of innovation. Lastly, the Scale Development theory serves as an essential instrument for increasing investment in agricultural research for development to enhance agricultural yields, farm returns, and food security among rural households. This theory is also crucial for developing a scale for assessing various sources of extension capacity within international and national extension systems, allowing stakeholders to identify local needs and guide the evolution of extension resources based on the characteristics of an innovation, the innovation-decision process, and the environmental and social frameworks surrounding their region.

3. METHODOLOGY

3.1. Description of Study Area

The study was conducted in the Eastern Cape and KwaZulu-Natal provinces of South Africa. These two provinces are hubs for agricultural activities, and farming significantly contributes to livelihood generation. They are home to both commercial and smallholder farmers who shape the agricultural sector of South Africa. The climate is highly fertile and favours all types of farming, including citrus, livestock, crop, and vegetable farming. A list of different categories of farmers actively involved in agriculture—communal, smallholder, and commercial—was obtained from the Department of Agriculture, Forestry and Fisheries

(DAFF) and the Agricultural Research Council (ARC). The literature was reviewed (Agholor, 2012; Sikwela, 2013; DAFF, 2016; StatsSA, 2017; Sinyolo & Mudhara, 2018), and the authors' experience was instrumental in selecting the study areas. It was established that the Eastern Cape and KwaZulu-Natal provinces house numerous smallholders practising livestock and crop production. Moreover, farmers in these provinces receive agricultural support from the government, the private sector, and other institutions (Sikwela, 2013; Sinyolo & Mudhara, 2018).

3.2. Research Design, Population, and Sampling Technique

This study employed a cross-sectional survey, collecting data at a single point in both provinces. The population of interest for this part of the study comprised smallholder farmers in the Eastern Cape and KwaZulu-Natal provinces. A sampling frame was created from the Department of Agriculture, Forestry and Fisheries and the Agricultural Research Council's database of commercial farmers in South Africa. Using a stratified two-stage sampling technique, 265 farmers (111 commercial and 154 smallholders) were recruited from a population of 397 to ensure that the sample was representative of all farmers in South Africa. The first stage involved stratifying respondents into commercial and smallholder farmers across the two provinces' data sets corresponding to the types of questionnaires. The second stage consisted of selecting all sampled farmers' respondents across the two provinces in South Africa.

3.3. Instrumentation and Data Collection

Data was collected through semi-structured interviews that combined closed-ended and open-ended questions. A content analysis was conducted on various extension sources and printed materials distributed to farmers to ensure relevance and objectivity. The interview guide was pre-tested with 30 farmers from Zibeleni in the Chris Hani District of the Eastern Cape, an area excluded from the main study. The data collection period extended from January to September 2019, with six trained enumerators and principal investigators administering the interviews. Interviews were conducted at central locations selected by the farmers and farm organisations, as local agricultural extension workers recommended, to optimise time and resources. These sessions were held privately in IsiXhosa and IsiZulu, the predominant languages of the respective provinces, with each interview lasting approximately one hour. The collected data

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included farm characteristics, land ownership, access to agricultural extension services, sources of agricultural information, factors limiting information access, and challenges farmers face.

3.4. Data Analysis

This section gives insights into the analysis tools used for this study. The study used descriptive and inferential statistics to estimate farmers' characteristics and perceptions using mean, frequencies, tables, figures, and pie charts. The perception index was also used to assess farmers' perceptions of various extension sources. Factors influencing farmers' use of multiple extension sources for agricultural information were analysed using a multivariate probit model (MVP) framework. The general MVP model can be written in two systems equations. Following Kpadonou *et al*. (2017), let U_a indicate the utility of using j_{th} extension and otherwise. Farmers can use the j_{th} approach if $Y_{ij} = U_a - U_o > 0$. Therefore, net utility Y*ij, which a farmer obtains for using the jth practice, is a latent variable that can be predicted by the experimental factors and the multivariate normally distributed error terms (ε_i).

$$Y^*_{ij} = \beta_j X_i + \varepsilon_i \quad \text{.....1}$$

Where Xi indicates a vector of independent variables, j varied sources of extension, βj Vector coefficient, and εi error term. According to the utility maximisation theory, farmers could use varied extension sources if the expected benefits are higher than non-users. This can be presented as an observable dichotomous outcome for each choice of extension source used by smallholder farmers, which could be described as shown in equation 2:

$$Y_{ij}\ (1\ if\ Y^*_{ij} > 0, 0\ otherwise), j = \text{PUE}, \text{P}RE, PLE \quad \text{.....2}$$

Where Yij indicates a binary observable variable for using jth extension source by the ith farmer. Suppose the use of varied sources of extension is assumed to co-occur; the error terms of the equation can be described using a variance-covariance matrix (Eq. 3).$\pi =$

$$\begin{bmatrix} 1 & \rho_{12}\rho_{13} \\ \rho_{21} & 1\ \rho_{23} \\ \rho_{31} & \rho_{32}\ 1 \\ \vdots & \vdots\ \vdots \\ \rho_{i1} & \rho_{i2}\ \rho_{i3} \end{bmatrix} \quad \text{.....3}$$

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4. RESULTS AND DISCUSSION

The section below looked at the study's socioeconomic characteristics and empirical results, explicitly focusing on farmers using various extension sources for agriculture-related information.

4.1. Demographic Characteristics of Farmers

TABLE 1: Demographic Information of Farmers

Sources of extension n = 265	**Explanatory variables %**					**Chi-Square significance**
	Type of farmer					
	Full-time farmer		Part-time			
Public	38		42			ns
Private	10		14			
Pluralistic	52		44			
	Age groups (years)					
	21-35		36-50	51-65	65+	
Public	42		33	36	49	**
Private	6		13	12	6	
Pluralistic	42		54	52	45	
	Farming experience (years)					
	≤10	11-25	26-35	36-45	>46	
Public	39	39	32	57	50	ns
Private	13	10	7	-	-	
Pluralistic	48	51	61	43	50	
	Gender					
	Male			Female		
Public	40			35		ns
Private	11			10		
Pluralistic	19			55		
	Level of education					
	No education		Primary	Secondary	Tertiary	**
	57		39	36	37	

Public	4	7	12	15
Private	39	54	52	48
Pluralistic				

*Notes: *** , **, *, means significant at 1%, 5% and 10% levels of significance, respectively
ns = not statistically significant

Table 1 shows the demographic characteristics of farmers in this study: type of farmer, age, farm experience, gender, and level of education. The Chi-square test was used to examine the relationship between demographic features and the use of various extension sources for agricultural information.

Age was statistically significant relative to various extension sources for agricultural information ($p<0.05$). The findings showed that the age group 36-50 years (54%) and 51-65 years (52%) had a higher proportion of farmers favouring different extension sources for agricultural information. The rationale could be that farmers recognise that using various extension sources caters to different farming needs inherent in farmer enterprises. The results agree with Uddin and Qijie's (2013) findings that various service providers attend to varied client groups (farmers) in different contexts, ensuring farmer satisfaction. Education was significant relative to farmers' use of various extension sources for agriculture-related information ($p<0.05$). The results showed that farmers with primary (54%), secondary (52%), and tertiary (48%) levels of education tilted towards using various extension sources for information compared to their counterparts. Moreover, as farmers' level of education increases, their preference for using various extension sources for farming information also increases.

4.2. Farming Characteristics

The study used the Chi-square test to evaluate the relationship between farming characteristics and the use of various extension sources for agricultural information (Table 3).

Land tenure was significant at 5% relative to farmers' use of various extension sources. As shown in Table 2, farmers who practised commercially (58%) indicated using various extension sources for agriculture-related information.

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TABLE 2: Farmer Activities

Sources of extension n = 265	**Explanatory variable %**			**Chi-Square significance**
	Farming enterprise			
	Crop farming	Livestock farming	Mixed farming	
Public	41	46	36	ns
Private	11	7	12	
Pluralistic	48	47	52	
	Land tenure			
	Commercial	Smallholder		
Public	28	46		**
Private	14	9		
Pluralistic	58	45		
	Farming reasons			
	HH Consumption	Selling	Both HHC and selling	
Public	33	41	39	ns
Private	11	14	10	
Pluralistic	56	46	52	
	Land Ownership			
	Yes	No		
Public	36	41		ns
Private	11	10		
Pluralistic	53	49		

*Notes: *** , **, *, means significant at 1%, 5% and 10% levels of significance, respectively

ns = not statistically significant

4.3. Access to Extension Services

The Chi-square test was used to assess the extension services received and operations of varied sources of agricultural information for farmers. Table 3 reported the findings.

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TABLE 3: Access to Extension Services

Sources of extension n = 265	**Explanatory variables %**					**Chi-Square significance**
	Access to extension services					
	Yes		No			
Public	39		29			**
Private	10		42			
Pluralistic	51		29			
	Perceived access to extension services					
	Easy		Difficult			
Public	38		42			*
Private	13		4			
Pluralistic	49		54			
	Extension visits					
	Weekly	Monthly	Quarterly	Annual		
Public	50	40	36	40		ns
Private	7	11	12	4		
Pluralistic	43	49	52	56		
	Satisfied with an extension visit					
	Yes		No			
Public	36		42			ns
Private	14		9			
Pluralistic	50		49			
	Quality of extension serviced received					
	Very good	Good	Neutral	Poor	Very poor	**
Public	61	31	42	43	43	
Private	21	11	7	4	29	
Pluralistic	18	58	51	53	28	

Notes: *** , **, *, means significant at 1%, 5% and 10% levels of significance respectively
ns = not statistically significant

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Access to extension services was statistically related to farmers' use of various extension sources for agricultural information ($p<0.05$). As shown in Table 3, more than 51% of the farmers used varied extension sources for agricultural knowledge. The perceived access (easy or difficult) to extension services was significant at 10%. The results indicate that farmers (54%) experienced challenges accessing pluralistic sources of extension providers. The quality of extension services received was significantly related to farmers' pluralistic extension sources ($p<0.05$). According to Table 4, most farmers (58%) who had access to pluralistic sources rated the quality of extension services received as good, which was higher than the private and public sectors.

4.4. Impact of Extension Services Received

The agricultural support services in South Africa focus primarily on improving smallholder farmers' farming practices, and extension officers provide much of this support. Although there have been changes in the extension policy, Sikwela (2013) and Hlomendlini (2016) postulated that there needs to be evidence to suggest any improvements in farmers' output, particularly those in the former homelands. According to Nkosi (2017), there has been no improvement in the implementation of extension services; in fact, the impact of extension support appears to have declined dramatically. The necessity for more relevance of extension programmes to local needs and the limited interest from farmers demonstrate the need for a reassessment of extension policy (Williams *et al.,* 2008).

Table 4 highlights the findings on the impact of extension services on farmers and the prospects for extension services privatisation in South Africa. The Chi-square test was used.

According to Table 4, changes in farm practices were significant at 5% related to farmers' use of various extension sources for agricultural-related knowledge. The variable for change in farm practices showed that most farmers (52%) who changed farming methodologies received only services from the public sector. Change in farm yield returns was significant at 10% relative to farmers' use of various extension sources for agricultural-related knowledge. As shown in Table 4, 54% of the farmers who had yield improvements indicated receiving assistance from pluralistic extension sources.

TABLE 4: Impact of Extension Services

Sources of extension n = 265	**Explanatory variable %**		**Chi-Square significance**
	Change in farm practices		
	Yes	No	
Public	52	34	**
Private	11	11	
Pluralistic	37	54	
	Changes in farming yields		
	Yes	No	
Public	35	54	*
Private	11	9	
Pluralistic	54	37	
	Willingness to pay		
	Yes	No	
Public	27	54	***
Private	14	6	
Pluralistic	60	40	

*Notes: *** , **, *, means significant at 1%, 5% and 10% levels of significance, respectively

ns = not statistically significant

Farmers' willingness to pay for extension services was significant relative to using different sources for agriculture-related information ($p<0.01$). The results indicated that 60% of the farmers receiving extension services from pluralistic sources were willing to pay. This rationale is that farmers can select agricultural-related knowledge suited to their farming enterprises. Munthali (2013) posited that farmers are willing to pay for a product or service that is unobtainable for free, and the benefits are greater than the cost.

4.5. Factors Influencing Farmers' Use of Various Extension Sources for Agricultural Information

This section reports on the results of the multinomial regression model. Nine (9) explanatory variables were fitted into the multinomial logistic regression to determine factors influencing

smallholder farmers' use of varied sources of extension for agricultural information in the Eastern Cape and KwaZulu-Natal provinces.

TABLE 5: Factors that Influence the Use of Different Extension Services

Explanatory variables for Sources extension services	**Coefficient**	**Std. Err.**	**Z**	**P>z**
0 Public extension (base outcome)				
1 Private extension				
Age groups	-0.2876788	0.2636777	-1.09	ns
Gender	-0.98022	0.5199284	-0.19	ns
Level of education	0.2577008	0.2875454	0.90	ns
Agricultural income	-5.60e-07	3.32e-07	-1.69	*
Land Size	.000215	.0005747	0.37	ns
Cost of production	.0000281	8.09e-06	3.47	***
Distance to access extension	0.014531	.0110158	-1.32	ns
Frequency of response	1285908	.2252807	-0.57	ns
Yield returns	.17 28103	.498637	0.35	ns
_cons	-1.022238	1.621286	-0.63	ns
2 Pluralistic extension				
Age groups	-.1341719	.167294	-0.80	ns
Gender	-0.2323793	.3318477	-0.70	ns
Level of education	-0.0709013	.1761475	-0.40	ns
Agricultural income	6.35e-07	2.79e-07	-2.27	**
Land Size	0.0001948	.0004367	0.45	ns
Cost of production	0.0000288	8.01e-06	3.59	***
Distance to access extension	-0.0279193	.0079276	-3.52	***
Frequency of response	0.4504991	.1548144	2.91	***
Yield returns	0.9043985	.38513	2.35	**
_cons	-0.3096931	1.053499	-0.29	ns
Number of obs = 263				
Prob > chi2 = ***				

*Notes: *** , **, *, means significant at 1%, 5% and 10% levels of significance, respectively
ns = not statistically significant

Greene (2003) postulated that the logit model coefficients could not be deduced from the actual output, necessitating marginal effects. The marginal effects help to predict how much the probability of the outcome variable changes when the value of an explanatory variable changes, holding all other variables constant. The marginal effects are shown in Table 6.

TABLE 6: Marginal Effects of the Multinomial Logistic Model

Explanatory variables for Sources of extension services	**dy/dx**	**Std. Err.**	**Z**	**P>z**
0 Public extension (base outcome)				
Age groups	0.0321822	0.0313392	1.03	ns
Gender	0.0406394	0.0627012	0.65	ns
Level of education	0.0015493	0.0331877	0.05	ns
Agricultural income	0.0011125	5.18e-08	2.36	**
Land Size	-0.0000391	0.0000832	-0.47	ns
Cost of production	-0.0139554	1.44e-06	-3.90	***
Distance to access extension	-0.0049865	0.0013279	3.76	***
Frequency of response	-0.066765	0.0269586	-2.48	**
Yield returns	-0.1502921	0.0665871	-2.26	**
1 Private extension				
Age groups	-0.0190745	0.0224008	- 0.85	ns
Gender	0.0034981	0.0438654	0.08	ns
Level of education	0.0273214	0.0247243	1.11	ns
Agricultural income	-0.0005736	2.33e-08	2.24	*
Land Size	0.0228045	0.000044	0.21	ns
Cost of production	0.0025283	3.45e-07	2.96	**

Distance to access extension	0.0001689	0.0009189	0.18	ns
Frequency of response extension	-0.0358665	.0193955	-0.73	ns
Yield returns	-0.0326636	0.0433335	-0.75	ns
2 Pluralistic extension				
Age groups	-0.0131077	0.0330097	- 0.40	ns
Gender	-0.0441375	0.0650677	- 0.68	ns
Level of education	-0.0288707	.0351268	-0.82	ns
Agricultural income	-0.0009574	4.84e-08	-2.17	**
Land Size	0.0000299	0.00008	0.37	ns
Cost of production	0.0114270	1.19e-06	3.87	***
Distance to access extension	0.0051554	.0014784	-3.49	***
Frequency of response extension	0.1026314	0.291624	3.52	***
Yield returns	0.1829557	0.0753529	2.43	**

*Notes: ***, ** ,* means significant at 1%, 5% and 10% levels of significance, respectively

ns = not statistically significant

*dy/dx is for discrete change in the variable from 0 to 1

4.5.1. Agricultural Income

Agricultural income was significant at a 5% level in outcomes 0 and 2; outcome 1 was at a 10% level relative to farmers' decision to use various extension sources for agricultural information. The coefficient in outcomes 1 and 2 was negative, indicating that agricultural income did not positively affect farmers' choice to use varied extension sources. Outcome 0, however, had a positive coefficient, suggesting that agricultural income positively affected farmers' choice of extension source/s. The average marginal effect on the probability of y = 1 relative to agricultural income increases by 0.1%, ceteris paribus. This means a farmer is likelier to choose public extension over other extension sources because of the positive change of 0.11% in the agricultural income. Chuks (2014) support this type of experience and asserts that a farmer will choose an extension supplier that will give profit to their farms.

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4.5.2. Cost of Production

The cost of production was significant at a 1% level in outcomes 0 & 2 and 5% for outcome one, relative to farmers' choice to use varied sources of extension for agricultural information. The coefficients differed; for outcome 0, the coefficient was negative, indicating a decrease of -1.3% in the probability of y = 1. Outcomes 1 and 2 had positive coefficients, indicating a favourable direct effect costs of production have on farmers' decision to use varied extension sources. The average marginal effect on the probability of y = 1 relative to the cost of production increases by 0.25% in outcome 1 and 1.1% in outcome two ceteris paribus. This means a farmer is more likely to choose public extension services because the cost of production is less by -1.3% compared to other sources of extension providers. Koch and Terblanché (2013) posited that the government carries out the cost of extension provision services in South Africa; therefore, it makes sense that farmers are less likely to choose sources with higher costs.

4.5.3. Distance to Access Extension

The distance a farmer travels to access extension services was significant in outcomes 0 and 2 at a 1% level related to farmers' decision to use varied extension sources for agricultural information. The coefficients differed; outcome 0 was a negative coefficient, indicating no positive direct effect on the farmers' decision to use various extension sources. Outcome 2 was positive, indicating a positive direct effect distance to access extension has on the farmers' decision to use multiple extension sources. Moreover, the average marginal effect on the probability y = 1 relative to the distance travelled to access extension increased by 0.51% ceteris paribus. The findings mean that a farmer is likely to use pluralistic sources because a change in the coefficient indicates a 0.51 km decrease in the distance a farmer travels to access extension. This suggests that a combination of pluralistic sources of extension services is more easily accessible than a single source.

4.5.4. Frequency of Response from Extension

The frequency of extension response was significant at 5% in outcome 0 and 1% in outcome 2 related to farmers' use of various extension sources for agriculture-related information. The coefficient for outcome 0 was negative, indicating no direct effect on the farmers' choice of extension sources for agricultural information. The coefficient for outcome 2 was positive, suggesting a positive direct effect frequency of response has on farmers' choice to use varied

extension sources. The expected outcome in the probability of y = 1 associated with the frequency of response increases by 10.2%, ceteris paribus. This means a farmer is likely to choose a combination of pluralistic sources of extension services because of the increased response frequency from extension officials compared to other sources. Gómez *et al.* (2016) support this experience.

4.5.5. Yield Returns

Yield returns were significant in outcomes 0 and 2 relative to farmers' choice to use varied extension sources for agricultural information ($p<0.05$). The coefficient for outcome 0 was negative, suggesting no positive direct effect on the farmers' choice of extension sources. For outcome 2, the coefficient was positive, indicating a significant direct effect yield returns have on farmers' choice to use varied extension sources. Moreover, the anticipated difference in the probability of y = 1 relative yield returns increases by 18.2%, ceteris paribus. This means a farmer is more likely to choose a combination of pluralistic sources of extension services because of the increased yield returns (0.182 units) than other sources. Düvel (2002) and Hellin (2012) made similar findings.

4.6. Discussion

The study's findings indicate that elderly farmers engage in agricultural practices across two provinces, possessing extensive experience and primary education, enhancing their awareness of numerous agricultural extension resources available to improve productivity. While access to agricultural extension services was noted, it was inconsistent; furthermore, landownership positively correlated with the farmers' propensity to utilise a diverse range of extension sources for agricultural information. Results demonstrated that farmers who integrated multiple sources of extension within their farming operations observed improvements in agricultural production and farm profitability, thus further bolstering food security compared to their counterparts who refrain from investing in various extension sources. Moreover, farmers were willing to invest in various extension services, attributing this need to the inadequacies of public extension in delivering satisfactory agricultural information, in contrast to the pluralistic and private extension alternatives. The farmers' readiness to finance these services appeared significantly associated with utilising diverse resource channels for agriculture-related information, as it directly influenced the transformation of their farming management and economic returns. The study elucidates that pluralistic and private extension services are predominantly adopted and

employ a choice framework that enables farmers to procure agricultural knowledge tailored to their specific farming frameworks. Additionally, employing multiple extension sources was contingent upon many factors, including the household's agricultural income, production costs, accessibility to extension resources, yield outcomes, and the responsiveness frequency of extension services. These determinants played a crucial role in shaping farmers' decisions concerning the assortment of extension sources utilised for agricultural advancement.

5. CONCLUSION AND RECOMMENDATIONS

In conclusion, this study elucidates the significant role of varied extension sources in enhancing agricultural productivity and farm profitability. The findings indicate a positive correlation between adopting pluralistic extension sources and improved farm returns, underscoring the necessity for farmers to embrace diverse information channels. Specifically, empirical evidence suggests that factors such as agricultural income, production costs, and the responsiveness of extension officers are instrumental in farmers' decisions to utilise these pluralistic sources. Therefore, the study advocates for a concerted effort among public and private stakeholders to optimise extension service delivery. By leveraging the unique comparative advantages of each sector, it is posited that a more effective and value-driven approach to extension services can be achieved, tailored to the heterogeneous needs of smallholder farmers. Furthermore, international extension systems must align with both national and global frameworks to facilitate the integration of innovative technologies and relevant information dissemination strategies. The recommendations in this study urge national governments and international extension leaders to formulate policies that foster an environment conducive to the utilisation of diverse extension sources, ultimately contributing to the sustainability and advancement of the agricultural sector in developing countries.

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