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Oladimeji Idowu Oladele[1], **Nthapeliseng Nthama** [2]
University of Kwa-Zulu Natal, South Africa

Effects of Information Providers, Channels and Types on the Adoption of Climate – Resilient Practices in Lesotho

Abstract. This study examined the effects of information providers, channels and types on the adoption of climate-resilient practices in Lesotho, deviating from the usual separate analysis of the relationships between information provider, channels and types. Previous studies have generated only partial insights into the influence of different information variables on adoption behaviour, neglecting a holistic representation of the interactive effects of all dimensions of information and adoption. Using a sample of 1,659 farmers from the Bureau of Statistics (BOS) database on the 2019/2020 agricultural production survey, the data was analysed using frequency counts, percentages and Probit regression. The results show that the majority of the farmers are male (53%), less than 30 years of age (59%), possess an education level between High School form 1 to 5 (59%), have between 5 and 10 persons per household (50%) and rely on subsistence farming as their main source of income (36%). The extension services provided, as indicated by at least 90% of the farmers, include information on farm management, crop selection, input use, credit, farm machinery, livestock, crop protection, conservation, marketing, irrigation and nutrition. In contrast, the information received is more focused on marketing, livestock production, agronomic practices, irrigation and fisheries production. The major extension service providers and sources of information are public service providers and radio. Agricultural extension information providers, channels and types influence the adoption of climate-resilient practices. The study recommends that extension information providers, channels and types be matched to specific contexts for improved effectiveness.

Keywords: information providers, channels, information types, adoption, climate, resilience, information sources, extension services

JEL Classification: Q10, Q16

Introduction

Climate change poses threats and exacerbates high vulnerability to agricultural livelihoods due to low adaptive capacity, human development, political resolve, infrastructure/technology and inadequate resources, which require crucial actions by individuals and governments (IPCC, 2021). The concern becomes more existential due to the need to meet the food needs of a rapidly growing population and changing diets. Fadairo et al. (2020) and IPCC (2021) stated that adaptation practices are crucial to reducing the impacts of climate change on food systems and agriculture. Antwi-Agyei et al. (2023) and Dougill et al. (2021) have reported that the adoption of climate-smart agriculture enhances food security and livelihoods, increases farmer adaptation, mitigates greenhouse gas (GHG) emissions and increases resilience. Climate resilience, as a basic concept of climate risk management, is the ability of an agricultural system to anticipate and prepare for, as well as adapt to, absorb and

[1] Dr, Department of Agricultural Extension and Rural Resources Management, School of Agriculture, Environment and Earth Sciences, University of Kwa-Zulu Natal, Pietermaritzburg, e-mail: Oladeleo@ukzn.ac.za; https://orcid.org/0000-0001-6004-1419

[2] Department of Agricultural Extension and Rural Resources Management, School of Agriculture, Environment and Earth Sciences, University of Kwa-Zulu Natal, Pietermaritzburg, e-mail:nnthama@gmail.com

recover from the impacts of changes in climate and extreme weather. The adoption and improvement of agricultural practices increase the propensity for climate resilience. These practices are often depicted as sustainable agriculture, regenerative agriculture, nature-based solutions, environmentally friendly agriculture and agricultural clean production technologies. The characteristics of value-chain actors would influence the eco-efficiency and cleaner production decisions regarding the use of farm equipment and machinery. Climate-smart agriculture practices promote integrated cleaner production approaches through the minimisation of resource extraction, increased use efficiency, recycling waste residue and energy savings (Athira et al., 2019). Farmers' adaptation to the challenges of climate change and improving societal well-being is enhanced through the framework of climate-smart agriculture (Zilberman et al., 2018). Climate information services have led to an increase in adaptation strategies for climate change, specifically weather variability (Djido et al., 2021), productivity enhancement and livelihood protection (Yegbemey et al., 2021; Alidu et al., 2022). Agricultural production is enhanced through information by creating awareness, knowledge and skills (Anmol and Mohammed, 2021), facilitating all activities across the value chain for efficient management through changing operational contexts. The utility of information is often correlated to its influence on profitability; thus, limited access to information and technical knowledge constitutes a major barrier to the effective management of agricultural risks (Duong et al., 2019; Skaalsveen et al., 2020). Information is crucial to the effective management of agricultural risks (McKune et al., 2018), making adoption decisions (Mulwa et al., 2017), increasing resilience (Chaudhuri and Kendall, 2021; Blazquez-Soriano, 2022), adaptation and mitigation (Ponce, 2020), improved capacity (IPCC, 2021) and decision-making (Antwi-Agyei and Stringer, 2021).

Farmers are simultaneously exposed to multiple risks and, thus, need access to diverse information throughout the production cycles of their enterprises (Korell et al., 2020). The diversity of farmers' information needs extends to the content (Amah et al., 2021), typologies and message adequacy (Kumar et al., 2020), alignment to users' needs (Kumar et al., 2020) and preferred sources and channels of information (Mottaleb et al., 2017). The majority of research on information needs has focused on production and market risks (Komarek et al., 2020), neglecting the adequacy of measures required by end-users (Nwafor et al., 2020), specific information for different stages of the value chain (Diemer et al., 2020) and emerging needs (Chen and Lu, 2019). Harvey et al. (2014) stated that farmers' vulnerability is related to agricultural risks, resilience capacity (Heeks and Ospina, 2018) and perceived consistency of meteorological data (Rapholo and Makia, 2020; Simelton et al., 2013).

This study is anchored in the Diffusion of Innovation Theory, which – according to Rogers (2003) – posits that innovation passes through the process of knowledge about the innovation, persuasion, the decision to adopt or not, implementation of the innovation and confirmation of adoption to determine adoption. This process is often evaluated through the indicators of perceived relative advantage, compatibility with existing cultural norms, attitudes and beliefs, complexity and the ease of understanding and use by end-users, trialability and observability. Diffusion theories focus on how innovative technologies are introduced to prospective adopters at different temporal scales and are used to explain the transfer and adoption of agricultural technologies between farmers. The diffusion of innovation theory was applied to explore the adoption of various technologies due to its generalisability and applicability covering a wide range of potentially influential variables and constructs across many sectors and contexts, such as small-scale irrigation pumps among farmers in Malawi (Kamwamba-Mtethiwa et al., 2021) and improved cassava varieties in Ghana. Kondo et al. (2020) used the theory to examine the various dissemination strategies and factors determining farmers' adoption.

Magesa et al. (2024) noted that farmers' misperceptions of agricultural information sources and messages exist and, thus, explore multiple information sources. Naveed & Hassan (2021) reported that farmers relied overwhelmingly on their prior experience and fellow farmers or friends, as well as progressive farmers, for agricultural information. Lv et al. (2024) noted that different information sources affect farmers' adoption behaviour differently, with formal and informal personal information sources having significant positive effects on intentions; informal information sources being the strongest determinant of adoption behaviour, while impersonal information sources had no significant influence. Masephula & Olorunfemi (2023) reported that farmers' access to extension visits was a significant correlate of their extension and marketing information needs. Fidelugwuowo & Omekwu (2023) found that factors relating to the propensity to adopt include access to extension services and the cost of innovation. Naveed & Hassan (2021) stated that farm size, education and income predict information needs and sources and that information acquisition by farmers was hindered by poor timely access, inaccessibility, unawareness, bad timing of television programmes, poor economic conditions, infrequent visits from extension staff, low levels of education and language barriers.

The novelty of this study is to show the combined effects of information providers, channels and types on the adoption behaviour of farmers with respect to climate-resilient practices. This is predicated on the fact that several studies and authors have separately examined the relationship between information providers, channels, types and socio-demographic characteristics and adoption behaviour, which has generated a partial understanding of the different information variables' influence on adoption behaviour, neglecting the holistic representation of the interactive effects of all dimensions of information and adoption. This study changes the existing narrative of singling out information dimensions rather than considering the collective impacts of the information variables. This study, therefore, fills the knowledge gap concerning how the interactive effects of information variables address the vacuum created by the unidimensional analysis of the impact of information on adoption behaviour. The objective of this study is to determine the effects of information providers, channels and types on the adoption of climate-resilient practices in Lesotho.

Methodology

The study was carried out in Lesotho, a country enclosed and landlocked by South Africa, featuring a high-altitude terrain that comprises lowlands, foothills and the Sengu River Valley as agro-ecological zones. These zones range from 1,400 to 2,000 m for the valleys and from 2,000 to 3,400 m above sea level for the highlands. Lesotho covers ten administrative districts, with a total land area of 30,355 km². The rainy season lasts from October to April, while the dry-cold season extends from May to September. The administrative districts are Mokhotlong, Butha-Buthe, Quthing, Qacha's Nek, Thaba-Tseka, Mafeteng, Mohale's Hoek, Berea and Maseru (Lepheana et al., 2018).

Fig. 1. Map showing the study area

Source: Nthapeliseng Nthama & O. I. Oladele (26 Mar 2024): Effects of Radio-Based Extension Services on farmers' Adoption of Organo-Mineral Fertilizers, Biofertilizers, and Manure in Lesotho, Journal of Radio & Audio Media, DOI: 10.1080/19376529.2024.2332714.

The data used in this study was obtained through permission from the Lesotho Bureau of Statistics (BOS) for the 2019/2020 Agricultural Production Survey, which included 8,000 agricultural households from rural areas across all four ecological zones. This encompassed 500 sample Primary Sampling Units (PSUs) stratified according to the ten administrative districts and later clustered into the four agro-ecological zones. The criteria for determining the sample size included levels of production of key cereal crops, the number of small and large ruminant livestock and districts as the lowest domain of estimation, with a minimum of 400 agricultural households based on a 7.5% Coefficient of Variation. The data covered agricultural practices, extension services received, service providers, extension information, sources of information, types of services received, demographics and social characteristics. A sample of 1,659 farmers was extracted from the survey database as they are linked to the adoption of climate-resilient practices. The extracted data was analysed using SPSS IBM version 29, with frequencies, percentages, Probit regression and summarised with tables and graphs.

A Probit regression analysis was applied to determine the effects of information providers, channels and types on the adoption of climate-resilient practices in Lesotho. For the Probit models, it is assumed that farmers have two alternatives: to adopt climate-resilient practices or not, as expressed by Nagler (1994). Binary outcome variables were considered dependent variables with two possibilities, such as yes or no. The model is appropriate as it can overcome heteroscedasticity and satisfies the assumption of a cumulative normal probability distribution (Gujarati, 2004).

Table 1. Independent variables of the Probit model and their expected signs

Variables	Description	Measurement	Expected sign
infomainsource	Main source of information	Dummy (0 = no, 1 = yes)	+/-
infoagrono	Information on agronomy	Dummy (0 = no, 1 = yes)	+
infodiesepest	Information on diseases and pest	Dummy (0 = no, 1 = yes)	+
infocredit	Information on credit	Dummy (0 = no, 1 = yes)	+
infovarieties	Information on varieties	Dummy (0 = no, 1 = yes)	+/-
infoweather	Information on weather	Dummy (0 = no, 1 = yes)	+/-
infonewpractice	Information on new practice	Dummy (0 = no, 1 = yes)	-
EXTPFU	Farmers Union as extension provider	Dummy (0 = no, 1 = yes)	+
EXTPMAFSAEO	Ministry of Agriculture as Extension provider	Dummy (0 = no, 1 = yes)	+
EXT1cropprotection	Extension services on crop protection	Dummy (0 = no, 1 = yes)	+
EXT1conserva	Extension services on soil conservation	Dummy (0 = no, 1 = yes)	+
EXT1credit	Extension on credit	Dummy (0 = no, 1 = yes)	+
EXTAgrodealers	Extension services by agro-dealers	Dummy (0 = no, 1 = yes)	+/-
inforsource1	Information sources	Dummy (0 = no, 1 = yes)	+/-

Source: Authors' compilation.

It is assumed that Y can be specified as follows:

$Y = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots\ldots + \beta_{ki} X_{ki} + U_1$ ……………………..1

And that:

$Y_i = 1$ if $Y > 0$ ………………..……………………………………2

$Y_i = 0$

Otherwise, Where X_1, $X_2, \ldots\ldots X_n$ represents a vector of random variables, β represents a vector of unknown parameters and U represents random disturbance terms (Nagler, 1994).

Results and Discussion

The results and discussions are organised into sections on personal characteristics, farm characteristics, extension service providers and information sources, information types received and Probit regression analysis of the effects of information providers, channels and types on the adoption of climate-resilient practices in Lesotho. Figure 2 presents the results of the personal characteristics of farmers and reveals that the majority of the farmers are male (53%), less than 30 years of age (59%), never married (57%), had an education level between form 1-5 (59%), make complete decisions on their farming enterprises (74%), did not receive formal agricultural training (89%), have between 5 to 10 persons per household (50%), rely on subsistence farming as their main source of income (36%) and derive their entire income from agriculture (34%). Rantso et al. (2019) reported that although agriculture is a male-dominated activity, more female farmers participated in block farming than male farmers in Lesotho. Seko and Jongrungrot (2022) reported that over two-thirds of farming households were male and were either separated or widowed, deriving most of their income from pensions, with an average household size of five members. Rantso et al. (2019) found that the majority of farmers in Lesotho are married, have primary education and have household sizes ranging between five and nine members. This may be attributed to the use of family labour in agricultural chores such as weeding, ploughing and harvesting, among others. The agricultural sector in Lesotho is dominated by small-scale farmers who produce mainly for consumption (Rantso et al., 2019).

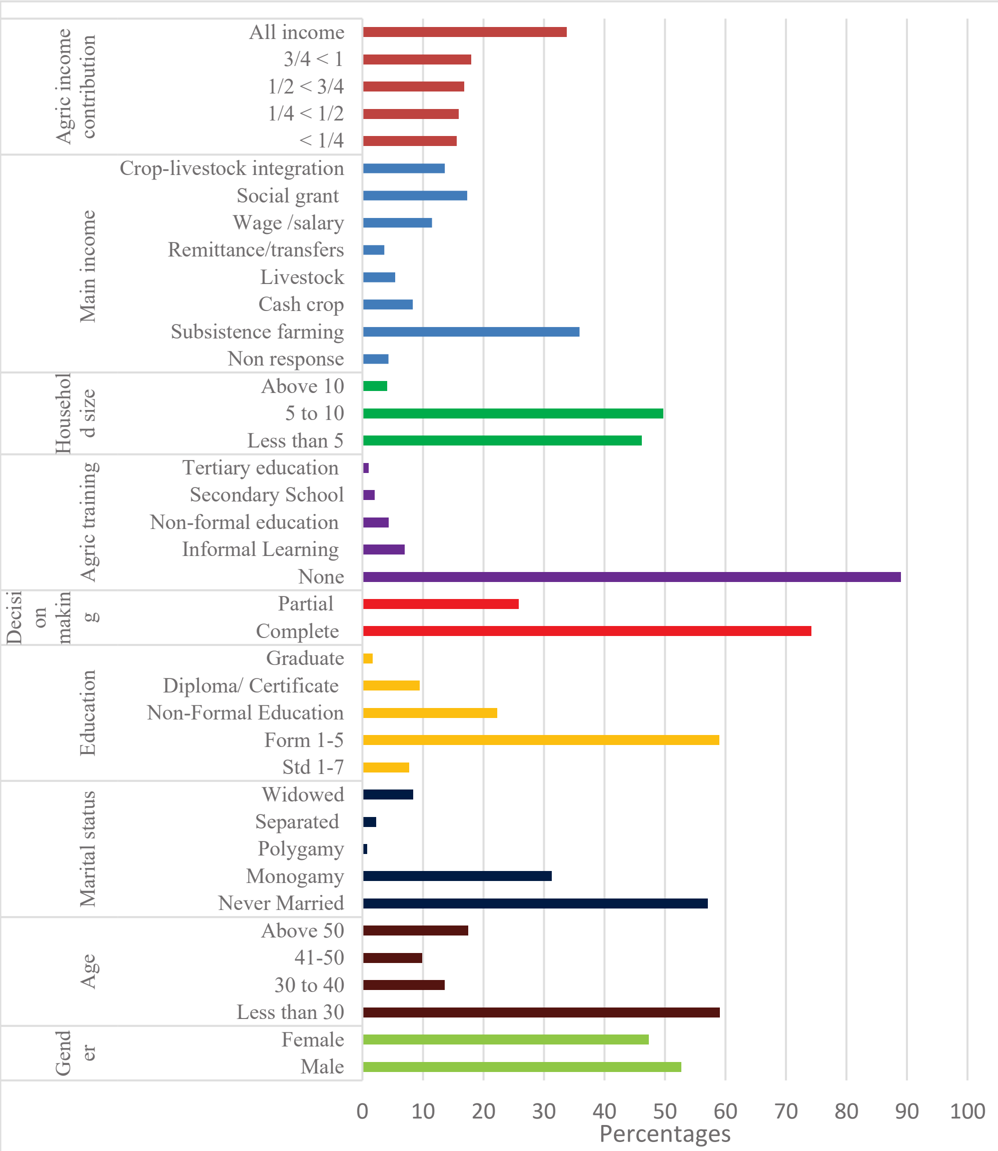

Fig. 2. Distribution of respondents based on personal characteristics

Source: Authors' compilation.

Table 2. Distribution of respondents based on farm characteristics

Variables	Options	Frequency	Percentages
Percentage loss	less than 2	1 483	89.4
	2–10	88	5.3
	above 10	88	5.3
Loss location	on the field	1 100	66.3
	during storage	260	15.7
	during transport	86	5.2
	loss during processing	116	7.0
	loss during packaging	78	4.7
	loss during sales	20	1.2
Proportion planted temporary crops	less than ¼	71	4.3
	¼	123	7.4
	½	241	14.5
	¾	86	5.2
	whole field	1 138	68.6
Proportion harvested	less than ¼	244	14.7
	¼	111	6.7
	½	158	9.5
	¾	75	4.5
	whole field	1 073	64.7
Area fertilized	all	911	54.9
	not all	748	45.1
Types of fertiliser	mineral fertilisers (inorganic fertiliser)	703	42.4
	organo-mineral fertilisers	111	6.7
	organic fertilisers	181	10.9
	bio fertilisers	20	1.2
	manure	644	38.8
Product purpose	producing only for sale	85	5.1
	producing for sale with some own consumption	166	10.0
	producing for own consumption with some sale	491	29.6
	producing mainly for own consumption	987	59.5
Land use type	unclassified land	71	4.3
	land under temporary crops	1 546	93.2
	land under temporary and permanent crops	41	2.5
Land tenure	inherited	1 030	62.1
	purchased	93	5.6
	community land / use right from local Authority	224	13.5
	sharecropping	108	6.5
	borrowed / rented	133	8.0

Source: Authors' compilation.

Ogundeji et al. (2018) found that savings, scale of production, membership of farmer associations and financial record keeping exert significant positive effects on access to credit for farmers in Lesotho. Farmers did not achieve the required yields (Seko & Jongrungrot 2022). Social capital influences participation in the informal markets, while market information, membership in farmer organisations, farming experience and access to transport influence participation in the formal markets by farmers in Lesotho (Rantlo et al. 2021).

The results of the farm characteristics of farmers are presented in Table 2 and show that the majority of farmers had less than 2 per cent crop loss (89%) (crop loss is operationalised as crop failure), with crop loss occurring on the field (66%), planting the whole field (66%), harvesting the whole field (65%), applying fertiliser on the whole field (55%), using inorganic fertilisers (42%), producing crops mainly for their own consumption (60%), with a land use type of temporary crops (93%) and inheritance as land tenure (62%). The crop loss could be due to a combination of the effects of climate change and access to and utility of information on climate-resilient practices. The results may further be attributed to the fact that the majority of the farmers are small-scale and their level of production is subject to associated inefficiencies. Seko & Jongrungrot (2022) found that crop management strategies, such as seeding rate – which was found to be lower than recommendations by the Ministry of Agriculture and Food Security (MAFS) – seed type and soil fertility, are significant factors. According to Rantso & Seboka (2019) and Seko & Jongrungrot (2022), inheritance is the most predominant method of land tenure among farmers in Lesotho and is closely related to the customary land tenure practiced in the country.

Figure 3 presents the results of the extension service providers and information sources, revealing that the majority of farmers – between 73 and 99% – indicated that extension service providers include private fisheries, forestry, farmers' unions, the Ministry of Agriculture and Food Security, extension and veterinary officers, agro-input dealers and local and international non-governmental organisations. This may be related to the prevalence of the pluralistic extension system, where several role players provide extension services to farmers along the value chain. The pluralistic extension system is considered to be the co-occurrence of several service providers with not-for-profit, profit-based, public, private and mixed extension systems, based on numerous sources of funding, coverage and specialisations (Davis & Terblanché, 2016). Odongo et al. (2023) stated that the management style of extension agents and participatory monitoring and evaluation of smallholder farmer extension activities had positive and significant effects on socioeconomic resilience. Loki et al. (2020) noted that farmers who are dissatisfied with the frequency of extension visits and poor technical advice on agriculture use multiple sources of extension services.

The results on information show radio as the main source of information among farmers (73%), followed by television (14%) and farmers' associations (6%). These results agree with findings that farmers explored and established preferences for various risk management information sources (Rejesus et al., 2020): radio as a preferred information source (Rahman et al., 2016), the main source of information for the adoption of sustainable agricultural intensification practices in East Africa (Kansiime et al., 2021), a determinant of the adoption of agro-weather information sources in Kenya and Ethiopia (Oladele et al., 2019) and perceived as a sufficient source of information (Brhane et al., 2017). In Rwanda, the use of radio broadcasts, call-in shows and radio listening clubs extended climate services and scaled up participatory integrated climate services for agriculture. Radio-based dissemination overcomes literacy issues and enables mass coverage, while the use of call-in options and call centres provides two-way communication. Nthama and Oladele (2024) found that radio-based extension services in Lesotho covered information such as agronomy, pests/diseases, credit, new practices, varieties, weather, land tenure, soil conservation and crop protection, while technologies promoted by radio include soil conservation, terraces, cover cropping, crop rotation, organo-mineral fertiliser, organic fertiliser, biofertilisers, manure and improved seeds. Radio continues to play a major role in the dissemination of agricultural information and influences adoption behaviour, despite the multimedia approach to agricultural communication.

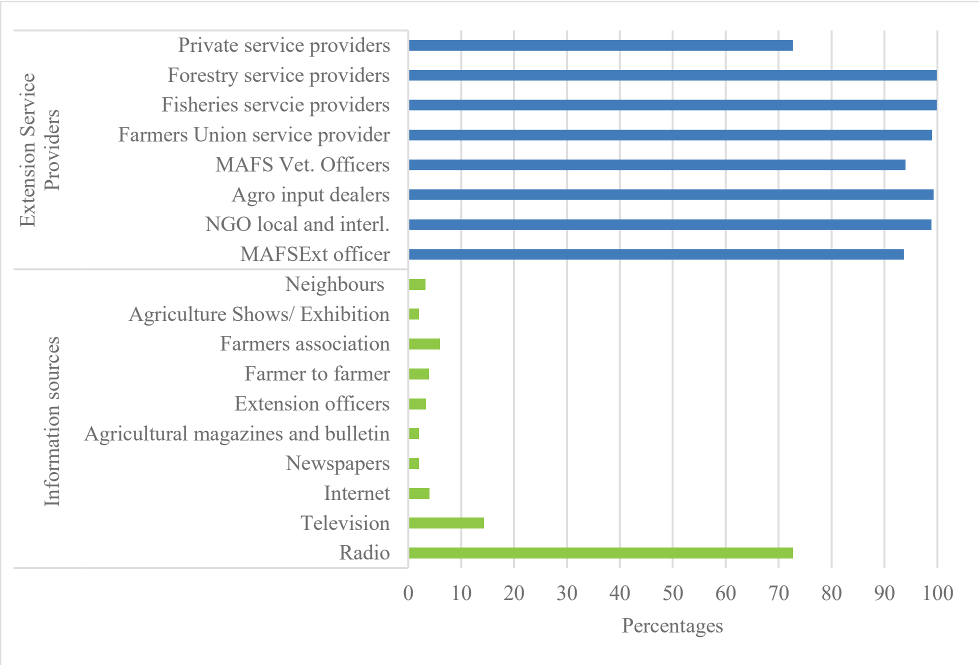

Fig. 3. Extension Service Providers and Information sources

Source: Authors' compilation.

Table 3 presents the distribution of extension services provided and shows that at least 90% of farmers indicated that they received information on farm management, crop selection, input use, credit, farm machinery, livestock, crop protection, conservation, marketing, irrigation and nutrition. The trend of this result can be attributed to the prevalence of pluralistic extension services, where several extension service providers with different specialisations and scopes reached farmers with various extension messages. Mbatha (2024) reported that extension services received by farmers in South Africa include seed supply, manure preparation, implementation of irrigation schemes, farm fencing, training and assistance with vaccinating crops and livestock, while Sahu et al. (2024) found that inputs (seeds, fertilisers, plant protection) were the most sought-after information. Agwu et al. (2023) recommended strengthening, coordination and elimination of gaps and duplications among role players in agricultural innovation systems for effective linkage mechanisms. Sahu et al. (2024) stated that due to the era of changing needs, farmers strive to acquire additional information on aspects such as marketing, climate change and post-harvest functions.

Table 3. Distribution of extension services provided the respondents

Extension services provided	No	Yes
Farm management	37 (2.2)	1622 (97.8)
Crop selection	87 (5.2)	1572 (94.8)
Input use	22 (1.3)	1637 (98.7)
Credit	2 (0.1)	1657 (99.9)
Farm machinery	9 (0.5)	1650 (99.5)
Livestock	53 (3.1)	1606 (96.9)
Crop protection	55 (3.3)	1604 (96.7)
Conservation	19 (1.1)	1640 (98.9)
Marketing	9 (0.5)	1650 (99.5)
Irrigation	9 (0.5)	1650 (99.5)
Nutrition	9 (0.5)	1650 (99.5)

Source: Authors' compilation.

Table 4 presents the distribution of farmers according to the types of information received and shows that the proportion of farmers ranged from 86% for weather information to 99% for disease and pest management, among others. The extension services covered various types of information due to the generalist approach of extension service providers and their response to demand-driven information aimed at enhancing the livelihoods of farmers. The demand-driven services imply making extension more responsive to the needs of all farmers, including women, the poor and the marginalised, as well as being accountable to them. According to Sahu et al. (2024), the type of information sought influences farmers' preferred sources of extension services. Kwapong et al. (2020) found that information received by farmers from both farmer-to-farmer exchanges and agricultural extension agents focused on motivation towards farming businesses, financial resources for the production season, willingness to reinvest profits, access to farmland for future expansion, group formation, marketing challenges, diversification of farm operations and good agricultural practices. Abu Harb et al. (2024) stated that information received by farmers includes farm productivity, adopted technology, environmental challenges, livelihood improvement, livestock production and crop production.

Table 5 presents the results of the Probit regression analysis of the effects of information providers, channels and types on the adoption of climate-resilient practices in Lesotho. All the models are well-fitted, as confirmed by the Chi-Square values and a significance level of 0.01. All indicators of variables on different information providers, channels and types across various climate-resilient practices are significant, although at different significance levels (Table 5).

Table 4. Distribution of respondents according to Information received

Information types	No	Yes
Info-general agriculture	139 (8.4)	1520 (91.6)
Info-weather	219 (13.2)	1440 (86.8)
Info-varieties	158 (9.5)	1501 (90.5)
Info-new practice	22 (1.3)	1637 (98.7)
Info-machinery	9 (0.5)	1650 (99.5)
Info-credit	94 (5.6)	1565 (94.4)
Info-disease & pest	14 (0.8)	1645 (99.2)
Info-market	167 (10.0)	1492 (90.0)
Info-livestock	15 (0.8)	1644 (99.2)
Info-agronomy	17 (1.0)	1642 (99.0)
Info-irrigation	3 (0.1)	1656 (99.9)
Info-fisheries	26 (1.5)	1633 (98.5)
Info-HIV/AIDS	29 (1.7)	1630 (98.3)

Source: Authors' compilation.

The extension factors and variables influencing the adoption of soil conservation, cover cropping, terracing, crop rotation and improved seeds as climate-resilient practices are the main channels of information: agronomy information, disease and pest information, credit information, information on varieties, weather information, information on new practices, farmers' unions as extension providers, the Ministry of Agriculture as an extension provider, crop protection extension services received, conservation extension services received, credit extension services received, agro-dealers as extension providers and multiple information channels. Smallholder farmers source climate information through radio because it is believed to be accessible, credible, timely and location-specific, eliminating mismatches of services and users' needs (Yegbemey et al., 2021; Kumar et al., 2020). Agro-dealers facilitate the distribution of improved farm inputs, extension information and post-harvest handling services to smallholder farmers (AGRA, 2016; Das et al., 2019). Several authors have reported that factors influencing farmers' adoption of climate-resilient practices include the availability and accessibility of inputs (Mulema et al., 2020), access to information (Kassie et al., 2021; Mofya et al., 2021) and that contact with extension agents positively predicts the intensity of joint adoption of climate-smart agriculture practices. Serote et al. (2023) reported that contact with extension services removes barriers to the adoption of climate-smart agriculture. Kelil et al. (2020) noted that extension services improve access to and use of climate-smart agricultural information. Elia (2017) indicated that extension services increased farmers' awareness and understanding of climate change and variability in central semi-arid Tanzania, thus facilitating the adaptive response to climate change. Colussi et al. (2022) stated that communication affects the adoption of technologies and that extension services are a major source of communication with farmers.

Table 5. Probit regression analysis of the effects of information providers, channels and types on the adoption of climate –resilient practices in Lesotho

Parameter	Soil Conservation Coefficient (Std err)	Cover cropping Coefficient (Std err)	Terrace Coefficient (Std err)	Crop rotation Coefficient (Std err)	Improved seeds Coefficient (Std err)
infomainsource	.124 (.017)***	.126 (.020)***	.128 (.016)***	.128 (.017)***	.121 (.017)***
infoagrono	-.214 (.020) ***	-.200 (.023) ***	-.232 (.019) ***	-.222 (.020) ***	-.195 (.020) ***
infodiesepest	.345 (.032) ***	.310 (.037) ***	.347 (.031) ***	.348 (.032) ***	.340 (.032) ***
Infocredit	.061 (.011) ***	.050 (.013) ***	.065 (.011) ***	.062 (.011) ***	.057 (.011) ***
infovarieties	-.010 (.008)	-.010 (.009)	-.011 (.007)	-.010 (.008)	-.011 (.008)
infoweather	.014 (.007) **	.012 (.008)	.014 (.006) **	.014 (.007) **	.013 (.007) **
infonewpractice	.051 (.021) **	.063 (.025) **	.070 (.021) ***	.058 (.021) ***	.032 (.022)
EXTPFU	-.035 (.019) *	.010 (.023)	-.036 (.019) **	-.032 (.019) *	-.030 (.020)
EXTPMAFSAEO	.217 (.020) ***	.218 (.024) ***	.234 (.020) ***	.226 (.020) ***	.204 (.020) ***
EXT1cropprotection	.005 (.011)	.000 (.013) **	.005 (.011)	.004 (.011)	.004 (.011)
EXT1conserva	-.173 (.019) ***	-.168 (.022) ***	-.186 (.018) ***	-.176 (.019) ***	-.160 (.019) ***
EXT1credit	.414 (.102) ***	.063 (.094)	.345 (.094) ***	.268 (.091) **	.401 (.104) ***
EXTAgrodealers	-1.148 (.073) ***	-.933 (.083) ***	-1.094 (.073) ***	-1.028 (.075) ***	-1.132 (.074) ***
inforsource1	.023 (.001) ***	.020 (.001) ***	.023 (.001) ***	.023 (.001) ***	.022 (.001) ***
Intercept	-.971 (.249) ***	-.979 (.250) ***	-.936 (.237) ***	-.947 (.235) ***	-.995 (.255) ***
Chi-Square	83189.585	46879.643	89086.666	82171.704	75501.072
Df	1644	1644	1644	1644	1644
Sig	.000	.000	.000	0.000	0.000

* significant < 10%, ** significant < 5%, *** significant < 1%
Source: Authors' compilation.

It is noteworthy that information on varieties does not significantly influence any of the climate-resilient practices. This may be due to the fact that extension services did not cover specialised information on varieties, as many extension agents might lack competence in this area. Walsh et al. (2015) found that community seed production improves links between formal and farmer seed systems, sustains the transition into commercial entities and fosters connections with publicly funded programmes. Ayenan et al. (2021) reported that available seed varieties are predominantly open-pollinated and that private sector-mediated seed systems offer a higher potential for seed quality and profitability, with community-based seed systems showing the greatest potential for ensuring access to seeds. Kimenye and McEwan (2014) stated that foundation seeds are critical for promoting better access to high-quality seeds, which can be achieved through farmer-led seed production models, contract models, research models and quality declared seed models for acquiring skills in establishing and managing seed production and marketing. Ncube et al. (2023) found that local seed systems contribute to household seed security through timely and effective distribution networks that offer several choices and alternatives. CIMMYT (2023) stated that last-mile delivery of stress-tolerant and nutritious seeds addresses the impacts of climate change, pests and diseases and shocks on food systems by enhancing access to a diverse range of seeds. This allows farmers to choose the best varieties to suit their needs and local environment. Myeni and Moeletsi (2023) stated that the adoption of improved seed varieties was driven mainly by factors such as easy and stable access to seeds. Branca et al. (2022) found that access to extension services, land, credit and input and output markets impacts the adoption of improved seeds.

Similarly, the extension services received on crop protection were not significantly related to the adoption of soil conservation. Weather information, farmers' unions as extension providers and the extension services received did not influence the adoption of cover cropping. This may be attributed to the fact that the provision of information without the supply of associated inputs could have hindered the utility of the extension services provided. The adoption of terraces due to the topography of the farms in the study area, crop rotation and improved seeds were not influenced by the extension services received on crop protection. This may be because of the peculiarities and disease/pest-specific needs of crop protection, as opposed to the generalised information provided. Jena et al. (2023) stated that the adoption of crop rotation was found to be influenced by access to extension services, access to credit and subsidies for seed. The adoption of climate-resilient practices is influenced by climate and ecological zoning, access to extension services and farming system diversity (Nyang'au et al., 2021), information (García-Jiménez 2022) and improved access to extension programmes (Dhehibi, 2022).

Conclusions

This paper provides large-scale evidence of the effects of information providers, channels and types on the adoption of climate-resilient practices in Lesotho using the combined effects of these factors on the adoption behaviour of farmers regarding climate-resilient practices. This is based on the fact that several studies and authors have separately examined the relationship between information providers, channels, types and socio-demographic characteristics and the adoption behaviour, generating partial insights into the influence of the different information variables on adoption behaviour while neglecting a holistic representation of the interactive effects of all dimensions of information and adoption. This study, therefore, fills the knowledge gap concerning how the interactive effects of information variables address the vacuum created by the unidimensional analysis of the impact of information on adoption behaviour. The results indicate that extension service providers include private entities, fisheries, forestry, farmers' unions, the Ministry of Agriculture and Food Security, extension and veterinary officers, agro-input dealers and local and international non-governmental organisations. Similarly, the information received ranged from general agricultural advice to specific information on weather, varieties, machinery, credit, diseases/pests and irrigation, with the finding that information providers, channels and types significantly influenced the adoption of climate-resilient practices in terms of scope and intensity.

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