

Access to Agricultural Extension Services Among Smallholder Farmers in the North West Province, South Africa: Socio-Economic Characteristics and Service-Delivery Patterns

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Abstract: Agricultural extension services play a critical role in enhancing smallholder agricultural productivity through the provision of knowledge, technologies, and advisory support. However, access to extension services remains uneven across many developing agricultural contexts, including South Africa. This study examines the socio-economic and service delivery factors associated with smallholder farmers' access to agricultural extension services in Northwest Province, South Africa. A cross-sectional survey design was employed, and data were collected from 115 smallholder farmers using a structured questionnaire. Descriptive statistics and Spearman's rank correlation analysis were utilised for data analysis. The findings revealed that while awareness of agricultural extension services was universal, actual access to extension support varied among farmers, with 84.35% reporting interaction with extension services. Public extension services were identified as the primary source of advisory support, complemented by contact farmers and radio-based communication channels.

Farmers primarily accessed information related to livestock health, weather conditions, crop protection, and farm management practices. The study further found that the frequency of extension visits and the relevance of extension information were key determinants influencing farmers' engagement with extension services. Spearman's correlation analysis demonstrated significant positive associations between extension access and socio-economic variables such as gender, marital status, and education level, while household size exhibited a weaker positive relationship. Overall, the study illustrates that access to agricultural extension services is shaped by both farmer-level socio-economic characteristics and institutional service delivery conditions. The study recommends strengthening extension outreach, improving the relevance of advisory information, and promoting inclusive extension approaches to enhance agricultural knowledge dissemination and support smallholder agricultural development.

Keywords: Agricultural extension services, smallholder farmers, extension access, socio-economic determinants, service delivery factors.

1. Introduction

Agricultural extension services are pivotal in supporting smallholder farmers by facilitating access to information, technologies, and advisory support that can enhance productivity, food security, and rural livelihoods (Gebremariam et al., 2021; Davis et al., 2020; Ongachi & Belinder, 2025). In numerous developing-country contexts, effective extension systems have been linked to improved agricultural productivity, the uptake of innovation, poverty alleviation, and strengthened rural resilience. Nonetheless, access to extension services remains uneven, with many smallholder farmers continuing to experience limited or irregular engagement with these systems.

In South Africa, smallholder farmers frequently operate at the periphery of formal agricultural support systems, particularly in remote or historically disadvantaged areas, where the reach and effectiveness of extension services remain constrained (Nyawo & Mubangizi, 2021). Public extension

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services constitute the primary source of agricultural information for many resource-poor farmers; however, such support is often characterised by infrequent visits, limited coverage, and advisory services that may not adequately align with farmers' production and market requirements. These limitations hinder farmers' ability to adopt improved agricultural practices, access markets, and enhance productivity. Although previous studies in the North West Province have examined issues related to agricultural support and farmer development, their focus has diverged from that of the present study. For instance, Modirwa (2019) found that farmers' access to agricultural information was influenced by socio-economic characteristics such as age and education, while extension personnel were identified as a significant source of information. Mazibuko and Antwi (2019) reported that access to agricultural infrastructure and extension services varied among smallholder farmers and was influenced by factors such as farming experience, organisational membership, and extension contact. Similarly, Ijatuyi et al. (2017) found that extension visits and advisory support were significantly associated with the livelihoods of Nguni cattle farmers. However, less attention has been devoted to understanding the socio-economic characteristics associated with farmers' access to agricultural extension services themselves. Consequently, evidence concerning extension access remains fragmented within the North West Province, underscoring the need for further context-specific investigation.

In light of this background, the present study specifically concentrates on smallholder farmers in the North West Province of South Africa. The study examines the extent of farmers' access to agricultural extension services and investigates the socio-economic and service-delivery factors associated with such access. By providing empirical evidence from a province where smallholder agriculture remains a vital livelihood activity, the study contributes context-specific insights that can inform the design of more inclusive and responsive extension systems.

2. Conceptual Framework

This study adopts a conceptual framework that elucidates the variation in smallholder farmers' access to agricultural extension services as the result of the interaction between demand-side (farmer-level) and supply-side (service delivery) factors within the broader context of the Agricultural Knowledge and Information System (AKIS). The framework guides an empirical associational analysis of extension access rather than the testing of a formal causal theory.

From the demand-side perspective, the socio-economic characteristics of farmers influence their likelihood of being aware of, engaging with, and utilising extension services. Factors such as gender, education level, marital status, farming experience, household size, and farm size shape farmers' capacity and readiness to interact with extension systems. Studies in Sub-Saharan Africa indicate that women farmers often encounter structural and social barriers that restrict their interaction with extension agents, contributing to disparities in access (Ragasa et al., 2013). Education and farming experience further affect farmers' awareness of available services and their confidence in engaging with extension officers (Anderson & Feder, 2007). In Northwest Province, where smallholder farming is characterised by differences in resource endowments and settlement patterns, variations in farm size, household labour availability, and farming experience may influence farmers' visibility to extension officers and their ability to consistently participate in extension activities (Nyawo & Mubangizi, 2021).

From the supply-side perspective, access is also shaped by the organisation and delivery of extension services. Factors such as the frequency of extension visits, the relevance of the information provided, and the modes of interaction influence the extent to which farmers are reached and supported. Even when farmers are willing to engage, access may remain limited when extension visits are infrequent, advisory information is inadequately tailored to local conditions, or delivery approaches do not accommodate farmers' circumstances (Davis et al., 2020). In South Africa, extension systems often face capacity constraints, high farmer-to-extension officer ratios, and logistical challenges, resulting

in uneven service coverage, particularly among smaller or remote farmers (Nyawo & Mubangizi, 2021). Within this framework, access to agricultural extension services is treated as the outcome of interest and is operationalised through awareness, participation, and utilisation. Access is therefore viewed as multidimensional, requiring farmers first to be aware of extension services, to have opportunities to participate, and ultimately to utilise the information provided.

The framework is further situated within the AKIS perspective, which conceptualises extension services as part of a broader system of agricultural knowledge generation, dissemination, and use involving farmers, extension agents, research institutions, and other actors (Röling & Engel, 1991; Klerkx et al., 2012). Within this system, extension services function as intermediaries linking farmers to agricultural knowledge and innovations. Accordingly, uneven access to extension services is understood to arise from the interaction between farmer-level socio-economic conditions and institutional service delivery dynamics, thereby providing a structured basis for analysing the determinants of extension access among smallholder farmers in Northwest Province.

2.1 Hypothesis development

The conceptual framework posits that farmers' access to agricultural extension services is influenced by both socio-economic characteristics and service delivery factors. Drawing on the theoretical arguments and empirical evidence reviewed in this study, it is anticipated that variations in these factors may be correlated with differences in extension access among smallholder farmers. Consequently, the study tests the following hypotheses:

- **H₀:** There is no statistically significant association between selected socio-economic factors and smallholder farmers' access to agricultural extension services in the North West Province of South Africa.
- **H₁:** There is a statistically significant association between selected socio-economic factors and smallholder farmers' access to agricultural extension services in the North West Province of South Africa.



Figure 1: Conceptual framework illustrating demand-side and service-delivery

3. Methodology

This study was conducted among smallholder farmers in selected municipalities within the Northwest Province of South Africa, an area characterised by mixed crop–livestock farming systems and active public agricultural extension programmes. The Northwest Province was selected due to the significant role agriculture plays as a source of livelihood for many rural households, with a substantial proportion of smallholder farmers relying on public extension services for agricultural

information and support. The province also exhibits considerable variation in socio-economic conditions, farming practices, and levels of extension service provision, making it an appropriate setting for examining factors associated with access to agricultural extension services. Furthermore, the province has been identified as a key agricultural region with ongoing efforts to enhance smallholder farmer participation in agricultural development initiatives (Mbatha, 2024; Nyawo & Mubangizi, 2021). Smallholder agriculture remains an important livelihood strategy in rural South Africa and contributes significantly to local food systems and rural development.

A cross-sectional survey design was adopted to examine the socio-economic and service-delivery factors associated with farmers' access to agricultural extension services. Primary data were collected using a structured questionnaire administered by trained enumerators. The questionnaire was pre-tested among a small group of farmers to assess its clarity, relevance, and reliability. A test-retest procedure produced a reliability coefficient of $r = 0.81$, indicating good instrument stability over time (Field, 2024; Kothari, 2004). Feedback from the pre-test was utilised to refine the questionnaire prior to the final survey.

A multi-stage sampling procedure was employed to select respondents. Initially, three municipalities within the North West Province, namely Mahikeng, Ratlou, and Ramotshere Moiloa, were purposively selected based on the prominence of smallholder farming activities and the presence of active agricultural extension programmes (Etikan et al., 2016). With the assistance of local extension officials, eight villages with active crop and livestock farming activities were identified. These included Lokaleng and Modimola in Mahikeng Municipality; Setlagole, Disaneng, and Logageng in Ratlou Municipality; and Ramatlabama, Dinokana, and Gopane in Ramotshere Moiloa Municipality. Farmers were selected from extension service records maintained within each village. A random sampling approach was subsequently used to select active smallholder farmers involved in crop and/or livestock production from the identified villages. The final sample comprised 115 farmers distributed across the villages as follows: Lokaleng (15), Modimola (14), Setlagole (16), Disaneng (13), Logageng (15), Ramatlabama (14), Dinokana (14), and Gopane (14). The use of extension records as sampling frames is common in rural agricultural research, where comprehensive farmer databases are often unavailable (Danso-Abbeam et al., 2018; Etikan et al., 2016).

Data were analysed using descriptive statistics and Spearman's rank correlation analysis. Frequencies and percentages were employed to summarise farmers' socio-economic characteristics and patterns of extension access, while Spearman's rho was used to assess associations between selected socio-economic variables and access to extension services. Spearman's correlation was deemed appropriate due to several variables being ordinal and non-normally distributed (Field, 2024; Pallant, 2020). Ethical clearance for the study was obtained from the Faculty of Natural and Agricultural Sciences Research Ethics Committee (FNASREC) of North-West University (NWU-00590-21-A9). Participation was voluntary, informed consent was obtained from all respondents, and confidentiality and anonymity were upheld throughout the study.

4. Results and Discussion

Table 1 presents the socio-economic characteristics of farmers, which play an important role in shaping agricultural participation, productivity, and engagement with extension services. Overall, the findings illustrated in Table 1 indicate a predominantly male, middle-aged farming population operating within small- to medium-scale diversified farming systems supported by household labour and moderate farming experience. These patterns have significant implications for agricultural development and extension delivery in the study area.

The predominance of male farmers suggests that agriculture in the study area remains male-dominated, reflecting broader patterns in developing agricultural systems where men often have greater access to land, productive resources, and extension support (Ankrah et al., 2020; FAO, 2022;

Ragasa et al., 2013). This may contribute to gender disparities in access to agricultural information and institutional support, despite evidence that greater female participation improves household food security and productivity outcomes (Cavatassi et al., 2025; Diiro et al., 2018). Concurrently, the age distribution indicates that farming activities are largely undertaken by middle-aged and older farmers, raising concerns about the ageing farming population and limited youth participation in agriculture (FAO, 2014; Jayne et al., 2014). While older farmers possess substantial experiential knowledge, lower youth involvement may hinder the adoption of innovative technologies and digital agricultural practices (Ayalew & Girma, 2025).

The dominance of married farmers further suggests that agriculture functions primarily as a household-based livelihood activity. Household cooperation can enhance labour availability, resilience, and the sharing of agricultural knowledge, whereas single-headed households may face labour and resource constraints (Badstue et al., 2020; Kiriti & Tisdell, 2003). Similarly, variations in educational attainment indicate differences in farmers’ ability to access, interpret, and apply extension information. Farmers with higher levels of education are generally better positioned to adopt improved practices and respond to market opportunities, while limited education may restrict the effective utilisation of extension services (Huffman, 2020; Kansime et al., 2022). These findings highlight the need for extension approaches that accommodate varying educational backgrounds through participatory and practical learning methods.

Large household sizes and significant farming experience indicate a continued reliance on household labour and indigenous agricultural knowledge. Household labour can lower production costs and support labour-intensive farming activities (Ayaz & Mughal, 2024; Tennhardt et al., 2024), while experienced farmers often have valuable insights into local agro-ecological conditions (Salerno et al., 2022). However, relying solely on traditional practices may hinder innovation, highlighting the crucial role of extension services in integrating indigenous knowledge with scientific farming methods (Yu & Luo, 2022).

The prevalence of small- to medium-sized farms underscores the dominance of smallholder production systems in the study area. These farmers often encounter challenges related to limited capital, mechanisation, and market access (Zerssa et al., 2021). Nevertheless, smallholder systems can remain productive when bolstered by effective extension services, improved inputs, and better market access (High Level Panel of Experts, 2020). Additionally, the various forms of land acquisition—such as inheritance, purchase, and leasing—reflect diverse tenure arrangements that may affect farmers’ willingness to invest in long-term productivity improvements (Akram et al., 2019; Asaaga et al., 2020; Bambio & Agha, 2018; Higgins et al., 2018).

The reliance on both family and hired labour suggests a hybrid labour system typical in smallholder agriculture, where households supplement family labour during peak production periods (Aubron et al., 2022). Although hired labour can boost productivity, labour costs can diminish profitability, particularly when agricultural income is limited (Pawłowska & Jaroszevska, 2020). Furthermore, the prevalence of mixed crop-livestock farming reflects a diversification strategy that enhances household resilience, improves resource efficiency, and reduces vulnerability to climatic and market shocks (Brewer & Gaudin, 2020; Sekaran et al., 2021).

Table 1: Socio-economic characteristics of respondents

Variable	Category	Frequency	Percentage (%)
Gender	Male	76	66.09
	Female	39	33.91
Age distribution	20–30	2	1.74
	31–40	19	16.53
	41–50	46	40.02

	51-60	40	34.80
	61+	8	6.96
Marital status	Single	40	34.78
	Married	64	55.65
	Divorced	4	3.48
	Widowed	7	6.09
Education	Informal	26	22.61
	Primary	33	28.70
	High school	30	26.09
	Tertiary	26	22.61
Household size	1-5	10	8.70
	6-10	94	81.74
	11-15	11	9.56
Farming experience	1-5 years	6	5.22
	6-10 years	33	28.70
	11-15 years	44	38.26
	16-20 years	21	18.27
	21+ years	11	9.57
Farm size	1-30 ha	34	29.58
	31-60 ha	52	45.21
	61-90 ha	20	17.40
	91+ ha	9	7.81
Land Acquisition	Inherited	37	22.84
	Purchased	81	50
	Leased	44	27.16
Sources of Labour	Family Members	12	10.43
	Self and hired	23	20
	Both	80	69.57
Type of Agricultural Practices	Livestock farming	12	10.43
	Crop Production	10	8.70
	Both	93	80.7
Monthly Income	10000-50000	101	87.83
	51000-100000	6	5.22
	101000-150000	7	6.09
	151000-200000	1	0.87

4.1 Smallholder access to agricultural extension services in North West province

The findings presented in Table 2 indicate a generally high level of awareness and engagement with agricultural extension services among smallholder farmers in Northwest Province. The high awareness of extension programmes suggests that advisory systems have gained significant visibility within rural farming communities, which is crucial, as awareness is a prerequisite for participation and knowledge transfer (Muatha et al., 2017; Ullah et al., 2022). Most farmers reported accessing extension information, demonstrating a relatively strong connection between extension systems and farming communities. Access to extension services remains a vital mechanism for enhancing

smallholder productivity through the dissemination of improved technologies, management practices, and climate-responsive farming strategies (Dasgupta, 2025; Wossen et al., 2017).

Public extension services emerged as the primary source of advisory support, in line with the structure of South Africa's agricultural extension system, where government institutions predominantly provide services to smallholder farmers (Gboko et al., 2021). However, the involvement of non-governmental organisations and farmer networks among some respondents suggests the gradual emergence of a more pluralistic extension system. Regular interaction between farmers and extension agents further indicates relatively frequent advisory contact, which is widely associated with increased technology adoption, trust building, and improved technical understanding among farmers (Cawley et al., 2023; Ruzzante et al., 2021).

Most farmers regarded the extension information as relevant to their production needs, underscoring the importance of context-specific advisory support. Farmers are more likely to adopt recommended practices when extension information addresses local production constraints and agro-ecological conditions (Dowsing & Cardey, 2020; Le Hoang Nguyen et al., 2023). The findings presented in Table 2 further suggest that extension services positively contribute to agricultural productivity by improving farm management practices related to crop and livestock management, disease control, post-harvest handling, and climate-smart agriculture (Argaw et al., 2023; Danso-Abbeam et al., 2018; Kalogiannidis & Syndoukas, 2024).

Extension agents and contact farmers have been identified as the primary sources of agricultural information, with radio also playing a significant supporting role. Extension agents remain central actors within agricultural innovation systems, as they facilitate communication between research institutions and farming communities (Davis et al., 2020). Similarly, contact farmers enhance peer-to-peer learning and local knowledge diffusion, an approach increasingly acknowledged for promoting innovation through trusted social networks (Franzel et al., 2018). The primary types of information accessed by farmers pertain to livestock health, weather conditions, crop protection, and farm management, reflecting the practical challenges encountered by mixed crop-livestock farmers. Climate-related advisory services are particularly crucial in light of increasing climate variability and production risks (Ferdinand et al., 2021; Workalemahu & Dawid, 2021).

The study also revealed that most farmers provide feedback to extension agents regarding the outcomes of recommended practices, underscoring the importance of two-way communication within extension systems. Feedback mechanisms enhance learning processes and enable extension providers to adapt recommendations to local conditions (Cernea et al., 1985; Ejem et al., 2023). Farmer-to-farmer learning and the training-and-visit model emerged as the most preferred extension approaches, while demonstrations and individual farm visits were perceived as the most effective teaching methods. These participatory and experiential learning approaches enhance practical understanding, strengthen local capacity, and improve innovation adoption among smallholder farmers (Dhehibi et al., 2020; Martini et al., 2023; Sseguya et al., 2021).

Lastly, extension meetings and peer learning among fellow farmers were identified as the preferred channels for accessing agricultural information, reinforcing the significance of social learning and collaborative knowledge exchange within farming communities (Martini et al., 2023). Overall, the findings highlight the crucial role of agricultural extension services in strengthening knowledge dissemination, improving farm management practices, and supporting agricultural productivity in Northwest Province. Concurrently, the results suggest that enhancing participatory learning approaches, farmer-led knowledge networks, and pluralistic extension systems could further improve the inclusiveness and effectiveness of extension delivery.

Table 2: Smallholder access to agricultural extension services in the Northwest Province

Variable	Category	Frequency	Percentage (%)
Awareness of Extension Services	Yes	115	100
	No	0	0
Access to information through extension services	Yes	97	84.35
	No	18	15.65
Accessed extension information through	Government	71	61.7
	Non-Government	18	15.7
	Both	26	22.60
Frequency of access to extension information	Very Often	36	31.3
	Often	51	44.3
	Rarely	23	20
	Not at all	5	4.3
Relevance of extension information to beneficiaries' needs	Yes	98	85.2
	No	17	14.8
Does information enhance farmers' productivity	Yes	93	80.9
	No	22	19.1
Sources of extension information	Extension Agents	97	38.6
	Radio Broadcast	47	18.88
	Contact Farmers	88	35.34
	Workshops/Farm Courses	7	2.81
	Others	10	4.02
Specific extension information accessed	Vaccination Programs	45	24.86
	Record Keeping Methods	24	13.26
	Weather Information	29	16.02
	Crop Protection	19	10.5
	Post-Harvest Techniques	19	10.5
	New Technology for Farming	8	4.41
	Diseases and Pest Control	18	9.94
	New Medicine for Livestock	7	3.9
	Drip Irrigation Techniques	4	2.21
	Feeding and Breeding of Livestock	6	3.31
	NR (No Response)	2	1.10
Do you feedback extension agents on results of information applied?	Yes	93	80.9
	No	22	19.1

Preferred extension teaching approach	Farmer Field School	17	14.9
	Training and Visit	38	33.04
	Farmer to Farmer	49	42.6
	Contract Farming	11	9.56
Preferred extension teaching method	Physical Demonstration / Hands-on Experience	70	60.92
	Group Discussion / Activities	8	6.96
	Individual Visits	37	32.17
Preferred method of accessing agricultural information	Mass Media (Radio/TV/Newspaper)	14	12.17
	Phone	17	14.8
	Extension Farmers Meetings	46	40
	Fellow Farmers	38	33.04

4.2 Determinants, constraints, and proposed solutions

The results presented in Table 3 highlight several institutional and operational factors that influence farmers' access to extension services in Northwest Province. Among the most significant determinants identified are the frequency of visits by extension agents and the relevance of the extension information to farmers' production needs. Regular interaction between farmers and extension personnel enhances knowledge transfer, builds trust, and enables the provision of context-specific advisory support (Cawley et al., 2023; Mesfin et al., 2023). Frequent contact with extension services has also been linked to improved technology adoption, better farm management practices, and an increased capacity to address production challenges (Ruzzante et al., 2021; Takahashi et al., 2020).

The relevance of extension information further emerged as a key factor in farmer participation in advisory systems. Farmers are more likely to engage with extension services when the information provided aligns with local production challenges and farming conditions (Ayalew et al., 2022; Jack et al., 2020). In contrast, generic or poorly adapted recommendations can reduce farmer engagement and limit the adoption of improved practices (Birner & Anderson, 2007; Birner et al., 2021; Dowsing & Cardey, 2020). The findings also suggest that the type of farm enterprise influences access to extension support, with some respondents perceiving that commercial farmers receive preferential attention over smallholder farmers. Such disparities are often linked to limited institutional resources, high farmer-to-extension officer ratios, and uneven service distribution within extension systems (Sebeho & Stevens, 2019).

Several operational challenges limiting effective extension delivery were identified. Farmers reported that some extension advice lacked practical relevance, while logistical constraints, such as inadequate transport and limited travel allowances, reduced the frequency of farm visits and restricted field engagement (Birner et al., 2021; Martin, 2023). Respondents also indicated that extension information was sometimes outdated or not delivered on time, which hindered farmers' ability to respond effectively to issues such as pest outbreaks, weather variability, and seasonal planning (Mapiye et al., 2025; Mulungu, 2025; Tuheirwe-Mukasa, 2019). Additionally, perceived bias towards larger farms was seen as a factor that may discourage smallholder participation in extension programmes and reinforce inequalities in access to agricultural knowledge (Sebeho & Stevens, 2019).

To improve access to extension services, farmers proposed increasing the frequency of farm visits, strengthening research-extension linkages, and enhancing the training and resourcing of extension personnel. Strong collaboration between research institutions and extension systems is essential to

ensure that farmers receive accurate, relevant, and up-to-date information (Biam & Barman, 2017; Deneke & Gulti, 2016). Farmers also highlighted the importance of improving information dissemination through rural communication platforms such as community radio, which can complement direct extension contact and expand knowledge dissemination in underserved areas (Akhter et al., 2021; Posthumus et al., 2025). Furthermore, respondents recommended increasing the number of extension personnel and encouraging greater involvement of private extension organisations to strengthen pluralistic extension systems and enhance advisory coverage (Birner et al., 2021).

Therefore, the findings, as presented in Table 3, demonstrate that farmers' access to extension services is shaped by the interaction of institutional capacity, information relevance, logistical support, and the structure of the extension system itself. Strengthening extension infrastructure, improving research-extension collaboration, and adopting more inclusive and participatory advisory approaches will therefore be essential to enhance the effectiveness of extension services in Northwest Province.

Table 3: Determinants, constraints, and solutions for extension service access (n = 115)

Category	Variable	Frequency	Percentage (%)
Determinants of Access to Extension Services	Frequency of extension agents' visits to farms	83	39.9
	Relevance of information to farmers' needs	80	38.46
	Type of farm enterprise (small-scale vs commercial)	21	10.1
	Distance and location of extension offices	14	6.73
	Literacy level of farmers to comprehend the training	7	3.37
	Ratio of extension agents to farmers	3	1.44
Constraints Affecting Access to Extension Services	Relevance of information accessed	28	24.3
	Limited monthly mileage/kilos allocated to extension agents	20	17.4
	Outdated information	18	15.7
	Access to current agricultural programs	16	13.9
	Less attention is given to small-scale farmers	15	13.0
	Information transfer not timely	13	11.3
	High ratio of extension agents to farmers	5	4.34
Suggested Solutions to Improve Access	Frequent farm visits by extension agents	25	21.7
	Improvement in agricultural research	23	20.0

Extension agents should be better equipped	22	19.10
Provide community radio stations	13	11.3
Prioritize small-scale farmers	9	7.8
Recruit and train more extension officers	8	7.0
Establish more private extension services	6	5.2
Ensure implementation of extension programs	5	4.3
Improve transparency and accountability	4	3.50

4.3 Relationship between farmers' socio-economic characteristics and extension service access

As presented in Table 4, Spearman’s rank correlation analysis was conducted to investigate the relationship between selected socio-economic characteristics of smallholder farmers and access to agricultural extension services in Northwest Province. Spearman’s rho was deemed appropriate due to the ordinal nature of the variables and their non-normal distribution. The findings indicate that socio-economic characteristics significantly influence farmers’ access to extension services.

Gender exhibited a positive and statistically significant relationship with access to extension services ($p < 0.05$), indicating that male farmers were more likely to engage with extension agents and participate in extension activities compared to their female counterparts. Such patterns have been extensively documented in developing countries, where women frequently encounter barriers related to mobility, access to productive resources, and social norms that constrain their participation in agricultural programmes (Adebayo & Worth, 2024; Midamba & Ouko, 2024; Nyberg et al., 2025; Quaye et al., 2019).

Marital status also revealed a positive and significant association with access to extension services ($p < 0.05$), suggesting that married farmers were more likely to participate in extension activities than unmarried farmers. The household structure and labour-sharing dynamics within married households may enhance participation in training sessions and extension programmes, as responsibilities related to farming and household management can be distributed among family members (Okello et al., 2023). Educational attainment similarly demonstrated a positive and significant correlation with access to extension services ($p < 0.05$), implying that more educated farmers possess a greater capacity to interpret technical information, seek advisory support, and adopt recommended agricultural practices (Huffman, 2020; Ruzzante et al., 2021).

Household size exhibited a weak positive relationship with access to extension services ($p < 0.10$). Larger households may offer increased labour availability, allowing some members to engage in extension activities while others manage farm operations. Comparable findings have emerged from studies linking household labour availability to participation in agricultural programmes and technology adoption (Tennhardt et al., 2024).

In summary, the results suggest that socio-economic characteristics, including gender, marital status, education, and household size, significantly influence farmers’ engagement with agricultural extension services. These findings underscore the necessity for more inclusive and targeted extension approaches that address gender disparities and enhance outreach to farmers with diverse socio-economic conditions.

Table 4: *Spearman's correlation of socio-economic characteristics with extension service access*

Variable	Spearman's ρ	Significance
Gender	0.8246	$p < 0.05$
Marital Status	0.9723	$p < 0.05$
Educational Level	0.5620	$p < 0.05$
Household Size	0.3658	$p < 0.10$

The results of the Spearman's rank correlation analysis indicate statistically significant relationships between several socio-economic variables and farmers' access to agricultural extension services. Gender, marital status, and educational level were positively and significantly associated with access to extension services at the 5% significance level, while household size demonstrated a weaker but positive relationship. These findings provide empirical evidence to reject the null hypothesis (H_0) and support the alternative hypothesis (H_1), indicating that socio-economic characteristics are significantly associated with smallholder farmers' access to agricultural extension services in Northwest Province.

5. Conclusion and Recommendations

This study examined the socio-economic and service delivery factors influencing smallholder farmers' access to agricultural extension services in Northwest Province, South Africa. The findings confirm that extension services remain a crucial mechanism for disseminating agricultural knowledge and supporting farm productivity among smallholder farmers. Although awareness of extension services was generally high, access to extension support was uneven across farmers, reflecting disparities in extension reach and engagement.

Public extension services constituted the primary source of advisory support, complemented by contact farmers and communication platforms such as radio. Farmers predominantly accessed information related to livestock management, crop protection, weather conditions, and general farm management practices. The study further identified that the frequency of extension agents' farm visits and the relevance of extension information were among the most significant determinants of extension access, underscoring the importance of regular and context-specific engagement with farmers. Additionally, socio-economic characteristics such as gender, marital status, and education level significantly influenced farmers' access to extension services.

Hence, the findings demonstrate that access to agricultural extension services is shaped by the interaction between farmers' socio-economic conditions and institutional service delivery factors within the broader agricultural knowledge system. Based on these findings, the study recommends strengthening the frequency of extension visits, improving the provision of locally relevant agricultural information, promoting gender-responsive and inclusive extension approaches, enhancing research-extension linkages, and expanding pluralistic extension systems involving public, private, and community-based actors to improve advisory coverage and effectiveness.

5.1 Study limitations and future research directions

While this study provides important insights into smallholder farmers' access to agricultural extension services in Northwest Province, several limitations should be acknowledged. The study employed a moderate sample size of 115 farmers and focused on selected municipalities, which may limit the generalisability of the findings beyond the study area. Additionally, the use of a non-probability sampling approach, although common in rural agricultural research involving dispersed populations (Etikan et al., 2016), may introduce sampling bias.

Future research could employ larger and more representative samples across multiple provinces to better capture regional variations in extension access and service delivery. Comparative and longitudinal studies may also yield deeper insights into how extension access influences technology

adoption, productivity, and rural livelihoods over time. Furthermore, research should explore the role of digital extension platforms, climate-smart advisory systems, and pluralistic extension models involving public, private, and farmer-based actors in strengthening agricultural knowledge dissemination and innovation systems.

7. Declaration

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Conflicts of Interest: The author declares no conflict of interest.

Data Availability Statement: The data supporting the findings of this study are available from the corresponding author upon reasonable request. Access will be granted to researchers who meet the criteria for data sharing established by the institutional review board or ethics committee.

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