FARMERS' ACCEPTABILITY OF UNIVERSITY-BASED AGRICULTURAL EXTENSION IN A PLURALISTIC EXTENSION SYSTEM IN GAUTENG PROVINCE OF SOUTH AFRICA

by

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DECLARATION

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DEDICATION

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ABSTRACT

Pluralistic extension systems involving various stakeholders have been implemented in many countries to improve the efficiency of, and access to, extension and advisory services. From the perspective of some sections of society, universities offering agricultural programmes have the potential to render extension and advisory services in collaboration with the government because they are involved in knowledge generation through research and teaching. However, it is unknown whether farmers are in favour of a pluralistic extension system involving universities. The aim of the study was to explore farmers' willingness to accept university-based agricultural extension in a pluralistic extension system in the province of Gauteng in order to establish whether the extension services are demand-driven. The objectives of the study were to profile the socio-demographic characteristics of farmers who receive public agricultural extension and advisory services in Gauteng; to determine farmers' perception of public agricultural extension and advisory services, with specific reference to the perceived quality of extension services and influencing factors, as well as the frequency of access to public extension services and its determinants; to ascertain farmers' access to sources of extension services; to determine farmers' perception of the effectiveness of public agricultural extension and advisory services, with specific reference to perceived effectiveness and influencing factors, as well as exploratory factors associated with the perceived effectiveness; to ascertain farmers' acceptance of university agricultural extension in a pluralistic extension system, with specific reference to willingness to accept, the perceived benefits of university agricultural extension and factors influencing the acceptability of university agricultural extension; to determine which university agricultural extension delivery system(s) farmers preferred, as well as factors influencing their choice; to identify the reasons why farmers prefer different university extension delivery systems; to ascertain farmers' perception of a suitable funding model for university agricultural extension services; and to determine farmers' willingness to pay for university agricultural extension services, as well as factors influencing their choice.

A sample of 442 farmers from Gauteng who were receiving agricultural extension and advisory services from the government were randomly selected to participate in the

study. Using a semi-structured survey instrument, primary data were collected through face-to-face interviews. Quantitative data were subjected to descriptive statistical analysis, principal axis factoring (PAF), Kendall’s tau correlation, binary logistic regression (BLR), multiple linear regression (MLR), multinomial logistic regression (MNLR), ordered logistic regression (OLR), Cochran’s Q test, McNemar’s test and the binomial test found in the IBM Statistical Package for Social Sciences (SPSS) version 27. Qualitative data were analysed using codes, themes and indicators and converted to frequencies and percentages. The results obtained in respect of the socio-economic and demographic characteristics of the respondents showed that the majority of the respondents were black African females who were above 35 years of age, had an average of six years' farming experience, spoke Southern Sotho and had spousal support through marriage and cohabitation. Most of the farmers farmed in small-scale settings for non-commercial purposes – the average farm/plot size being 4.55 ha – and occupied communal and rented farmlands. On average, the respondents earned a net income of about R21 387.56 from farming per annum and had various sources of income. Large-scale and highly educated farmers a substantial” income from farming, whereas farmers who were frequently visited by extension officers did not. It was found that nearly half of the respondents had access to extension services from various sources apart from the government, such as commodity organisations, mines, local municipalities, non-governmental organisations and universities. On average, the respondents were located about 42.4 km away from public extension offices, and the majority of the farmlands were ≤50 km from the offices. As a result, the respondents were visited on average twice a month by public extension officers, and farmers who relied on farm income to sustain their livelihoods and who were satisfied with the quality of public extension and advisory services received more monthly visits. However, farmers who made a larger profit received fewer visits per month. About 51.1% of the respondents were satisfied with the quality of public extension and advisory services, and they included farmers who were frequently visited by extension officers, commercial farmers and farmers who regarded public extension services as effective in complying with the principle of Batho Pele in dealing with people and planning activities.

The results obtained in respect of the perceived effectiveness of public extension and advisory services showed that the majority of the respondents were of the view that the services were ineffective. Highly educated farmers, older farmers, farmers who were frequently visited by extension officers and farmers who were satisfied with the quality of services perceived public extension and advisory services to be effective. In addition, the exploratory factor analysis indicated that public extension and advisory services that provided relevant and good-quality services, information that improved agricultural production and access to technologies were perceived as effective by farmers. The study found that pluralistic extension involving the government and universities was demand-driven because a significant majority (91.2%) of the farmers accepted the inclusion of university extension in a pluralistic extension system, even though most of them did not know universities that offered agricultural programmes in the study area. The majority of the respondents were in favour of university extension because of the various benefits it presents, such as better access to extension and advisory services; access to formal education and training; and the opportunity to get advice from subject matter specialists and others. The results of the BLR showed that farmers who made a larger profit from their agricultural enterprises and perceived their association with universities as an opportunity to access research funding accepted the inclusion of universities in a pluralistic extension system. Moreover, three important factors associated with the acceptability of university extension that were extracted from the exploratory factor analysis were access to research resources, improved extension services and training, and the diffusion of university research. The study findings showed that most farmers (56.8%) in the study area preferred an extension delivery system that involved public extension as a means of coordination between farmers and universities (farmer–public extension–university extension delivery system). The mentioned system was preferred most importantly because it would enable farmers to acquire more information from various sources and to maintain a relationship with the government. The results of the MNLR indicated that farmers who made a greater profit form their agricultural enterprises preferred a farmer–public extension–university extension delivery system over a farmer–university extension delivery system. About half of the respondents preferred to receive extension services from universities at their farming places, whereas the other proportion of farmers was divided into those who preferred to visit universities only and those who chose both locations (universities and farming places). Again, most of the farmers (41.9%) preferred to receive extension and advisory services from universities in their vernacular languages. From a funding perspective, it was found that the majority (55.4%) of farmers, especially those who relied on farming as their main source of income, were willing to pay for university extension services. However, commercial farmers and those who were located far from public extension offices were not willing or less likely to pay for university extension services, as shown by the results of the BLR. However, the majority (91%) of the respondents agreed that the government should provide funding for transport, university staff allowances, medical aid (where necessary), Unemployment Insurance Fund (UIF) and pension fund contributions (if applicable), office space (if required), office equipment and furniture, information and communication technology (ICT), stationery, training programmes for farmers and research for university extension services. Therefore, farmers expect the government to provide most of the funding for university extension services.

To improve the effectiveness of public extension and advisory services, it is recommended that public extension agents render relevant, good-quality services and provide information that improves agricultural production and facilitates access to the technologies required by farmers. Further, it is recommended that a formal framework for a pluralistic extension system be developed through a participatory process involving the Ministry of Higher Education and Training, the Ministry of Agriculture, farmers, universities and other stakeholders. The framework for a pluralistic extension system should enable universities to provide research resources to farmers; to improve access to extension services and training of farmers; and to create a platform for the diffusion of university research outcomes to farmers. An extension delivery system involving public extension as the means of coordination should be the main system of university extension. University extension services should be provided mostly in the farming areas (farmlands) using South African vernacular languages. The government should provide most of the funding for transport, gross income, medical aid, UIF and pension fund contributions, office space, office equipment and furniture, ICT, stationery, training programmes for farmers and research for university extension services. Moreover, farmers, universities and farmers' organisations should pay a negotiated fee for university extension services.

KEY WORDS: Public extension, advisory services, quality, effectiveness, pluralistic extension, university extension, extension delivery system, funding

SEPEDI ABSTRACT (SETSOPOLWA)

Mananeo a go hlahla balemi go ya ka dinyakwa tša bona ao a akaretšago batšeakarolo ba mehutahuta a phethagaditšwe ka dinageng tše ntši go kaonafatša go šoma gabotse ga, le go fihlelela, ditirelo tša tlhahlo le keletšo ya balemi. Go ya ka kwešišo ya dikarolo tše dingwe tša setšhaba, diyunibesithi tšeo di rutago dithuto tša temo di na le bokgoni bja go aba ditirelo tša tlhahlo le keletšo ya balemi ka go dirišana le mmušo ka gobane ba kgatha tema ka tšweletšong ya tsebo ka go dira dinyakišišo le go ruta. Le ge go le bjale, ga go tsebje ge eba balemi ba rata lenaneo la go hlahla balemi go ya ka dinyakwa tša bona go tšwa ka diyunibesithing. Maikemišetšo a dinyakišišo tše e bile go utolla go nyaka ga balemi go amogela tlhahlo ya balemi go tšwa ka diyunibesithing ka go lenaneo la go hlahla balemi go ya ka dinyakwa tša bona tše di fapanego ka phrobentsheng ya Gauteng ka nepo ya go tseba ge eba ditirelo tša tlhahlo ya balemi di theilwe go go nyaka ga bona. Maikemišetšo a dinyakišišo e bile go hlaloša seemo sa balemi bao ba hwetšago ditirelo tša tlhahlo le keletšo go lebeletšwe dipalopalo tša setšhaba ka Gauteng; go tseba maikutlo a balemi mabapi le ditirelo tša tlhahlo le keletšo ya setšhaba ka tša temo, go lebeletšwe boleng bjo bo bonwago bja ditirelo tša tlhahlo ya balemi le mabaka ao a di huetšago, gammogo le phihlelelo ye e diregago kgafetšakgafetša go ditirelo tša tlhahlo ya setšhaba le tšeo di laolago se; go tseba phihlelelo ya balemi go methopo ya ditirelo tša tlhahlo ya bona; go tseba maikutlo a balemi mabapi le go šoma gabotse ga ditirelo tša tlhahlo le keletšo ya setšhaba ka tša temo, go lebeletšwe kudu go šoma gabotse le mabaka ao a huetšago se, gammogo le mabaka a kutollo ao a amanago le go šoma gabotse fao go bonwago; go tseba go amogela ga balemi ga tlhahlo ya balemi go tšwa ka yunibesithi ka go lenaneo la go hlahla balemi go ya ka dinyakwa tša bona tša go fapana, go lebeletšwe kudu go nyaka go amogela, dikholego tše di lebeletšwego tša tlhahlo ya balemi go tšwa ka yunibesithi le mabaka ao a huetšago go amogelega ga tlhahlo ya balemi go tšwa ka yunibesithi; go tseba gore ke lenaneo(mananeo) lefe la tlhhalo ya balemi la go tšwa ka yunibesithi leo balemi ba le ratago, gammogo le mabaka ao a huetšago kgetho ya ona; go tseba mabaka a gore ke ka lebaka la eng balemi ba rata mananeo ao a fapanego a kabo ya tlhahli ya balemi; go tseba maikutlo a balemi ka ga mokgwa wa maleba wa thušo ya ditšhelete wa ditirelo tša tlhahlo ya balemi go tšwa

ka yunibesithi; le go tseba go nyaka ga balemi go lefa ditirelo tša tlhahlo ya balemi go tšwa ka yunibesithi, gammogo le mabaka ao a huetšago kgetho ya bona.

Sampole ya balemi ba 442 go tšwa ka Gauteng bao ba bego ba hwetša ditirelo tša tlhahlo le keletšo ya balemi go tšwa mmušong ba kgethilwe ka sewelo gore ba kgathe tema ka dinyakišišong. Ka go šomiša setlabelo sa dinyakišišo sa dipotšišo tša go nyaka gore baarabi ba hlatholle, tshedimošo ya motheo e kgobokeditšwe ka go dira dipoledišano tša sebele. Tshedimošo ya bontši e ile sekasekwa ka dipalopalo tša tlhathollo, mokgwa wa dikamanyo tša tshedimošo (PAF), kamanyo ya *Kendall tau*, mokgwapoelomorago ya kgokaganyo (BLR), mokgwapoelomorago ya karolo ka bontši (MLR), mokgwapoelomorago ya dipalontši (MNLR), mokgwapoelomorago wa tatelanyakgokaganyo (OLR), teko ya *Cochran's Q*, teko ya McNemar le teko ya payonomiale yeo e hwetšwago ka go Sehlopha sa Dipalopalo sa IBM sa Sengwalwa sa Dipalopalo sa Dithutamahlale tša Leago (SPSS) bešene ya 27. Tshedimošo ya bontši e ile ya sekasekwa ka go šomiša dikhoute, merero le dilaetši gomme ya fetošetšwa go difrekhwentshi le go dipersente. Dipoelo tšeo di hweditšwego mabapi le seemo sa ekonomi ya setšhaba le sa dipalopalo ka ga baarabi di laeditše gore bontši bja baarabi ba be ba le basadi ba bathobaso bao ba bego ba na le mengwaga ya ka godimo ga ye 35, ban a le palogare ya mengwaga ye tshela ya maitemogelo a bolemi, ba be ba bolela Sesotho sa Borwa ebile ba na le thekgo ya balekane ka lenyalong le go dula mmogo. Bontši bja balemi ba be ba lema ka mafelong a mannyane mabakeng a go se rekiše ditšweletšwa tša bona – palogare ya bogolo bja polasa/pholoto e le dihekthara tše 4.55 – le go ba dinageng tša dipoloasa tša setšhaba le tšeo di rentišitšwego. Ka kakaretšo, baarabi ba be ba hwetša palomoka ya letseno la tšhelete ye e ka bago R21 387.56 go tšwa go bolemi ka ngwaga ebile ba na le methopo ya mehutahuta ya letseno. Balemi ba bagolo le bao ba rutegilego kudu ba hwetša letseno le lentši go tšwa go bolemi, mola e le gore balemi bao ba bego ba etelwa kgafetšakgafetša ke bahlankedi ba tlhahlo ya balemi bas a hwetše letseno le lentši. Go hweditšwe gore tekano ya go nyaka go ba seripagare sa baarabi ba bile le phihlelelo go ditirelo tša tlhahlo ya balemi go tšwa go methopo ya mehutahuta ka ntle le mmušo, go swana le mekgatlo ya ditšweletšwa, meepo, mebasepala ya selegae, mekgatlo ye e sego ya mmušo le diyunibesithi. Ka kakaretšo, baarabi ba be ba le dikhilometara tše di ka bago tše 42.4 kgole le dikantoro tša tlhahlo ya balemi, gomme bontši bja dipolasa di be di le dikhilometara tše ≤50 kgole le dikantoro tšeo. Ka lebaka la se, baarabi ba be ba etelwa ka kakaretšo gabedi ka kgwedi ke bahlankedi ba tlhahli ya balemi, gomme balemi bao ba bego ba tshephile kudu letseno go tšwa ka polaseng go tšwetša pele go iphediša ga bona le bao ba bego ba kgotsofetše ka boleng bja ditirelo tša tlhahlo le tša keletšo ya balemi ba be ba hwetša diketelo tše ntši mo kgweding. Le ge go le bjale, balemi bao ba bego ba dira dipoelo tše ntši ba hweditše diketelo tše mmalwa ka kgwedi. Tekano ye e ka bago 51.1% ya baarabi ba be ba kgotsofetše ka boleng bja ditirelo tša tlhalo le tša keletšo ya balemi, gomme bona ba be ba akaretša balemi bao ba bego ba etelwa kgafetšakgafetša ke bahlankedi ba tlhahlo ya balemi, balemi ba tša kgwebo le balemi bao ba bego ba bona ditirelo tša tlhahlo ya balemi bjalo ka tšeo di šomago gabotse go obamela molawana wa Batho Pele go šoma le batho le go beakanya mešomo.

Dipoelo tšeo di hweditšwego mabapi le go šoma gabotse ga ditirelo tša tlhahlo le keletšo ya balemi di laeditše gore bontši bja baarabi ba be ba na le maikutlo a gore ditirelo tšeo ga di šome gabotse. Balemi bao ba rutegilego kudu, balemi bao ba tšofetšego, balemi bao ba bego ba etelwa kgafetšakgafetša ke bahlankedi ba tlhahlo ya balemi le balemi bao bao bego ba kgotsofetše ka boleng bja ditirelo ba bone gore ditirelo tša tlhahlo le keletšo ya balemi di šoma gabotse. Godimo ga fao, tshekatsheko ya kutollo ya mabaka e laeditše gore ditirelo tša tlhahlo le keletšo ya balemi yeo e abago ditirelo tša maleba le tše kaone, tshedimošo yeo e kaonafaditšego tšweletšo ya tša temo le phihlelelo ya ditheknolotši e bonwe bjalo ka yeo e šomago gabotse ke balemi. Dinyakišišo di utollotše gore lenaneo la go hlahla balemi go ya ka dinyakwa tša bona leo le akaretšago mmušo le diyunibesithi ke leo le bego le phethagatšwa go ya ka ge le nyakwa ka lebaka la gore bontši (91.2%) bja balemi bo amogetše kakaretšo ya tlhahlo ka diyunibesithi ka gare ga lenaneo la go hlahla balemi go ya ka dinyakwa tša bona, le ge e le gore bontši bja bona ga ba tsebe diyunibesithi tšeo di abago mananeo a tša temo ka mo lefapheng le la dinyakišišo. Bontši bja baarabi ba ratile lenaneo la tlhahlo ka diyunibesithi ka lebaka la dikholego tša mehutahuta leo le fanago ka tšona, go swana le phihlelelo ye kaone go ditirelo tša tlhahlo le keletšo ya balemi; phihlelelo go thuto le tlhahlo tša semmušo; le sebaka sa go hwetša keletšo go tšwa go ditsebi le go tšwa go ba bangwe. Dipoelo tša BLR di laeditše gore balemi bao ba dirago poelo ye kgolo go tšwa go dikgwebo tša bona tša temo ebile ba bona kamano ya bona le diyunibesithi bjalo ka sebaka sa go fihlelela thušo ya dinyakišišo ba ile ba amogela go akaretšwa ga diyunibesithi ka go lenaneo la tlhahlo ya balemi go ya ka dinyakwa tša bona. Godimo ga fao, mabaka a mararo a bohlokwa ao a amanago le go amogelega ga tlhahlo ka diyunibesithi ao a hweditšwego go tshekatsheko ya kutollo ya mabaka e bile phihlelelo go methopo ya dinyakišišo, ditirelo le tlhahlo ya balemi tšeo di kaonafetšego, le go phatlalatšwa ga dinyakišišo tša ka yunibesithi. Dikutollo tša dinyakišišo di laeditše gore bontši bja balemi (56.8%) ka lekaleng le la dinyakišišo le ratile lenaneo la phethagatšo ya tlhahlo ya balemi leo le akaretšago tlhahlo ya setšhaba ka tša temo bjalo ka mokgwa wa kgokaganyo magareng ga balemi le diyunibesithi (lenaneo la kabo ya tlhahlo ya balemi–tlhahlo ya setšhaba–ka diyunibesithi). Lenaneo leo go bolelwago ka lona le be le ratwa kudukudu ka gobane le tla kgontšha balemi go hwetša tshedimošo ka botlalo go tšwa go methopo ya mehutahuta le go tšwetša pele kamano le mmušo. Dipoelo tša MNLR di aleditše gore balemi bao ba bego ba dira poelo ye kgolo go dikgwebo tša bona tša temo ba ratile lenaneo la kabo ya tlhahlo ya balemi–tlhahlo ya setšhaba–ka diyunibesithi go feta lenaneo la tlhahlo ya balemi ka yunibesithi. Tekano ye e ka bago seripagare sa baarabi e nyakile go hwetša ditirelo tša tlhahlo ya balemi go tšwa ka diyunibesithi mafelong a bona a temo, mola e le gore karolo ye nngwe ya balemi e be e arogane magareng ga bao ba nyakago go etela diyunibesithi fela le bao ba kgethilego mafelo ka bobedi (diyunibesithi le mafelo a temo). Gape, bontši bja balemi (41.9%) ba nyaka go hwetša ditirelo tša tlhalo le keletšo ya balemi go tšwa ka diyunibesithing ka dipolelo tša bona tša ka gae. Mabapi le thušo ya ditšhelete, go hweditšwe gore bontši (55.4%) bja balemi, kudukudu bao ba tshephilego bolemi bjalo ka letseno la bona le legolo, ba be ba nyaka go lefa ditirelo tša tlhahlo ka diyunibesithi. Le ge go le bjale, balemi ba kgwebo le bao ba lego kgole le dikantoro tša tlhahlo ya balemi ba be ba sa nyake goba go na le kgonagalo ye nnyane ya gore ba ka lefela ditirelo tša tlhahlo ka diyunibesithi, ka ge go laeditšwe ke dipoelo tša BLR. Le ge go le bjale, bontši (91%) bja baarabi ba dumetše gore mmušo o swanetše go aba thušo ya ditšhelete tša dinamelwa, diputseletšo tša bašomi ba yunibesithi, thušo ya tša kalafo (fao go hlokagalago), Sekhwama sa ba go Lebogišwa Mešomong (UIF) le ditefelo tša tšhelete ya phenšene (ge go kgonagala), dikantoro (ge di nyakega), ditlabelo tša dikantoro le fenišara, theknolotši ya tshedimošo le dikgokagano (ICT), setešenari, mananeo a tlhahlo a balemi le dinyakišišo tša ditirelo tša tlhahlo tša yunibesithi. Ka fao, balemi ba emetše gore mmušo o abe thušo ya ditšhekete go bontši bja ditirelo tša tlhahlo ka diytunibesithi.

Go kaonafatša go šoma gabotse ga ditirelo tša tlhahlo le keletšo ya setšhaba, go šišinywa gore badiredi ba ditirelo tša tlhahlo ya setšhaba ba fane ka ditirelo tša maleba, tša boleng bjo bokaone le go fana ka tshedimošo yeo e kaonafatšago tšweletšo ya temo le go nolofatša phihlelelo go ditheknolotši tšeo di nyakwago ke balemi. Godimo ga fao, go šišinywa gore motheo wa semmušo wa lenaneo la tlhahlo ya balemi go ya ka fao ba nyakago ka gona le hlongwe ka go diriša tshepedišo ya go kgatha tema ga ga makala a mangwe go akaretšwa Kgoro ya Thuto le Tlhahlo ya Godingwana, Kgoro ya Temo, balemi, diyunibesithi le batšeakarolo ba bangwe. Motheo wa lenaneo la tlhahlo ya balemi go ya ka fao ba nyakago ka gona o swanetše go kgontšha diyunibesithi go fana ka methopo ya dinyakišišo go balemi; go kaonafatša phihlelelo go ditirelo tša thušo ya balemi le go hlahla balemi; le go hlama sefala sa go phatlalatša dipoelo tša dinyakišišo tša yunibesithi go ya go balemi. Lenaneo la kabo ya tlhahlo ya balemi leo le akaretšago tlhahlo ya setšhaba bjalo ka mokgwa wa kgokaganyo le swanetše go ba lenaneo le legolo la tlhahlo ka yunibesithi. Ditirelo tša tlhahlo ka yunibesithi di swanetše go abja kudukudu ka mafelong a temo (ka dipolaseng) ka go šomiša dipolelo tša ka gae tša Afrika Borwa. Mmušo o swanetše go aba bontši bja thušo ya ditšhelete tša mabapi le dinamelwa, palomoka ya letseno, thušo ya kalafo, ditefelo tša UIF le tša phenšene, dikantoro, ditlabelo tša dikantoro le fenišara, theknolotši ya tshedimošo le dikgokagano (ICT), setešenari, mananeo a tlhahlo a balemi le dinyakišišo tša ditirelo tša tlhahlo tša yunibesithi. Godimo ga fao, balemi, diyunibesithi le mekgatlo ya balemi ba swanetše go lefa tšhelete ye go kwanwego ka yona ya ditirelo tša tlhahlo ka diyunibesithi.

MANTŠU A BOHLOKWA: Tlhahlo ya setšhaba, ditirelo tša keletšo, boleng, go šoma gabotse, tlhahlo ya balemi go ya ka fao ba nyakago ka gona, tlhahlo ya balemi ka diyunibesithi, lenaneo la kabo ya tlhalo ya balemi, thušo ya ditšhelete

AFRIKAANS ABSTRACT (OPSOMMING)

In talle lande bevorder pluralistiese voorligtingstelsels waarby verskeie belanghebbendes betrokke is, die doeltreffendheid van en toegang tot voorligting en adviesdienste. Universiteite wat landboukursusse aanbied, kan volgens sommige sektore in die samelewing saam met die regering voorligting en adviesdienste lewer omdat hulle deur navorsing en onderrig kennis genereer. Dit is egter onbekend of boere te vinde sal wees vir ŉ pluralistiese voorligtingstelsel waarby universiteite betrokke is. Die doel van hierdie studie was om vas te stel of boere in die Gautengprovinsie universiteite se landbouvoorligting as deel van ŉ pluralistiese voorligtingstelsel sal aanvaar, en of daar ŉ vraag na sodanige voorligtingsdienste is. Die oogmerke van hierdie studie was ten eerste om ŉ sosiaal-demografiese profiel saam te stel van boere in Gauteng wat openbare landbouvoorligting en adviesdienste ontvang. Ten tweede om boere se siening van openbare landbouvoorligting en adviesdienste te bepaal, in die besonder hulle siening van die gehalte van voorligtingsdienste asook die faktore wat dit beïnvloed, en hoe gereeld boere toegang tot openbare voorligtingsdienste het en faktore wat dit bepaal. Ten derde om boere se toegang tot die hulpbronne van voorligtingsdienste vas te stel. Vierdens om boere se siening van die doeltreffendheid van openbare landbouvoorligting en adviesdienste en die redes daarvoor te bepaal. Vyfdens om vas te stel of boere universiteite se landbouvoorligting as deel van ŉ pluralistiese voorligtingstelsel sal aanneem, met verwysing na hulle aanvaarding van die voordele van universiteite se landbouvoorligting en die faktore wat dit bepaal. In die sesde plek om vas te stel watter universiteitsvoorligtingstelsel(s) boere verkies, en watter faktore hulle voorkeur bepaal. In die sewende plek om die vas te stel waarom boere verskillende universiteitsvoorligtingstelsels verkies. Die agtste doelwit was om boere se siening van ŉ geskikte befondsingsmodel vir universiteitsvoorligtingsdienste te bepaal. Die laaste oogmerk is om vas te stel of boere bereid is om vir universiteitsvoorligtingsdienste te betaal asook die faktore wat hulle bereidwilligheid beïnvloed.

ŉ Steekproef is lukraak geneem van 442 boere in Gauteng wat voorligting en adviesdienste van die regering ontvang. Die primêre data is met behulp van ŉ

halfgestruktureerde meningspeiling tydens onderhoude onder vier oë ingesamel. Die kwantitatiewe data is onderwerp aan ŉ beskrywende statistiese ontleding; hoofasfaktorering (HAF); Kendall se taukorrelasie; binêre logistiese regressie (BLR); meervoudige lineêre regressie (MLR); polinome logistiese regressie (PNLR); geordende logistiese regressie (OLR); Cochran se Q-toets; McNemar se toets; en die binome toets in die *IBM Statistical Package for Social Sciences* (SPSS) weergawe 27. Die kwantitatiewe data is aan die hand van kodes, temas en aanwysers ontleed en na frekwensies en persentasies herlei. Volgens die resultate wat behaal is ten opsigte van hulle sosiaal-ekonomiese en demografiese kenmerke, was die meeste respondente swart vroue van ouer as 35. Hulle het gemiddeld ses jaar ondervinding van boerdery gehad, was Suid-Sothosprekers en was getroud of het saam met ŉ man gebly. Die meeste van hulle het om niekommersiële redes op ŉ klein skaal – die gemiddelde grootte van hulle plasies of kleinhoewes is 4,55 ha – op gemeenskaplike of gehuurde grond geboer. Hulle het ŉ gemiddelde netto inkomste van nagenoeg R21 387,56 per jaar uit boerdery verdien, en op verskillende inkomstebronne staat gemaak. In teenstelling met grootskaalse en hoogs opgeleide boere, het hierdie boere, wat gereeld besoek van voorligtingsbeamptes ontvang, nie ŉ groot inkomste uit boerdery verdien nie. Sowat die helfte van die respondente kry toegang tot voorligtingsdienste uit verskillende bronne benewens die regering, soos landbouprodukorganisasies, myne, plaaslike munisipaliteite, nieregeringsorganisasies en universiteite. Die naaste openbare voorligtingskantoor was gemiddeld 42,4 km ver, en die meeste respondente se landbougrond was minder as 50 km vanaf ŉ voorligtingskantoor geleë. Gevolglik besoek openbare voorligtingsbeamptes respondente gemiddeld twee keer per maand. Boere wat ŉ bestaan uit boerdery maak en tevrede was met die openbare voorligting en adviesdienste, het egter meer besoeke per maand ontvang. Respondente wat ŉ aansienlike wins gemaak het, is egter minder kere per maand besoek. Sowat 51,1% van die respondente was tevrede met die gehalte van openbare voorligting en adviesdienste. Boere wat gereeld deur voorligtingsbeamptes besoek word, kommersiële boere en boere wat van mening was dat openbare voorligtingdienste wat deur hulle hulp en aktiwiteite die Batho Pele-beginsel nastrewe, word hierby ingereken.

Wat die boere se siening van die doeltreffendheid van openbare voorligting en adviesdienste betref, toon die uitslag dat die meeste respondente van mening was dat die dienste ondoeltreffend is. Hoogs opgeleide boere, ouerige boere, boere wat gereeld besoek van voorligtingbeamptes ontvang, en boere wat tevrede is met die gehalte van dienste, het te kenne gegee dat die openbare voorligting en adviesdienste doeltreffend was. Afgesien hiervan was openbare voorligting en adviesdienste volgens die verkennende faktorontleding relevant en van ’n goeie gehalte. Boere het laat blyk dat die inligting wat landbouproduksie laat toeneem en hulle toegang tot tegnologie verbeter, doeltreffend was. Hierdie studie het bevind dat daar inderdaad ’n vraag na pluralistiese voorligting deur die regering en universiteite bestaan, aangesien 91,2% van die boere, wat ’n oorweldigende meerderheid is, ten gunste was van die insluiting van universiteitsvoorligting by ’n pluralistiese voorligtingstelsel, ofskoon die meeste nie bewus was van universiteite in Gauteng wat landboukursusse aanbied nie. Die meeste respondente was ten gunste van universiteitsvoorligting vanweë die voordele wat dit inhou, soos beter toegang tot voorligting en adviesdienste, tot formele onderwys en tot opleiding asook vak- en ander spesialiste. Die uitslag van die BLR het getoon dat boere wat ’n groot wins uit hulle landboubedrywe maak en hulle verbintenis met universiteite beskou as ’n geleentheid om fondse vir navorsing te bekom, die insluiting van universiteite by ’n pluralistiese voorligtingstelsel aanvaar het. Hierbenewens is drie faktore rakende die aanvaarding van universiteite se insluiting uit die verkennende faktorontleding verkry, naamlik toegang tot navorsingshulpbronne, beter voorligtingsdienste en opleiding, en die verspreiding van universiteite se navorsing. Volgens die bevindings verkies 56,8% van Gautengse boere ’n leweringstelsel waarvolgens openbare voorligting ’n manier is om boere en universiteite te koördineer (’n leweringstelsel bestaande uit boere, openbare voorligting en universiteite). Boere het hierdie stelsel verkies omdat hulle sodoende meer inligting uit verskeie bronne kon inwin en betrekkinge met die regering kon handhaaf. Die resultate van die PNLR dui daarop dat boere wat ’n aansienlike wins uit hulle landboubedrywe maak, ’n leweringstelsel bestaande uit boere, openbare voorligting en voorligting deur universiteite verkies het bo ’n leweringstelsel bestaande uit boere en universiteitsvoorligting. Nagenoeg die helfte van die respondente het verkies om universiteitsvoorligtingsdienste op hulle boerderye te ontvang. Die ander helfte was dit oneens. Sommige boere het slegs besoeke aan universiteite verkies, terwyl ander weer besoeke aan sowel universiteite as hulle boerderye verkies het. Die meeste boere (41,9%) het verkies om universiteite se voorligting en adviesdienste in hulle eie taal te ontvang. Wat befondsing betref, was die meerderheid (55,4%), in die besonder boere vir wie boerdery hulle belangrikste inkomstebron was, bereid om vir universiteitsvoorligting te betaal. Kommersiële boere en boere vir wie openbare voorligtingskantore ver weg was, was egter volgens die uitslag van die BLR onwillig om vir universiteite se voorligtingsdienste te betaal. Die meeste respondente (91%) was dit eens dat die regering moet instaan vir vervoerkostes, die toelaes van universiteitspersoneel, mediese fondse (as dit nodig is), die Werkloosheidsversekeringsfonds (WVF), pensioenfondsbydraes (as dit toepaslik is), kantoorruimte (as dit nodig is), kantoortoerusting en -meubels, inligting- en kommunikasietegnologie (IKT), skryfbehoeftes, opleidingsprogramme vir boere en navorsing vir universiteitsvoorligtingsdienste. Kortom, boere het verwag dat die regering universiteite se voorligtingsdienste grotendeels befonds.

Ten einde die doeltreffendheid van openbare voorligting en adviesdienste te verbeter, word aanbeveel dat voorligtingsagente ŉ toepaslike, uitnemende diens lewer en dat hulle inligting nie alleen landbouproduksie nie, maar ook boere se toegang tot tegnologie verbeter. Voorts word aanbeveel dat ŉ raamwerk vir ŉ pluralistiese voorligtingstelsel ontwikkel word deur die Ministerie van Hoër Onderwys en Opleiding; die Ministerie van Landbou; boere; universiteite en ander belanghebbendes. Universiteite moet volgens hierdie raamwerk hulle navorsingshulpbronne aan boere beskikbaar kan stel, boere se toegang tot voorligtingsdienste kan verbeter, boere kan oplei en ŉ platform kan skep om hulle navorsingsuitkomste aan boere beskikbaar stel. ŉ Voorligtingleweringselsel waarby openbare voorligting betrek word om koördinering te vergemaklik, moet die hoofstelsel van universiteitsvoorligting word. Universiteite moet oorwegend in landbougebiede (boerderye) en in die inheemse tale voorligting gee. Die regering moet fondse bewillig vir vervoer, ŉ bruto inkomste, mediese hulp, bydraes tot die WVF en pensioenfondse, kantoorruimte en -toerusting, IKT, skryfbehoeftes, opleiding vir boere en navorsing met die oog op landbouvoorligting. Laastens moet boere, universiteite en boereorganisasies ooreenkom op ŉ tarief vir die voorligtingsdienste wat universiteite lewer.

SLEUTELBEGRIPPE: Openbare voorligting, adviesdienste, gehalte, doeltreffendheid, pluralistiese voorligting, universiteitsvoorligting, voorligtingleweringstelsel, befondsing

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Farmer's perceptions of effectiveness of public agricultural extension services in South Africa: an exploratory analysis of associated factors

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Abstract

Background: Effective public extension and advisory services have the potential to improve agricultural productivity; net farm income; and food security amongst resource-poor farmers. However, studies conducted to measure the effectiveness of extension and advisory services, offered by the Government of South Africa, have focused on the methods used, instead of the guiding principles, such as demand-driven services; equity; prioritization of farmer's needs; and social and human capital development. The aim of this research paper was to determine farmers' perceptions regarding the effectiveness of public extension and advisory services and associated factors. Perceptions of the effectiveness were measured using sixteen variables. A group of 442 farmers, in the Gauteng province, receiving government agricultural extension and advisory services, were randomly selected to participate in the study. Using a semi-structured survey instrument, primary data was collected through physical interviews and then analysed using computer software.

Results: The study found that public extension and advisory services in Gauteng were perceived as ineffective. Three socio-demographic factors (education level, age and farm/plot size) significantly influenced farmer's perceptions towards public extension and advisory services. Moreover, the Principle Axis Factoring (PAF) results indicated that there were three underlying factors of the perceived effectiveness of public extension services, namely: relevance and good quality services; provision of information on improving agricultural production; and availability of the technologies required by farmers.

Conclusions: Large-scale farmers perceived public extension services to be less effective. The exploratory factor analysis extracted three underlying factors which accounted for 81.81% of the variance of the perceived effectiveness of public extension services. Farmers recommended that public extension and advisory services should be of good quality; relevant; and should improve agricultural production to be considered as effective by the farmers. Moreover, provision of extension and advisory services should be determined by farm/plot size.

Keywords: Effectiveness, Extension, Factor analysis

Background

Agricultural extension is a source of information for most farmers with low literacy levels and poor access to Information and Communication Technology (ICT) in developing countries. Through access to extension and advisory services, farmers receive diverse information

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FOOD SCIENCE & TECHNOLOGY | RESEARCH ARTICLE

Determinants of the acceptability of university agricultural extension in the Gauteng province of South Africa

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Abstract: Universities offering agricultural programmes have the potential to complement public agricultural extension and advisory services because they are at the centre of knowledge generation—through research, teaching and community outreach programmes. The purpose of this study was to determine farmers' acceptability of university agricultural extension and the factors influencing their decision. Using probability sampling, a sample of 442 participants from Gauteng Province were selected for inclusion in the survey to collect data through face-to-face interviews. Primary data were subjected to descriptive statistical analysis and Exploratory Factor Analysis (EFA) found in IBM SPSS version 27. The results showed that a significant proportion of the respondents favoured the introduction of university agricultural extension to complement public extension services as part of a pluralistic extension system. Furthermore, most of the farmers were willing to pay for extension services and were optimistic about the perceived benefits of associating with universities. The exploratory factor analysis revealed that access to research resources, improved extension services and training, and diffusion of university research were the three factors underlying the acceptability of university agricultural extension. It is suggested that a formal framework for pluralistic extension system should be developed through a participatory process that involves all stakeholders.

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LIST OF ACRONYMS AND ABBREVIATIONS

AD	Anno Domini
ADRA	Adventist Development and Relief Agency
AGRA	Alliance for a Green Revolution in Africa
AIS	Agricultural Innovation Systems
ANOVA	Analysis of Variance
AKIS)	Agricultural Knowledge and Innovations Systems
ARC	Agricultural Research Council
ASAWA	Association for the Advancement of Women in Africa
ATMA	Agricultural Technology Management Agency
BC	Before Christ
BCE	Before the Common Era
BLR	Binary Logistic Regression
CADECOM	Catholic Development Commission
CARD	Churches Action in Relief and Development
CAES	College of Agriculture and Environmental Sciences
CIAT	International Centres for Tropical Agriculture
CV	Coefficient of Variation
CVM)	Contingent Valuation Method
DF	Degrees of Freedom
DoA	Department of Agriculture
DAFF	Department of Agriculture, Forestry and Fisheries
DALRRD	Department of Agriculture, Land Reform and Rural Development
DEC	Development Education Centre
DW	Durbin Watson
EU	European Union
EFA	Exploratory Factor Analysis
FUGs	Fadama User Groups
FUAs	Fadama Users Associations
FAO	Food and Agriculture Organization of the United Nations
EU	European Union
FADU	Farmers Development Union

FDGs	Farmers Development Groups
FSR	Farming Systems Research
FO	Farmers organisations
FBO	Farmer-Based Organisation
FFS	Farmer Field School
FITSE	Finance Trust for Self Employed
GDARD	Gauteng Department of Agriculture and Rural Development
GDP	Gross Domestic Product
ICT	Information and Communication Technology
ICAR	Indian Council of Agricultural Research
ICRAF	International Centre for Research in Agroforestry
IQR	Interquartile Range
GM	Genetically Modified
JSTOR	Journal Storage
KMO	Kaiser-Meyer-Olkin
KZN	KwaZulu Natal
MRD	Minimum Required Difference
MNLR	Multinomial Logistic Regression
MLR	Multiple Linear Regression
NGO	Non-Governmental Organisation
NPO	Non-Profit Organisation
NRF	National Research Fund
OLR	Ordered Logistic Regression
OLS	Ordinary Least Square
PAF	Principal Axis Factoring
PCA	Principal Component Analysis
PLAS	Proactive Land Acquisition Strategy
PLOS	Public Library of Science
PVAF	Percentage of Variance-Accounted-For
PRA	Participatory Rural Appraisal
PTD	Participatory Technology Development
SADC	Southern African Development Community
SAU	State Agricultural Universities

SciELO	Scientific Electronic Library Online
SPSS	Statistical Package for the Social Sciences
Stats SA	Statistics South Africa
SSA	Sub-Saharan African
USA	United States of America
TV	Television
T&V	Training and Visit
TOT	Transfer of Technology
UIF	Unemployment Insurance Fund
UK	United Kingdom
UNISA	University of South Africa
VIF	Variance Inflation Factor
WIA	Women in Agriculture
WVI	World Vision International
WOFAN	Women's Farmers Advancement Network
ZAR	South African Rand

CHAPTER 1: ORIENTATION OF THE STUDY

1.1 BACKGROUND

In most countries throughout the world, government has been the main provider of agricultural extension services (Cary, 1993; Kidd *et al*., 2000; Anderson & Feder, 2004; Ajayi, 2006; Magoro & Hlungwani, 2014; Maoba, 2016). One of the reasons that the government is highly involved in rendering extension services, is to ensure that farmers receive the support which will enable them to produce adequate and quality produce, and thus enabling the country to be food secure. Therefore, effective public extension services plays an important role in agricultural sustainability and food security of a country. However, there has been criticism about public agricultural extension services in many countries. The main criticism towards public agricultural extension services is that it is not effective, and unresponsive to the needs of the farmers or communities (Kidd *et al*., 2000; Qamar, 2005; Mutimba, 2014). Makapela (2015) found that public agricultural extension services were ineffective in prioritising development programmes that alleviate poverty; implementing short and medium-term goals; providing resources; and the ratio of extension officers to farmers. Maoba (2016) also reported that public extension services were ineffective in facilitating workshops, sharing information through printed material; and communicating through telephones. The quality of public extension services is one of the challenges that have also been raised by some of the farmers (Sharmin, 2012). For example, Mmbengwa *et al*. (2012) reported that nearly half of the farmers in the West Coast District Municipality in South Africa considered the quality of public extension services poor. Furthermore, Agholor *et al*. (2013) reported that more than half (>50%) of male farmers in the Amathole District in South Africa were not satisfied with the quality of timelines of delivery and the accuracy of extension services rendered by government. Kabir *et al*. (2020) reported that most farmers are not satisfied with the quality of public extension services, with specific reference to content offered, accuracy and relevance, timelines, efficiency, and feedback provided. In addition, Kassem *et al*. (2021) also discovered that farmers in Egypt were dissatisfied with the quality of some of the services rendered by government extension officers. Most of the studies cited above showed that farmers were not satisfied with extension services because they did not respond to their needs and failed to solve their problems. This is a concern because the quality and effectiveness of extension services influences agricultural productivity on the farms. If farmers do not receive extension services of good quality, their agricultural outputs are more likely to be lower, and they become food insecure due to loss of production and income.

Many countries have been reforming their public extension services because they are struggling to meet the demand for services due to high costs, limited resources, changes in extension philosophies or approaches, and slow increase in public funding activities (Picciotto & Anderson, 1997; Anderson & Feder, 2004; Afful & Lategan, 2014). In some countries, reforms are propagated by financial discipline implemented by the state; and agricultural extension has become a victim (Bennett, 1996; Kidd *et al*., 2000; Qamar, 2005). Generally, the main purpose of these reforms is to ensure that farmers are provided with the best agricultural extension services that are financially sustainable (Kidd *et al*., 2000; Afful & Lategan, 2014). Countries have come up with agricultural extension reform strategies; these reforms are either market or non-market strategies (Rivera *et al*., 2000; Laurent *et al*., 2006). Market reforms include pluralism, cost recovery, total privatisation and revision of public-sector extension services, while non-market reforms comprise decentralisation/devolution (transferring power to local government) and subsidiary (Rivera *et al*., 2001). In general, market reforms are adopted in developed countries, whereas non-market reforms are common in developing countries – mainly because most developing countries are not willing to pay for agricultural extension services that form part of market reform (Qamar, 2005; Foti *et al*., 2007; Ali *et al*., 2008; Oladele, 2008; Afful, 2012).

Agricultural extension reforms have yielded positive results in some countries but failed in others. In general, participatory reforms have been successful compared to fee-for-service, especially in low-income countries where there has been evaluation of the reforms (Davis, 2008). Participatory extension reforms have succeeded because they involve farmers and various stakeholders in planning and decision-making. On the other hand, fee-for-service extension systems may have failed because farmers cannot afford to pay for the services due to the low income earned from agricultural activities. For example, the willingness of the farmers to pay for extension services has been reported to be positively and significantly correlated with income (Ajayi, 2006; Oladele, 2008; Uddin *et al*., 2016; Loki *et al*., 2019; Shausi *et al*., 2019). Therefore, farmers with low farm income are reluctant to pay for extension services and/ they are likely to contribute less. Globally, the reform of agricultural extension has shifted towards pluralistic extension delivery systems (Nahdy *et al*., 2002; Rivera & Alex, 2004; Gemo *et al*., 2013; Knierim *et al*., 2017; Masangano *et al*., 2017; Alimirzaei *et al*., 2019). A pluralistic extension system is about the provision of extension services by different organisations such as government, private sector and non-profit organisations (Klerkx & Proctor, 2013; Phillipson *et al.*, 2016). Moreover, the system acknowledges the need to alleviate farmers' challenges using different approaches because of the diversity of the farming systems used by different farmers (Gemo *et al*., 2013).

In South Africa, the pluralistic extension system includes stakeholders such as government through the Ministry of Agriculture, agricultural cooperatives (farmer organisations), commodity organisations and the private sector (Zwane; 2009; Koch & Terblanché, 2013). Moreover, Zwane (2009) reported that research organisations, academic institutions, farmers' unions and non-governmental organisations provide extension services to the farmers in South Africa. However, government is the main service provider of agricultural extension services in South Africa (Zwane, 2009; Magoro & Hlungwani, 2014; Motiang & Webb, 2015; Nkosi, 2017). Private agricultural extension services are profit driven and thus exclude poor farmers (Koch & Terblanché, 2013). This means that extension services rendered by the private sector are only accessible to commercial large-scale farmers and highly profitable agricultural enterprises. However, farmers' unions and commodity organisations provide services to the farmers affiliated to them. Parallel to that, it is not mandatory for academic institutions such as universities to render agricultural extension services in South Africa. The provision of agricultural extension services by universities occurs at a limited scale through community engagement and outreach programmes. Nonetheless, from a societal perspective, university agricultural extension appears to be an attractive complement to public extension in South Africa. Universities may provide a viable option for pluralistic extension system because they are public funded; besides, most South African universities offer agriculture and life sciences programmes. Again, university agricultural extension services can be accessible to poor farmers if there is a government framework for pluralistic extension delivery system involving universities.

1.2 PROBLEM STATEMENT

In South Africa, the reform of agricultural extension started in 1994, after the new, democratically elected government came into power. The reform was aimed at correcting the dualistic agricultural extension services created by the apartheid government (Department of Agriculture, 2005; Düvel, 2004; Phuhlisani, 2008; Ngomane, 2010; Koch & Terblanché, 2013). The reform changed agricultural extension services in South Africa from dualistic services (separate services for commercial and small-scale farmers) to amalgamated services focused on both small-scale farmers and large-scale commercial farmers after 1994 (Department of Agriculture, 2005; Koch & Terblanché, 2013). The amalgamated system increased the number of extension personnel and improved access to extension services amongst black farmers who were previously disadvantaged by the dualistic agricultural extension. For example, Phuhlisani (2008) found that South Africa had about 2 155 extension agents in January 2007; about a year later, the number of extension officers increased to 2 800 (Williams *et al*., 2008). Few years later, it was reported that South Africa has about 3 369 extension officers employed by government in various provinces (Ngaka & Zwane, 2018). Despite the high number of extension agents in the country, Agricultural Research Council (ARC) reported that the average ratio of extension officer to farmers was 1:873, which is above government's recommended ratio (ARC, 2011). According to the Department of Agriculture, Forestry and Fisheries (DAFF, 2016), the low extension to producer ratio is due to the rapid increase in the number of smallholder farmers accessing land through land reform programmes and lack of clear definition of the target recipients of extension services (DAFF, 2016). As a results, there is assumption that all rural people are involved in agricultural production and entitled to public extension and advisory services. Because of the change in policies that governed agricultural extension services in South Africa in the post-apartheid government era, small-scale farmers started to depend heavily on public extension services as they could not afford private extension services (Ngomane, 2002). This change in policy created a burden on the public extension system because there were high expectations from government extension services. It has been reported that South African public extension services are not coping with the demand for extension services because the support provided to small-scale and resource-poor farmers is limited; this is hindering their aspirations to develop from emerging into commercial farmers (Phiri, 2009). As a result, these farmers are not satisfied with the public extension services (Ngomane, 2000; Phiri, 2009; Agholor *et al*., 2013). Therefore, there is a need to reform agricultural extension services in South Africa to improve the quality and effectiveness of the extension and advisory services rendered to the farmers.

Düvel (2005) suggested that there should be a wider partnership of extension and advisory services involving various stakeholders such as farmers, municipalities, non-governmental organisations and the private sector to address and boost the efficiency of services to farmers. Studies conducted in South Africa have shown that there are various organisations involved in the provision of extension services in South Africa (Zwane; 2009; Koch & Terblanché, 2013; Nkosi, 2017); thus, there is pluralistic extension system in the country. Similarly, the revised South African National Extension and Advisory Services policy advocate for pluralistic extension system involving the collaboration of various organisations (DAFF, 2016). The policy promote the participation and collaboration between organisations such as government, private sector, NPOs, producer and community organisations, and academic and agricultural development institutions. Although institutions of higher learning (universities) are listed as some of the organisations involved in the provision of extension services, there is no framework for university extension as part of pluralistic extension system. As a result, there is low participation of South African universities in the provision and extension and advisory services. This is mainly because universities are not obliged to render extension and advisory services to the farmers even though some of them does so, it is at a limited scale through community engagement and outreach programmes. Nonetheless, the outreach programmes rendered by universities contribute less to the key performance areas of most academics and are hardly evaluated by government extension personnel and/ administrators. The low participation of universities in rendering extension services is worrying because agricultural scholars at the universities are involved in agricultural development activities such as teaching, research, knowledge generation, curriculum and module development, and other academic activities. It is because of that backdrop that universities offering agricultural programmes are perceived as important stakeholders for pluralistic extension system in South Africa. However, there is no framework of pluralistic extension services involving universities and government in the country. Again, it is unknown whether farmers are in favour of the pluralistic extension system that involve universities (Institutions of higher learning) and willing to pay for extension services rendered by universities. According to Pye-Smith (2012), a pluralistic delivery system should be demand-led and follow a participatory approach. Therefore, a bottom-up approach to investigate the acceptability of pluralistic extension system involving government and universities should be explored to ensure that the development of pluralistic extension framework involving universities is demand-driven and supported by research-based evidence.

1.3 STUDY AIM AND OBJECTIVES

The aim of the study was to explore farmers' willingness to accept university agricultural extension in a pluralistic extension system in Gauteng province in order to establish whether the services are demand-driven. To achieve the study aim, the following research objectives were premised about farmers in Gauteng province:

i. To profile the socio-demographic characteristics of farmers receiving public agricultural extension and advisory services.
ii. To determine farmers' perception of public agricultural extension and advisory services with specific reference to:

- perceived quality of extension services and influencing factors; and
- frequency of access to public extension services and its determinants.

iii. To ascertain farmers' access to sources of extension services.

iv. To determine farmers' perceptions of effectiveness of the existing public agricultural extension and advisory services with specific reference to:
   - the perceived effectiveness and influencing factors; and
   - exploratory factors associated with the perceived effectiveness.

v. To ascertain farmers' acceptability of university agricultural extension in a pluralistic extension system with specific reference to:
   - willingness to accept and the perceived benefits of university agricultural extension; and
   - factors influencing the acceptability of university agricultural extension.

vi. To determine university agricultural extension delivery system (s) preferred by farmers and factors influencing their choice.

vii. To identify the reasons why farmers preferred different university extension delivery systems.

viii. To ascertain farmers' perceptions about funding model suitable for university agricultural extension services.

ix. To determine farmers' willingness to pay for university agricultural extension services and factors influencing their choice.

1.4 NULL HYPOTHESIS

From the foregoing specific objectives, the following null hypotheses were formulated:

i. **H_0**: There is no significant difference between the number of male and female farmers receiving public extension and advisory services in the study area.

ii. **H_0**: Age, gender, education level, farm/plot size, farming experience, number of extension visits and distance from extension office do not positively and significantly influence annual net farm income of farmers in the study area.

iii. **H_0:** The proportion of farmers with access to other sources of extension and advisory services is <50%.

iv. **H_0:** Gender, age, education level, farming category, farm/plot size, farming experience, main source of income, annual net farm income, distance from farm to extension office, perceived quality of public extension and advisory services and access to other sources of extension services respectively do not positively and significantly influence the number of visits by extension officers.

v. **H_0:** Gender, age, education level, farming category, farm size, farming experience, annual net farm income, number of monthly visits by extension officer, access to other sources of extension services and the perceived effectiveness of public extension and advisory services (compliance of extension services to the Batho Pele principle when dealing with people and planning activities), promoting equity through subsistence small-scale farmers, women, disabled and commercial farmers, facilitating and providing access to technology, and providing and facilitating advice on skills development in agriculture), respectively do not positively and significantly influence perceived quality of public extension and advisory services.

vi. **H_0:** Education Level, gender, age, farm/plot size, farming experience, main source of income, annual net farm income, number of visits by the extension officer, distance between the farm and the extension office and the perceived quality of public extension and advisory services respectively do not significantly influence farmers' perceptions of the effectiveness of public extension and advisory services.

vii. **H_0:** Significant majority of the farmers receiving public extension and advisory services in the study area were not willing to accept the inclusion of university agricultural extension in a pluralistic system.

viii. **H_0:** Farmers' gender, age, education level, farm/land size, farming experience, net farm income and land acquisition method do not positively and significantly influence their acceptability of university agricultural extension in a pluralistic extension system.

ix. **H_0:** Farmers' gender, age, education level, farming category, farm/land size, farming experience, main source of income, annual net farm income, monthly extension visits and distance from farmland to extension office do not positively and significantly influence farmers' willingness to pay for university agricultural extension services.

1.5 SIGNIFICANCE AND CONTRIBUTION OF THE RESEARCH TO THE BODY OF KNOWLEDGE

The study is based on the theory of adoption and diffusion of innovations, with specific reference to agricultural extension. The study presumes that farmers will perceive the formal involvement of universities in a pluralistic extension system as an innovation (new idea); thus, exploring the acceptability of such a system is crucial. The study suggest that investigating farmer's willingness to accept university agricultural extension will contribute significantly to the reform of agricultural extension and advisory services in South Africa. In addition, the findings of the study will influence government to develop a formal framework of pluralistic extension system that involve universities and other institutions of higher learning. Exploring independent factors associated with farmer's acceptability of university agricultural extension will provide evidence required to develop a pluralistic extension system that is preferred by the recipients of extension and advisory services. The evidence gathered will influence the selection of extension delivery systems and funding models that are accepted by most farmers; thus, it will serve as basis for formulation of policies and strategies. Moreover, the findings of the study will encourage universities to develop community engagement and outreach programmes that respond to farmer's needs and are associated with their socio-demographic characteristics. By identifying significant factors that predict farmer's acceptability of university agricultural extension in a pluralistic system, funding models and extension delivery systems preferred by farmers, the research will make a meaningful contribution in the reform of agricultural extension services. Lastly, it will create a foundation for the formal integration of universities in a pluralistic extension system and identify research themes for university-based agricultural extension and adoption of agricultural innovations.

1.6 THEORETICAL FRAMEWORK OF THE STUDY

Theoretical framework refers to a plan that is used to guide the research (Grant & Osanloo, 2014). Theoretical framework is derived from theories that have been documented in the literature, verified and authenticated by other researchers (Adom *et al*., 2018). In quantitative research, theoretical framework is based on theory because such studies often focus on testing the validity of documented theories in the literature; however, in qualitative research theoretical framework may not necessarily be a theory (Lederman & Lederman, 2015). The reason could be that situations can be predicted, controlled and tested using theoretical framework (Adom *et al*., 2018). However, in some qualitative research, the focus could be to develop new theories, describe and interpret research (Peshkin, 1993). Therefore, the definition of theoretical framework may vary in studies that employ qualitative and quantitative research paradigms. The importance of theoretical framework is that it outlines a structure that define philosophy, epistemology, methodology and analysis of the study (Grant & Osanloo, 2014). Therefore, theoretical framework provide guidance in the selection of relevant research approaches and methodologies that are appropriate for the subject under investigation. By so doing, the type of data collected, and analytical methods employed will enable the research to contribute to the existing theory (body of knowledge), especially in quantitative research paradigm.

The current study employed a quantitative research approach, and it is based on the theory of adoption and diffusion of innovation. Therefore, the theoretical framework selected in the study will test and validate the theories that exist about the adoption and diffusion of innovations. The There are various theories that outline factors associated the with diffusion and adoption of innovations (Ervin & Ervin, 1982; Lee & Swart, 1983, Gould *et al*., 1989; Düvel, 1991; Traore *et al*., 1998; Anim, 1999; Rodgers, 2003). For example, some of the authors cited above perceive adoption of innovations as a binary process whereas others argue that it is consist of levels and intensity of adoption. Therefore, there is a degree of polarisation about adoption and diffusion of innovations; mainly because it is associated with human behaviour. As a result, human behaviour forms the basis for adoption of innovation theories developed by various scholars. Therefore, the complexity of human behaviour is one of the key elements that makes scholars of adoption and diffusion of innovations to have different opinions and understanding about the phenomenon.

The theoretical framework developed by Düvel (1991) was selected as the basis for the study because it focuses on the analysis of adoption behaviour in extension work. The theoretical framework cited above clearly outlines independent and mediating variables associated with behavioural change and the consequences of the behaviour. Moreover, it categorises decision-making as a binary process (adoption or rejection) (Düvel, 1991). In relation to the current study, the inclusion of university agricultural extension in a pluralistic extension system is regarded as an innovation that farmers must either accept or reject; thus, it also follows a binary process of innovation adoption **Figure 1.1.**

Figure 1.1 indicate that behavioural change in agricultural development is associated with human (psychological) and economic-technical factors (Düvel, 1991). Human variables that influence behavioural change are either independent or mediating whereas economic-technical are dependant variables. The assumption of the framework is that independent variables influences the intervening variables which in turn affect the dependent variables (Annor-Frempong & Düvel, 2009). The authors further indicated that in the model, behavioural change is influenced by all the prior causal factors (personal and environment) and the intervening of which the latter is the immediate precursor to behaviour. From agricultural perspective, the model shows that farmers will adopt innovations that will improve their yield and profit, and their decision to adopt or reject an innovation is influenced by their farming needs, perceptions and knowledge about the innovation, and other independent factors illustrated in the model.

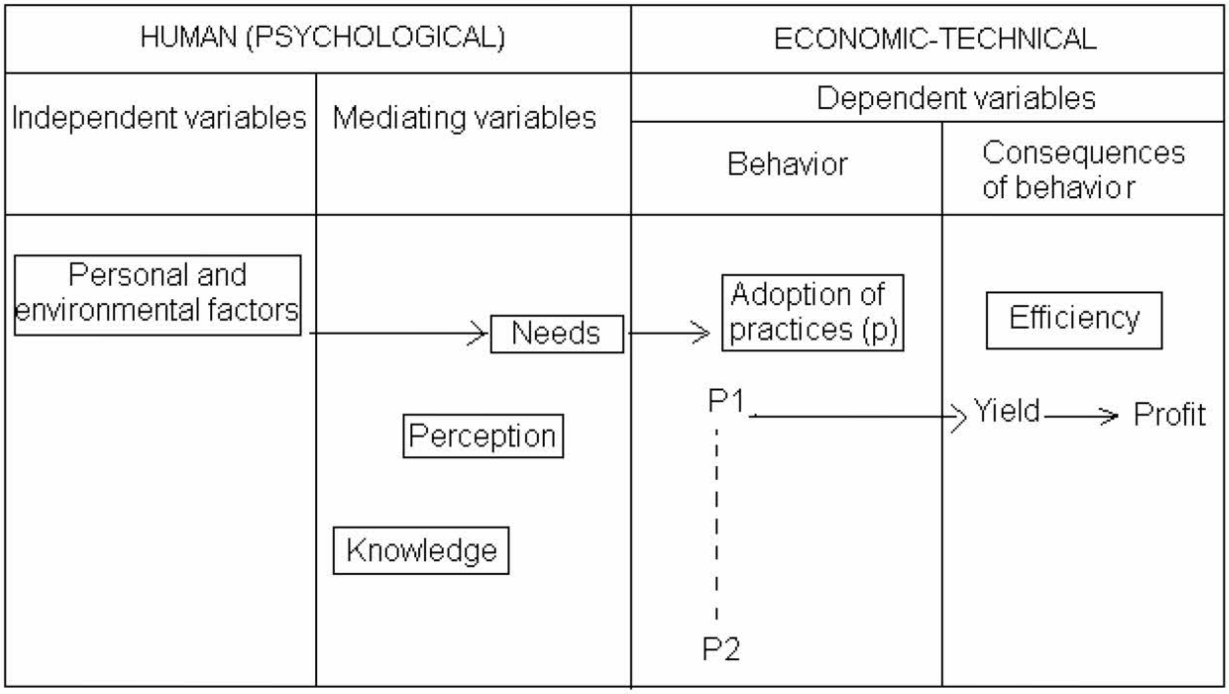

Figure 1.1: Theoretical framework for the relationship between behaviour-determining and behaviour dependent variables in agricultural development (Düvel, 1991)

1.7 CONCEPTUAL FRAMEWORK OF THE STUDY

According to Camp (2001), conceptual framework refers to the structure developed by the researcher to explain the development of the phenomenon to be studied. Moreover, framework indicate the logic that will be followed to undertake the research (Adom *et al.*, 2018). The theoretical frameworks by Düvel (1991) was used to develop the conceptual framework of the study. **Figure 1.2** shows the conceptual framework of the study.

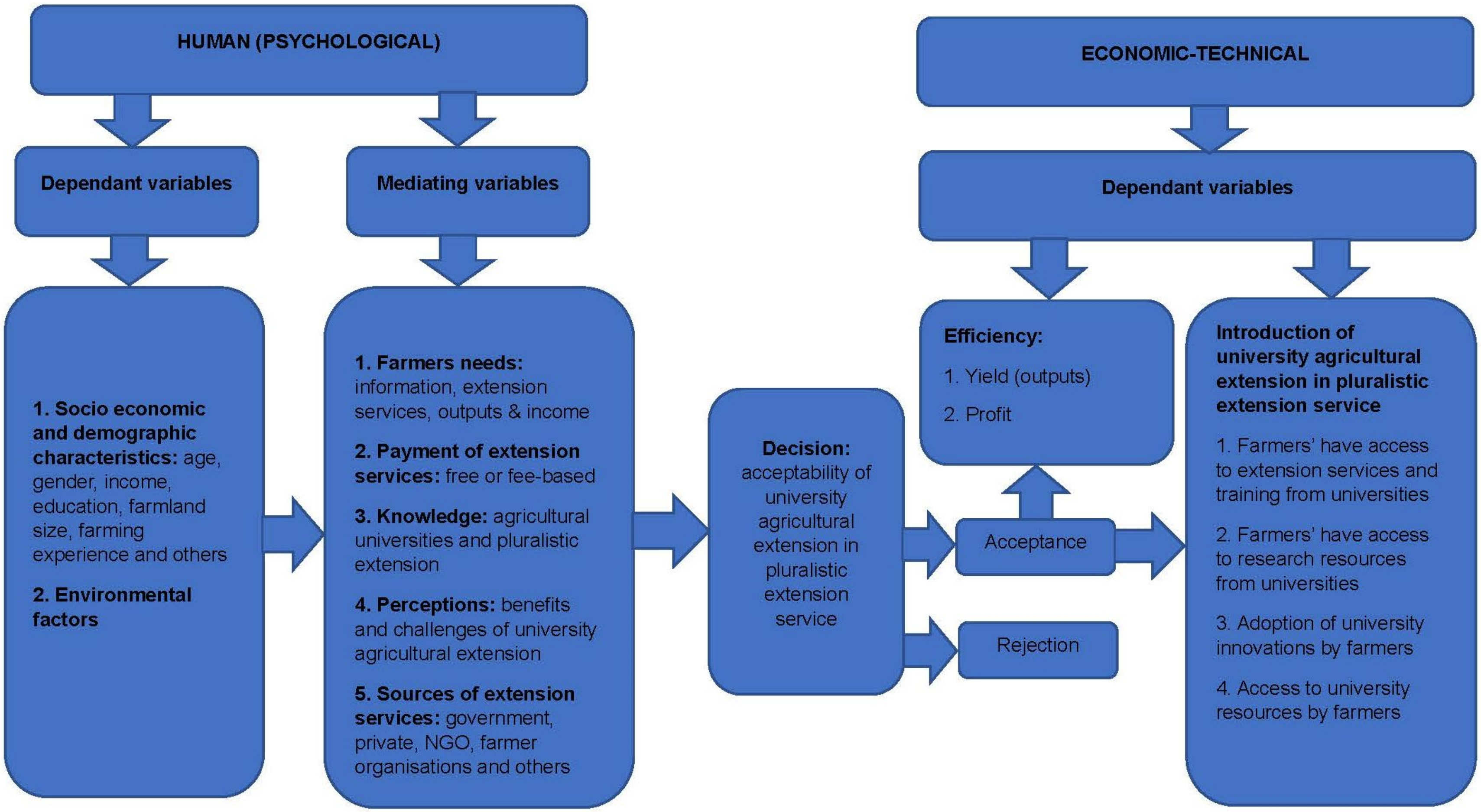

Figure 1.2: Conceptual framework of the study (After Düvel, 1991)

1.8 STRUCTURE OF THE THESIS

The thesis is divided into ten chapters. The structure of the thesis is as follows:

- Chapter one: the first chapter is about the orientation of the study. It provides the background that informed the study conceptualisation, problem statement, aim and objectives, hypothesis, significance of the study, study limitations and theoretical framework that guided the study.
- Chapter two: literature review about the important concepts of agricultural extension with specific reference to definition, history, role and sources of extension, access to services and influencing factors, perceived quality and effectiveness, challenges, funding, delivery systems, approaches and pluralistic extension system.
- Chapter three: the chapter is about description of the study area and methodology employed to conduct the study. It includes study design, sampling procedures, conceptual framework, data gathering and analysis, study limitations and delimitations, and ethical considerations.
- Chapter four to nine: in this chapters, background and introduction, research objective (s), hypothesis, type of data and analytical methods, results and discussions are provided. The background for each chapter is based on literature review about the concept under investigation. Chapter four is about the socio-economic and demographics of the recipients of public extension and advisory services in Gauteng province. Chapters five, six and seven focuses on access to extension and perceived quality of public agricultural extension and advisory services, perceived effectiveness of public agricultural extension and advisory services, and farmers' acceptability of university agricultural extension services, respectively. In respective order, chapter eight and nine are about delivery systems and funding for university agricultural extension services.
- Chapter 10: it provides conclusions, recommendations and the contributions of the study to the body of knowledge.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

The purpose of literature review was to gain knowledge about the subject under investigation and synthesize it. Moreover, literature review was aimed at identifying knowledge gap from various sources that have been published in the field of agricultural extension. To achieve the aim of literature review, evidence was gathered from published printed, and online materials. Online materials were accessed through academic research databases such as EBSCO, Google Scholar, Journal Storage (JSTOR), Public Library of Science (PLOS), ResearchGate, Sabinet, Scientific Electronic Library Online (SciELO), Science Direct, Scopus and others. In addition, online articles were accessed directly from the websites of the academic journals. On the other hand, printed materials were sourced from Unisa Library, colleagues, fellow students and the supervisors. The types of resources used for literature review were published materials such as peer-reviewed research papers, review papers, working papers, reports (annual, technical, surveys, census and others), books, book chapters, organisational websites information, Masters dissertations, and Doctoral theses. The sources of literature were traced from the 19^{th} century when agricultural extension was formalised to the most recent publications in the 21^{st} century. During literature research, keyword such as agricultural extension, extension services, extension and advisory services, university extension, cooperative extension, extension sources and organisations, farmer's access to extension services and challenges, pluralistic extension services, payment and funding of extension services, public/government extension services and other were used.

After identifying published materials that are related to the study topic, the review process started by either printing online materials and/ reviewing them electronically. During the review process, the methods included reading the background, introduction, problem statement, significance of the study, aim, objectives, hypothesis and research questions. The purpose of the above activity was to understand how the study was conceptualised and the intended outcomes. If literature review was available, it was also reviewed to gain more knowledge about the matter under investigation. Most importantly, the methodology employed to conduct the study was critically reviewed to determine its relevancy in attaining the research objectives. Again, methodology was reviewed to determine the validity and reliability of the methods and materials used to conduct the study. The literature about research methodology enabled the researcher to identify documented and validated methods that are suitable for the proposed study. In addition, the perusal of the research results and discussions was part of literature review process whereby quantitative and qualitative information were extracted. By so doing, the researcher was able to synthesize documented qualitative and quantitative information about the subject matter investigated and to do cross-sectional comparisons where necessary. Lastly, the research conclusions and recommendations were reviewed to synthesise key points and identify research gaps recorded by other scholars, respectively. If needs be, the list of references was perused in order to identify, trace and access some of the materials utilised to write the document under review.

In this chapter, literature on agricultural extension is reviewed. The chapter is divided into ten sections, excluding introduction (section 2.1). In the first part, the history of agricultural extension is provided, followed by the definition and role of agricultural extension and advisory services. The other sections covered in this chapter include literature about sources of agricultural extension, access to extension services, extension delivery systems and approaches, and funding for extension services. In addition, literature about the quality and effectiveness of extension services and pluralistic extension system is provided towards the end of the chapter. The last section provides chapter summary of the literature reviewed.

2.2 HISTORY OF AGRICULTURAL EXTENSION

In English, the word “extension” has various meanings such as adding to something that is existing, granting permission, postponing and others. According to Oxford Dictionary of

English, extension refers to “the action or process of enlarging or extending somethings” (Oxford University Press, 2010). Moreover, extension is defined as “an application of an existing system or activity to a new area. In academia, the term extension refers to “extending relevant and useful information to the adult population at large” (Jones & Garforth, 1997). Extension was popularized by universities of Oxford and Cambridge in the mid-19th century when they started discussing how they could serve the educational needs of their surrounding communities in the urban and industrial areas. After the discussions, the aforementioned English universities started extending their knowledge to local communities; as a result, university extension was established. Because universities are multidisciplinary institutions, knowledge from various subjects was therefore shared with the people through university extension programmes. Although the sharing of information with farmers was not labelled as agricultural extension towards the middle of the 19th century (1845) when there was outbreak of potato blight in Europe, the British government mandated the Agricultural Improvement Society of Ireland to appoint itinerant lecturers to inform and demonstrate (Jones & Garforth, 1997). Other European countries such as France, Italy, Germany, Netherlands, and other countries used the same approach of appointing itinerant farm advisers or itinerant agricultural teachers to dissemination agricultural information during the same period when there was potato famine due to the disease outbreak. Thus, agricultural extension has been in existence way before academic institutions in Britain labelled it. In another example, White (1977) reported that agricultural writing during ancient Greek and Phoenician civilizations in the 2nd B.C. to 4th century A.D., shared information with Roman landowners to enable them to improve their revenue. In Asia, agricultural extension can be dated back to the various dynasties (Qin and Han) in the BCE’s (221-207 and 220-202) when farming advisors were employed by government to provide support to the farmers through demonstration, training, and outreach (Fu *et al*., 2016). However, it was developed quickly after World War I and II because of low agricultural production.

It is no doubt that modern agricultural extension became more popular around the world because it occurred during the first industrial revolution when most countries started bilateral relations through trading and other matters. According to Deane (1979), industrial revolution in Britain was associated with agricultural revolution because agriculture is a pre-industrial economy that provide raw materials, food, market and capital that makes industrialisation possible. Some of the characteristics of the first industrial revolution include changes in the following: "(1) widespread and systematic application of modern science and empirical knowledge to the process of production for the market; (2) specialization of economic activity directed towards production for national and international markets rather than for family or parochial use; (3) movement of population from rural to urban communities; (4) enlargement and depersonalization of the typical unit of production so that it comes to be based less on the family or the tribe and more on the corporate or public enterprise; (5) movement of labour from activities concerned with the production of primary products to the production of manufactured goods and services; (6) intensive and extensive use of capital resources as a substitute for and complement to human effort; (7) emergence of new social and occupational classes determined by ownership of or relationship to the means of production other than land, namely capital" (Deane, 1979). Because the first industrial revolution was first formalized by British scholars, the probability of influencing other countries were very high because at the time, Britain had colonized countries in Africa, America, Asia and Australasia. The role played by industrial revolution in popularizing agricultural extension cannot be overlooked because "widespread and systematic application of modern science and empirical knowledge to the process of production for the market" was one of the characteristics of the first industrial revolution. Therefore, there was a need to disseminate scientific knowledge to agricultural producers to enable them to improve their production and supply their produce to the markets.

In the United States of America (USA), agricultural extension started in 1785 when agricultural societies were formed to improve agriculture by disseminating agricultural information through their publications, lectures, and newspapers articles (True, 1926). Extension was initiated as an education system for farming people, even though it was not labelled agricultural extension during inception in USA. Therefore, the conceptualization of the idea came from the farmers who started various agricultural societies before institutions of higher learning and government formalized the modern agricultural extension. Extension was then formalized after the 1862 Morrill Act that led to the establishment of Land Grant Colleges and Universities that provided agricultural education and research (Collins & Mueller, 2016; Perry, 2022). In addition, the Hatch Act of 1887 force Land Grant Colleges and Universities to conduct scientific agricultural research and diffuse practical agricultural information to the people in the United States of America. In Latin America (Argentina, Bolivia, Brazil, Colombia, Ecuador, Guatemala, Honduras, Nicaragua, Paraguay, Peru and Venezuela) agricultural extension was formalized in 1943 though funding and technical assistance provided by the United States of America (Otero & Selis, 2016).

In South Africa, agricultural Extension was first recognised in 1924; however, the first extension workers were appointed in 1925 by the Division of Agricultural Education and Extension (Bembridge, 1991). It is worth noting that, when agricultural extension was first introduced in South Africa (formerly Union of South Africa before 1961), the country was governed by British and Dutch white settlers who promoted policies that oppressed and segregated black people. Agricultural extension was aimed at bringing latest development to the farmers and providing services such as assisting farmer associations and show societies, selecting breeding livestock for farmers (Bembridge, 1991). It is shows that the approach adopted by South Africa in the introduction of agricultural extension was influenced by the British approach which was based on sharing information with agricultural producers. In other African countries such as Ethiopia, agricultural extension started in 1931 when Ambo Agricultural School was established to train agricultural students, demonstrate the impact of new varieties and practices to the farmer (Balay, 2003). The formalization of agricultural extension works in Ethiopia started in 1943 after the establishment of the Ministry of Agriculture; however, extension activities were limited because the Ministry had no separate division responsible for extension work. The establishment of Imperial Ethiopian College of Agriculture and Mechanical Arts (now Alemaya University) in the 1950's improved formal agricultural extension activities because it was based on the Land Grant College system from the United States of America (Balay, 2003).

In conclusion, literature review presented in this section has depicted that agricultural extension in Europe and United States of America was formalized in the 19th century compared to Latin American and selected Africa countries where extension was formally recognised in the 20th century.

2.3 DEFINITIONS OF AGRICULTURAL EXTENSION

There are various definitions of agricultural extension that have been developed by scholars, academic institutions, international and local organisations, farmer organisations and others. Therefore, agricultural extension has no single definition that is accepted in the society. Leagans (1971) defines agricultural extension as a non-formal adult education system that delivers research information in agricultural, social and communication to adults in rural areas with the anticipation of improving their operations. According to Bembridge (1991), agricultural extension is "an educational task consisting of communicating information to farmers and helping farmers to adapt their farming methods to take full advantage of proven and acceptable technology". Kim *et al*. (2009) defines agricultural extension as the transfer of scientific knowledge and techniques from agricultural research to the farmers in order to increase agricultural production or outputs. Extension is a system whereby knowledge generated through research is made available to the surrounding communities (Collins & Mueller, 2016). The basis for the aforementioned definitions is that agricultural extension is about sharing research-based information with agricultural producers to enable them to improve their agricultural operations and productivity. Therefore, agricultural extension is defined as a linear or top-town process whereby farmers are the recipients of knowledge generated by research institutions.

Extension is a function of providing need- and demand-based knowledge and skills to rural men, women and youth in a non-formal, participatory manner, with the objective of improving their quality of life (Qamar, 2005). According to Rivera and Qamar (2003), extension is a non-formal educational function that applies to any institution that disseminates information and advice with the intention of promoting knowledge, attitudes, skills and aspirations, although the term "extension" tends to be associated with agriculture and rural development. By looking at the above definitions, an extension is considered as an informal educational system that shares information with rural people to improve their livelihoods. Düvel (1999) referred to extension as a business of behavioural change or change facilitation. The argument is that extension is about changing farmer’s behaviour by convincing them to adopt technologies that will enhance agricultural productivity.

According to Zwane and Davis (2017), extension refers to “the systems that facilitate the access of farmers, their organisations and other market actors to knowledge, information, and technology”. The above definition of extension deviates from others presented in the first paragraph, which classify extension as transfer of technology from research organisations to the farmers. Therefore, the definition classifies extension as a participatory approach involving various stakeholders in knowledge generation and facilitation of access to information. The definition is aligned with the paradigm shift in the late 20th and 21st century that promote non-linear approach to agricultural extension and advisory services. In conclusion, there is no single definition of extension recognized globally, even though there are common elements in some definitions. Nonetheless, extension definitions are either categorized as linear (top-down) or nonlinear (participatory).

2.4 THE ROLE OF AGRICULTURAL EXTENSION AND ADVISORY SERVICES

Agricultural extension is sometimes referred to as agricultural advisory services or extension and advisory services in some countries. Meaning, it is not only about extending knowledge to the farmers or producers; but also giving suggestions which farmers can either accept or reject. Agricultural extension is one of the pioneers of agricultural and rural development, and food security through the provision of information to most farmers with low literacy levels and poor access to Information and Communication Technology (ICT), especially in developing countries. Agricultural extension services enable farmers to acquire skills and adopt innovations that improve agricultural productivity, and the livelihoods of the farmers (Christoplos, 2010; Nnadi *et al.*, 2012). Furthermore, extension services provide farmers with appropriate information that enables them to make decisions that improve their farming and solve problems (Davis & Heemskerk, 2012). Farmers' must make decisions ranging from production to marketing of their produce. Some of the important decisions that farmers can make through the advice from extension agents include adoption and management of technologies, optimum resource utilisation, human resource management, changing farming systems, legal and fiscal matters, production planning and others (van den Ban, 1998). Again, extension and advisory services can improve the livelihoods and well-being of people in rural areas and sustain agricultural activities (Meinzen-Dick *et al.*, 2011). Moreover, extension services improve the adoption of agricultural technologies (Wossen *et al.*, 2017). Hosseini *et al*. (2008) reported that agricultural extension has the potential to improve agricultural production and the quality of farmers' produce. By providing farmers with innovations and information that enhance production, farmer's quality of live will improve because they can generate more income. For example, Bonye *et al.* (2012) reported that the role of extension is to provide information to farming communities about innovations that have the potential to improve production, incomes and standards of living.

In South Africa, the Department of Agriculture, Forestry and Fisheries (DAFF, 2016) has indicated that, the role of extension and advisory services is to provide information, advice, education and training to producers to enable them to produce efficiently and sustainably (DAFF, 2014). Through access to extension and advisory services, farmers receive diverse information about cultivation practices; fertilisation; plant protection (pests, weeds and disease control); marketing; livestock and crop management; climate change; and so forth. The literature presented in this section indicate that the main role of agricultural extension is to provide support to producers in order to improve agricultural production, income and livelihoods. Support can be provided to the farmers through the provision of information, facilitating adoption of new innovations, education, training and acquisition of skills.

2.5 SOURCES OF AGRICULTURAL EXTENSION SERVICES

Literature has shown that there are various organisations that provide extension and advisory services to agricultural producers across the globe. Extension organisations can be classified as public, semi-public, private (profit and non-profit enterprises) and chambers of agriculture (ADE, 2009). The number and types of organisations rendering extension and advisory differs from one country to the other because circumstances such as farmer's challenges, sources of funds, scale of operation, agricultural productivity, access to information, farmer's demographic and socio-economic characteristics, number of extension personnel, and others are not similar. In Europe, extension services are rendered by government (public), private, farmer-based, and non-government organisation (Knierim *et al*., 2017). Even though European countries have been promoting privatisation of agricultural extension services, most extension advisors are found in government, followed by farmer-based organisations, private and non-government organisations. Similarly in big Asian countries such as India and China, there are various government and non-governmental organisations that render extension services to the farmers (Gao, 2014; Sajesh & Suresh, 2016). For example, Sajesh and Suresh (2016) reported that in India government through Department of Agriculture, State Agricultural Universities (SAU), Indian Council of Agricultural Research (ICAR), Agricultural Technology Management Agency (ATMA), Krishi Vigyan Kendra (farm science centre), Farmer Field School (FFS), FBO/SHG=farmer-based organisation/self-help group and Non-Governmental Organisations (NGO's), Agriclinics, Agribusiness centres, inputs dealers, Media/TV and e-Choupal play an important role in the provision of extension and advisory services. In China, agricultural extension organisations are classified into government-run, education-oriented, research-oriented, enterprise-run organisations, and self-service organisations (Gao, 2014). Although, the classification of extension organisations used by India and China appears to be different, the reality is that they are similar. For example, State Agricultural Universities found in India are common in China whereby they are classified as education-oriented organisations. Again, Indian Council of Agricultural Research (ICAR) and farmer-based organisation belong to the categories of research-oriented, and self-service organisations in the Chinese category, respectively.

In West Africa (Burkina Faso, Ghana, Liberia, Nigeria, Guinea, and Senegal), various institutions are responsible for the delivery of agricultural extension services (Abdu-Raheem & Worth, 2016). Likewise, Southern African Development Community (SADC) is no exception. According to Masangano *et al*. (2017), various organisations such as government, NGOs, International NGOs, private sector, farmer organisations, donor funded projects and research institutes in Malawi render agricultural extension and advisory services to farmer in the country. Again, in Mozambique, farmers received extension services from government, NGOs, and private organisations (Gêmo *et al*., 2013). The circumstances in South Africa are like other SADC countries whereby extension services are not solely the responsibility of government (public) through the Ministry of Agriculture. Apart from government, stakeholders such as agricultural cooperatives, commodity organisations and the private sector are part of the extension organisations (Zwane; 2009; Koch & Terblanché, 2013; DAFF, 2016). Moreover, Zwane (2009) reported that research organisations, academic institutions, farmers' unions and non-governmental organisations provide extension services to the farmers in South Africa. In conclusion, literature from selected African countries shows that state, private and civil organisation play an important role in agricultural extension and advisory services. Detailed literature about organisations involved in the provision of agricultural extension and advisory services is presented from section 2.5.1 to 2.5.8.

2.5.1 Government

In most countries, public extension services were introduced during the post-independence period; as a result, they were aligned with the developmental goals of many countries to reduce poverty, sustain agriculture and manage resources (Mbo'o-Tchouawou & Colverson, 2014). Because of the role played by government in the provision of extension services, agricultural development has improved is many countries. During the green revolution era, public extension has played a significant role in the acceleration of agricultural growth through the transfer of technologies (Adhiguru *et al*., 2009). As a result, government has become the main provider of agricultural extension services in many countries throughout the world (Cary, 1993; Kidd *et a*l., 2000; Anderson & Feder, 2004; Ajayi, 2006; Opara, 2008: Magoro & Hlungwani, 2014; Maoba, 2016). One of the reasons that the government is highly involved in rendering extension services, is to ensure that farmers receive the support which will enable them to produce adequate and quality produce, and thus enabling the country to be food secure. According to Farrington (1995), public agricultural extension is justified because of the following reasons:

- "*much of the information relevant to technological innovation is public good in character. For as long as it remains in appropriable by the private sector, farmers will, it is argued, receive less than economically optimal levels of information;*
- *considerable risk attaches to agricultural production: public provision of information is one way of reducing such risk and enhancing the average levels and stability of production;*
- *the institutional and physical infrastructure for information provision is often poorer in areas beyond the immediate radius of administrative and commercial centres; arguments relating to regional balance suggest that public action is needed to enhance the incomes and, ultimately, participation in civil society of people on the periphery; and*
- *potential adverse selection is associated with certain types of agricultural input (e.g. seeds and agrochemicals), when the quality of the input and the locally appropriate levels of application are uncertain. Public provision of information allied with the application of technical standards can reduce these. In (sometimes uncritical) pursuit of these arguments, governments have invested large sums in public sector extension*".

Despite the important role played by government in the provision of agricultural extension and advisory services, there has been some negativity towards government. Globally, public agricultural extension services have been criticised (Olusola, 2011). The main criticism towards public agricultural extension services is that it is not effective and unresponsive to the needs of the farmers or communities (Kidd *et al*., 2000; Qamar, 2005; Mutimba, 2014). In addition, various scholars have found that farmers are not satisfied with the quality public extension services (Mmbengwa *et al*., 2012; Sharmin, 2012; Maoba, 2016; Kabir *et al*., 2020; Kassem *et al*., 2021). Again, public agricultural extension is also perceived as financially unviable and not demand driven in many countries (Cary, 1993; Afful & Lategan, 2014). The opinion is that the need for agricultural extension and advisory services is higher than the fiscal allocation (Anderson & Feder, 2004). Political interference has also been identified as one of the main reasons why public agricultural extension and advisory services has failed in many countries (Anderson & Feder, 2004). For example, in some countries fiscal discipline has targeted agricultural extension; this resulted in reduced financial support for public agricultural extension services (Bennett, 1996; Kidd *et al*., 2000; Anderson & Feder, 2004). Other political interferences include unsustainable agricultural policies and political agendas that are not favourable for agricultural extension and advisory services. A practical example of political interference is South Africa whereby agricultural extension and advisory services were dualistic (different services for commercial and smallholder farmers) because of the apartheid government which segregated farmer according to race (Düvel, 2004; Department of Agriculture, 2005; Ngomane, 2010).

2.5.2 Private sector

Privatisation of agricultural extension can be classified as total withdrawal of government from extension services, cost recovery, provision of extension service by private companies for commercial gain (Kidd *et al*., 2000). Payment for services includes services rendered by private companies (inputs dealers, progressive farmers agribusiness, salesmen, mass media, NGOs, farmer’s organisations, and others) and consultants for a fee. In cost recovery system, government may charge a fee for certain services rendered to the farmers. Because private agricultural extension is demand-driven by nature, most services are provided by profit seeking organisations. This is evident because various private-sector organisations are involved in the provision of extension services on a market basis whereby farmers pay for services received (Feder *et al*., 2011). Some of the international organisations involved in private extension delivery are World Vision, FAO and others. In addition to private companies, NGOs, and Farmer-Based Organisations (FBOs) render extension services to the farming communities whereby fee-based services are common. For example, extension agents are paid by farmers through membership fee in the case of FBOs; alternatively, government may contract private companies and NGOs to extension services freely to the farmers (Feder *et al*., 2011). Private extension services often exclude resource-poor agricultural producers because they target elite farmers producing high-value agricultural commodities (Ramirez & Lee, 2007). Resource poor farmers are excluded from private agricultural extension because the services are profit driven (Koch & Terblanché, 2013). Thus, private-sector extension services are mostly accessible to commercial large-scale farmers and highly profitable agricultural enterprises. Furthermore, private extension services are very common in developed countries as opposed to the developing countries. This is not surprising because literature has shown that farmers' in developing countries are not willing to pay for agricultural extension services (Qamar, 2005; Foti *et al*., 2007; Ali *et al*., 2008; Oladele, 2008; Afful, 2012). In some instances, farmers' in developing countries cannot afford to pay for private extension despite their willingness. The reason is that farmer's willingness to pay for extension services is positively and significantly correlated with income (Ajayi, 2006; Oladele, 2008; Uddin *et al*., 2016; Loki *et al*., 2019; Shausi *et al*., 2019). Thus, farmer earning more income are more willing to pay for private extension services and/acquire extension services that are market-driven.

Various scholars have explored the level of access to private agricultural extension services in the 20th and 21st century. According to Anderson and Feder (2007), about five percent of agricultural extension services are provided by private institutions globally. Thus, majority of farmers have no or limited access to private agricultural extension services. In Europe, privatisation of extension was popularized in the 1990s when government in most countries started withdrawing funding, implementation, and programming of public extension services (Labarthe & Laurent, 2013). After the withdrawal of government support, it was anticipated that the state will facilitate the establishment of efficient private advisory service providers, lead to the quest for demand-driven services and improve resource allocation. Denmark and Latvia are European countries with the most private extension companies with about 30 and 14, respectively (Knierim *et al*., 2017). On the other hand, countries such as Belgium, Germany, Ireland, Italy, Sweden, and United Kingdom have between one (1) and seven (7) private sector companies. Nonetheless, the withdrawal of public-funded extension services in Europe led to poor access to extension and advisory services especially amongst the small-scale farmers (Labarthe & Laurent, 2013). Similarly, in the industrial countries like the United States of America (USA) and New Zealand, private extension services are common (Eicher, 2007). However, in most African countries the circumstances are different because most farmers rely of public extension services (Maoba, 2016, Cary, 1993; Kidd *et a*l., 2000; Anderson & Feder, 2004; Ajayi, 2006; Opara, 2008; Okwu & Umoru, 2009; Magoro & Hlungwani, 2014; Maoba, 2016; Nkosi 2017; Obeng-Koranteng *et al*., 2017). As a result, the level of access to private extension services is low (Adomi *et al*., 2003; Ngomane, 2002; Nkosi, 2017; Osei *et al*., 2017; Sang & Cheruiyot, 2020; Fidelugwuowo *et al*., 2021). In some areas, farmers have no access to private extension services at all (Acheampong *et al*., 2017; Popoola *et al*., 2020). According to Ngomane (2002), lack of access to private extension services is attributed to unaffordability, especially amongst smallholder farmers. In South Africa [Uthungulu District Municipality, KwaZulu Natal (KZN)] it was found that nearly two-thirds (66.5%) of emerging livestock farmers had no access to private extension services whereas 30% and 3.6%, respectively, had better and moderate access to private extension services (Nkosi, 2017). Similarly, Popoola *et al*. (2020) reported that most (99%) of the smallholder farmers in Amathole District in the Eastern Cape Province, had no access to climate change information from private extension services. Thus, access to private extension services is low amongst resource-poor farmers in South Africa. In other African countries like Uganda, privatisation of extension services occurred when government provided funds to farmers to seek extension services from private firms; however, government reintroduce public extension service after the private extension model failed (Swanson & Rajalahti, 2010). However, privatisation of extension services in Uganda has failed duo to poor monitoring, corruption in the selection of private organisations, focus on profit instead of the quality of extension services, inadequate extension personnel, high costs and political interference (AfranaaKwapong & Nkonya, 2015).

Additionally, more studies have investigated the benefits of private extension services. Firstly, Adebayo (2004) reported that private extension is efficient, flexible and accountable. Privatized extension renders good quality and relevant services to the farmers (Chapman & Tripp, 2003). The reason could be that private extension companies have skilled personnel responsible for the provision of extension services to the recipients (Chapman & Tripp, 2003; Feder *et al*., 2011). In support, Mengal *et al*. (2012) reported that private extension agents are more competent compared to government agents. Therefore, private extension services are more likely to be responsive to farmer's everchanging needs (economic, financial, social, and technical). According to Kunchala *et al*. (2012), some of the advantages of privatised extension services are timely availability of required information and needed inputs like (pesticide, fertilizers and others), creates awareness of marketing information, provides timely solution of farm problems at farm level, availability of finance for agricultural operations, cost efficiency with educated field staff, new information can be obtained speedily at farm itself, availability of complete and reliable information, provision of infrastructure and diagnosis services at proper time and loyalty and humbleness of extension staff towards client. The literature presented in this paragraph shows that most of the advantages associated with privatised extension services are in favour of the farmers. Moreover, there are many more advantages of privatising extension services.

Despite the advantages associated with private agricultural extension services; several scholars have argued that private extension cannot cope with the demands for agricultural extension services (Kidd *et al*., 2000; Anderson & Feder, 2007; Koch & Terblanché, 2013). Private agricultural extension focuses on commercial farmers and neglect poor farmers because it is profit driven (Kidd *et al*., 2000; Anderson & Feder, 2007). According to Anderson and Feder (2007), payment for the delivery of agricultural extension and advisory services is highly viable in the commercial sectors. Because of that, private companies may prioritise single or high-value crops, focus on farmers who perform better and activities in area of higher potential (Feder *et al*., 2011). The above disadvantages may result to a situation whereby farmers involved in agricultural commodities that are not appealing to private companies and performing poorly are neglected; thus, inequitable access to extension services will prevail in a dominant private extension environment. Such occurrences will result in high prevalence of poverty amongst resource-poor farmers and promote inequality in the society. Moreover, privatisation of extension and advisory services has negative impact on the productivity and performance of farms (Rivera & Sulaiman, 2009; Klerkx & Jansen, 2010). Therefore, total privatisation of agricultural extension will deny poor farmers access to extension services. For example, in South Africa, Ngomane (2002) reported that most small-scale farmers relied solely on public extension services because they could not afford private extension. As a result, total privatisation of agricultural extension services is not fully supported in some African countries. In South, Zwane (2016) found that majority of agricultural advisors in Limpopo Province were not in favour of privatisation of extension services. Even though private sector has the capacity to render certain services effectively, few extension agents were in support of privatisation. On the contrary, the South Africa extension policy support the provision of private extension services to the farmers who can afford to pay for the service; however, the policy advocate for private-public partnership to improve access to extension services amongst rural and resource poor agricultural producers (DAFF, 2016).

2.5.3 Non-Governmental Organisations (NGOs)

Non-Governmental Organisations refer to non-profit-organisations that address societal problems related to poverty, and social; and they are mostly found in the developing world (Lewis, 2014). In other context, NGOs can refer to any organisation that is not affiliated to government (state) and/ fully independent from the state. NGOs are perceived as charity or civil society organisations independent from government or business sector with the responsibility of providing services to the disadvantaged people, or directly through partnerships, campaigns, and policy advocacy (Lewis, 2014). Therefore, the NGOs are independent organisations that render services aimed at improving the livelihoods of the destitute. Because of the important role played by the NGOs in addressing global societal challenges, they are recognized in many countries, both in the developing and developed worlds. Again, some of the organisations are established at community level and categorized as community-based organisations.

In agricultural extension, various NGOs provide information to the farmers as part of extension, especially in areas where public extension is ineffective (Davis & Place, 2003). As a results, there are various international and national NGOs responsible for the provision of agricultural extension services. Globally, organisations such as African Bamboo, Africa Care Foundation, Care International, Foodtank, Kiss the Ground, One Acre Fund, Sustainable Agriculture Network, Sustainable Harvest International, TechnoServe, Winrock International, World Concern International, World Vision, and others operate in different countries in the agricultural sector. Agricultural NGO are involved in education and extension, provision of information, policy advocacy, financial support, skills development, farmer's training, diffusion of innovations and other activities. In some European Union (EU) countries (Belgium, Germany, Italy, and United Kingdom) there are various NGOs involved in the provision of extension services; however, they are the least source of agricultural extension with few extension personnel (Knierim *et al*., 2017). The above phenomenon is not surprising because developmental NGOs are mostly found in developing countries, of which majority of European countries are not. In Asian countries such as China, India and Pakistan, there are NGOs rendering extension services to farmers. However, in India it has been reported that very few (<5%) agricultural producers had access to extension services provided by NGOs; thus, their participation is low (Adhiguru *et al*., 2009; Nagar *et al*., 2021a). Similarly in Pakistan, Khyber Pakhtunkhwa found that only 4% of rural women received extension services from NGOs (Safdar & Pervaiz, 2020). According to Nagar *et al*. (2021a) most farmers do not access extension services from NGOs due to lack of awareness and unavailability of services. Therefore, lack of access to NGO's extension services may be attributed to institutional (availability) and personal factors (lack of awareness).

In sub-Saharan Africa, Wahab *et al*. (2011) reported that NGOs such as Development Education Centre (DEC), Women's Farmers Advancement Network (WOFAN), Farmers

Development Union (FADU), Fadama User Groups (FUGs); Fadama Users Associations (FUAs); and Women in Agriculture (WIA groups) provide extension services to farmers in Nigeria. A study conducted in Nigeria found that about majority (55%) of farmers in South-East Nigeria accessed agricultural information from NGOs (Fidelugwuowo, 2021). However, in North Central Nigeria, about four-fifth (20%) of farmers had adequate access to extension services from NGOs whereas 49% and 31% had inadequate and no access to NGOs extension (Soyemi, 2014). On the contrary, in some parts of Nigeria it found that farmers had no access to extension services from NGOs (Adomi *et al.*, 2003; Opara, 2008; Okwu & Umoru, 2009; Oyegbami *et al*., 2011; Mgbakor *et al*., 2013). In another West African country (Ghana), Adventist Development and Relief Agency (ADRA), World Vision International (WVI) and Association for the Advancement of Women in Africa (ASAWA) are some of the NGOs involved in agricultural extension services (Buadi *et al*., 2013). Similar occurrences were reported in Ghana whereby NGOs were least effective sources of extension services for farmers in Greater Accra Region because only 5.3% of farmers received such services (Folitse *et al*., 2018). However, in some parts of Ghana (Accra, Ashanti region, Eastern region, Aduamoa), farmers had access to extension services from NGOs (Acheampong *et al*., 2017; Obeng-Koranteng *et al*., 2017; Osei *et al*., 2017; Kavi *et al*., 2018; Anaglo *et al*., 2020). Despite the participation of NGO in the provision of extension services, it is evident very few farmers have access to such services in Ghana and Nigeria.

In East Africa (Kenya and Ethiopia), access to extension services from NGO's was also low and unavailable is some parts of the country. In Highland Zone, Kenya, it was found that less than quarter (22.6%) of farmers received horticultural information from NGOs in comparison to government which was the main source of information (Sang & Cheruiyot, 2020). Nonetheless, farmers in Ndhiwa Sub-county (Western Kenya), had no access to extension services offered by NGOs (Mbanda-Obura *et al*., 2017). The situation in Ethiopia was similar because in the wheat growing regions and southern part of the country, few farmers (0.5-18%) received extension services from NGOs (Philipos *et al*., 2014; Kelemu, 2017). On the contrary, in some country's regions (Mid Rift Valley and

Somali Regional State), NGOs were not sources of agricultural extension services (Egge *et al*., 2011; Umeta *et al*., 2011).

As part of Southern Africa, Malawi, Mozambique, and South have various NGOs that work independently, and collaboratively with government and other organisations to render extension services to agricultural producers. Therefore, the status of NGOs participation in agricultural extension services in Southern Africa is not much different from East and West African that were explored in the previous sections. NGOs such as Alliance for a Green Revolution in Africa (AGRA), Catholic Development Commission (CADECOM), Churches Action in Relief and Development (CARD), Finance Trust for Self Employed (FITSE) and others have supported farmers in Malawi by providing access to extension service in rural parts if the country (Chowa *et al*., 2013). The participation of NGOs was reported in areas such Chikwawa, Choma, Doroba, Lupaso, Phalombe, Zombwe I, Zombwe, and most districts whereby less than one-thirds (<33%) of agricultural producers received extension services from NGOs (Mudege *et al*., 2017; Phiri *et al*., 2019; Ragasa, 2020). Nonetheless, such services are not found in all segments of the country. For example, in some parts of two Districts (Mzimba and Kasungu District, access to extension services from NGOs were not found (Kerr *et al*., 2017). Similarly, findings from Mozambique were also mixed regarding access to extension services from NGOs whereby lack of and low access to NGO extension services were reported. Access to extension services from NGOs were reported in Maputo city, even though it was very few farmers who had the privilege to access such services (Mabuie *et al*., 2020). Extension services in Mozambique were received from organisations such as World Vision, Care International and Africare (Gêmo *et al*., 2013).

In South Africa, national extension policy acknowledges that there are various Non-Profit Organisations (NPOs) play a unique and vital role in agricultural extension by rendering the extension and advisory services to the marginalizsed communities on behalf of government (DAFF, 2016). According to Koch and Terblanche (2013), agricultural extension NGOs in South Africa are classified as cooperatives, commodity organisations and private (commercial) sector. Therefore, most extension organisations in the country are farmer-based organisations (FBOs) because cooperatives and commodity groups belong to farmers' organisations. In addition, organisations such as Lima Rural Development Foundation renders extension services to rural communities, mostly in KwaZulu Natal and Eastern Cape provinces of South Africa (Baiyegunhi *et al.*, 2019). Despite the availability of NGOs, Popoola *et al.* (2020) found that in Amathole District in the Eastern Cape Province, smallholder farmers had no access to climate change information from NGOs. The low participation of donor funded NGOs may be attributed by the fact that South Africa has large number of farmers organisation. The names of some farmers organisations will be provided in section 2.5.5.

Literature presented in the previous paragraphs has shown that NGOs play an important role in the provision of extension services; even though such services are not accessible to most farmers. Therefore, the contribution of NGOs cannot be overlooked in agricultural extension and development. NGOs are often preferred because they have abundant financial resources, better networking, application of participatory approaches, better understanding of community needs and utilisation of inclusive approaches, and teams with diverse skills (FAO, 2010). NGOs are more flexible in their extension programs compared to government extension systems because of their size and philosophy (Davis & Place, 2003). In addition to their programs, NGOs have motivated staff members due to the ability to pay salaries on time, fund required for transport and operational costs may be acquired easily and easily accessible. Nonetheless, NGO's have limited capacity to address social problems because they rely heaving on external support for resources (Bwana *et al.*, 2011). In addition, NGOs may succumb to political and expand programs beyond the available resources, experience withdrawal of resources by donors and become duo to socio-political environment (FAO, 2010). The main challenge with NGOs involved in agriculture is that most of their employees lack technical training about horticulture, livestock, fisheries, and other agricultural fields; as a result, they cannot provide necessary technical advice and training required by producers (Swanson, 2008).

2.5.4 Institutions of higher learning

Globally, institutions of higher learning such as Universities, Universities of Technologies, Polytechnic institutes, colleges, and others have played an important role by training agricultural professionals such as extension officers, agricultural economists, agronomist, animal and plant scientists, farm managers, and others. In addition, institutions of higher learning continue to play a pivotal role through knowledge generation about new agricultural innovations, ethnoveterinary medicine, farming practices, livestock and crop management, marketing of agricultural commodities, animal and crop breeding, adoption of innovations, land use planning, soil fertility and management and other agricultural sub-disciplines. Knowledge generated by institutions of higher learning can be promoted by creating platforms that will link farmers with those institutions. It is because of that backdrop that institutions of higher learning are perceived as an important stakeholder in agricultural extension. In the USA, university extension seated in land-grant universities has been the agent of innovation through research that improved the livelihoods of the beneficiaries (Franz & Townson, 2008). The system is referred to as cooperative extension; and it is an outreach for academics at land grant universities (Ilvento, 1997; Rennekamp & Engle, 2008). It is cooperative efforts between universities and the state in rendering agricultural extension services to the farmers (McDowell, 2003). In some parts of the world the system is known as university agricultural extension or simply university extension. Nonetheless, the principles that govern cooperative extension and university extension are the same. Universities become relevant to the communities because they are responsive to the needs of the communities through their extension services (National Research Council, 1996; Ilvento, 1997; Liu & Tao, 2021). This approach links academic institutions with practical extension work (Oladele, 2013). In addition, agricultural research and teaching at the universities becomes relevant to the farmers because it is responsive to their needs (Rodgers, 1992; Anderson & Feder, 2004).

Internationally, university agricultural extension (cooperative extension) has been successful in many countries including the United States of America (USA), India, Nigeria and others (Rodgers, 1992; McLean, 2007; Van den Ban, 2003; Okolo, 2010). For example, in USA farmers' productivity has increased enormously through university agricultural extension because it integrates farmers' needs and agricultural research

(McDowell, 2003). This was evident in Florida whereby largest majority (98%) of extension clients were satisfied with the quality of services received from cooperative extension system (Terry & Israel, 2004). The system is also practised in countries across the globe, even though it not regulated by the legislature like in the United States of America; thus, universities in such countries render extension services on a voluntary basis. For example, in the South African context, university academics are expected to render extension and advisory services to agricultural producers through community engagement and outreach programs (Department of Agriculture, 2005). In addition, South African institutions of higher learning (colleges and universities) are expected to conduct research that is responsive to farmer's needs, develop and transfer technologies, and provide accredited training to extension personnel and farmers (DAFF, 2016). Therefore, the scope of universities in agricultural extension and advisory service system is broad. However, the national policy on extension and advisory services outlines the role of institutions of higher learning in agricultural extension delivery system without a formal legislation that govern the endorsed system. As a result, the participation of universities in the provision of extension and advisory services is limited because the system is not formally legislated like in the United States of America (USA).

Through university agricultural extension, some academics use the research projects for post-graduate student to solve farmers' problems which often arise during engagement between academics and farmers (McDowell, 2003). Such achievements can be realized by universities because they have adequate resources that can be used in situations of economic and community disintegration (Atchoarena & Holmes, 2016). In China, it was found that there are sufficient experts at universities that can render extension services required by farmers; and solve production challenges through knowledge and technology transfer (Liu & Tao, 2021). State agricultural universities and colleges in India have been successful in rendering extension and advisory services to their surrounding communities (Van den Ban, 2003). In South Africa, there is evidence that university agricultural extension played a critical role in the success of white commercial farmers during the apartheid era before the year 1994 (Ngomane, 2010). During that era, farmers had easy access to agricultural research and information from universities through the Department of Agriculture; however, the cordial relationship that existed between universities and the Department of Agriculture has weakened in recent years (Koch & Terblanché, 2013). The reason could be that South African institutions of higher learning receive most of their funding from the Ministry of Education since their primary role is to provide education in the society. Nonetheless, research and community outreach are the second and third important roles of the universities, respectively. In countries where university-based agricultural extension is practised, funding is provided by universities through their outreach funds in collaboration with the state (Ilvento, 1997; Anderson & Feder, 2004). Because the state is involved in the funding of university agricultural extension, academics (scholars) in the universities and colleges are mandated to carry their research findings to the farmers (Boyer, 1990; Anderson & Feder, 2004; McLean, 2007).

Institutions of higher learning have the potential to render extension and advisory services because of various reasons. Some universities have adequate funding for research projects aimed at enhancing human development (Cummings, 2014). In addition, universities that teach agricultural programmes have infrastructure such as laboratories, farms and test stations that are used for research and student practical activities. University test stations are used to transform innovative agricultural technologies into applications that benefit local communities (Liu & Tao, 2021). Universities play an important role in the stimulation of innovations that create institutional linkages and accelerate the flow of ideas (Johanson & Saint, 2007). Moreover, literature has shown that university agricultural extension has advanced development and dissemination of new innovations that improve agricultural productivity (Okolo, 2010; Liu & Tao, 2021). Similarly, Lyons *et al*. (2018) found that in land grant universities that render extension services in the USA, new research knowledge supporting agricultural activities is disseminated through extension services. Despite the enormous advantages associated with university agricultural extension. It has been reported that cooperative extension system lacks timeliness when responding to issues, some extension agents are not willing to make necessary recommendations, and development of irrelevant programs due to poor need identification has occurred (Ghimire *et al*., 2014).

2.5.5 Farmer organisations

Farmers organisations (FOs) refers to any formal or informal membership-based group that provide services to its members who are involved in agricultural activities such as crop farming, fishery, livestock production and other activities (MasterCard Foundation, 2020). Farmer organisations varies by size, membership affiliation, functions, constitutions, codes of conducts and governing rules, and others. FO's can be classified as cooperatives, unions, commodity organisations, and others. In the United States of America, the basis for modern agricultural extension was the formation of agricultural societies that disseminated agricultural information through their publications, lectures and newspapers articles with the aim to improve agriculture (True, 1926). Today farmers' organisations continue to play an important role in the provision of extension services across the globe. According to Swanson (2008), the idea of organizing farmers into specific producer groups can provide relevant commodity-specific information and training required by farmers; thus, it improves the effectiveness and efficiency of agricultural extension system. However, FOs (farmers' unions and commodity organisations) provide extension and advisory services to the farmers affiliated to their organisations.

The participation of farmer organisations in the provision of extension services is evident in most African countries. In West Africa, it was reported that about 79.6% of urban Mushroom farmers in Accra, Ghana received information about cultivation from Mushroom Growers Association. Therefore, the main sources of extension services for Mushroom farmers in Accra was a farmer organisation. Similarly, majority (83%) of farmers in Ndo State, Nigeria received agricultural information from farmers' associations (Adetimehin *et al*., 2014). According to Soyemi (2014), in North Central Nigeria, more than one-thirds (38.1%) of farmers received extension services from farmer unions/cooperatives compared to 42.8% and 19.1% who had moderate and no access to such services, respectively. In Oho State, Nigeria, it was found that about 17.5% of poultry farmers received extension services from farmers' associations (Umunna *et al*., 2012). Again, a study conducted Imo State, Nigeria revealed that less than one-fifth

(18.9%) of farmers accessed agricultural information from cooperatives (Opara, 2008). The literature about selected West African countries (Ghana and Nigeria) shows that the level of access to extension services from farmers organisations ranged between 17.5% and 83%. Therefore, there is low, moderate and adequate access to extension services from various farmers groups. The variation could be influenced by availability of extension service providers, resources and extension policies in the countries cited above.

In East Africa, cooperative society provided dairy information to about 63.7% of dairy farmers in Murang'a county, Kenya (Thuo, 2018). In the Tanqua Abergelle wodera in Tigray Regional State, Ethiopia it was found that about 45.4% and 17.1% of smallholder farmers accessed agricultural information from Farmers Development Groups (FDGs) and Cooperatives, respectively (Brhane *et al*., 2017). However, extension services from farmers organisations (cooperatives/union/farmer's groups) in the wheat growing of Ethiopia were available to about 1.1% of the farmers; thus, very few received such services (Kelemu, 2017). Therefore, farmer organisations provided extension services to between 1.1% and 63.7% of the farmers in Kenya and Ethiopia. Meaning, low and high access to extension services from FOs are prevalent in both countries. Studies conducted in Southern Africa countries showed that about 20% and 27% of farmers in Malawi received agricultural information from cooperative societies and farmers' associations, respectively (Phiri *et al*., 2017). Nonetheless, in most District of Malawi, less than 5% of the agricultural households receive extension services form farmers organisations (Ragasa, 2020). In South Africa, Nkosi (2017) found that 14% of emerging livestock farmers in Uthungulu District has adequate access to extension services from farmers' cooperatives. Nonetheless, 26% and 60% had moderate and inadequate access to extension services from farmers' cooperatives. Farmer organisations involved in the provision of agricultural extension service in South Africa are mostly classified into commodities. According to Koch and Terblanché (2013), there are various commodity organisations linked to AgriSA that renders agricultural extension and advisory services to their members; these commodity organisations include sugar, wine and wool industries, and others (Koch & Terblanché, 2013). Other commodity organisations that are common in South Africa are Garlic Growers Association, Avocado Growers

Association, Citrus Growers Association, Macadamia Growers Association/Cooperatives and the indigenous chicken groups; just to mention a few (Mudau *et al*., 2009). In recent years South Africa has seen the formation of non-profit organisations such as FruitsSA which is the umbrella of fruit organisations. Most of the members belonging to these organisations are black commercial and emerging farmers (Koch & Terblanché, 2013).

2.5.6 Research institutions

In agriculture, research is about generating new knowledge aimed at improving agricultural production and sustainability. As a result, agricultural research has been one of the pillars of agricultural extension and advisory services across the globe. The first paradigm of extension involved diffusion of research from research institutions to farmers through extension officers (agents). It is against the aforementioned background that most countries have established agricultural research institutions that focuses on different commodities. In South Africa, a parastatal Agricultural Research Council (ARC) was established in 1992 after the merger of different research institutes (Liebenberg & Kirsten, 2006). The role of ARC is to conduct and promote research; develop and transfer technologies; promote agricultural industry; avail technological expertise to the public and share information (Agricultural Research Act 86 of 1990). The above roles of ARC indicate that the institution is involved in the provision of extension services to agricultural producers (farmers). According to ARC (2012), the ability of the institution to disseminate information about scientific agricultural solutions is critical to improve food security and agricultural development, economic growth, and competitiveness. Therefore, research institutions such as ARC have an important role to play in the provision of extension services by disseminating scientific information to the farmers. For example, in 2019/2020 financial year as part of training and extension, ARC disseminated information to 288 farmers (agricultural producers) through field days and popular publications; and trained 1 743 farmers in South Africa (ARC, 2020). Nonetheless, in Amathole District Municipality, in the Eastern Cape province, agricultural research institutes were the less important source of climate information for agricultural producers (Popoola *et al*., 2020). On the other hand, farmers in some parts of Limpopo province (Waterberg District) and

KwaZulu Natal province (uThungulu District) had no access to extension services from agricultural research institutions (Moagi & Oladele, 2012; Nkosi, 2017). Therefore, extension and advisory services from research institutions are not accessible to all farmers. In Malawi, research institutions such as International Centre for Research in Agroforestry (ICRAF), International Centres for Tropical Agriculture (CIAT), and International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) improved farmer's access to extension services by collaborating with government and other organisations (Chowa *et al*., 2013; Masangano *et al*., 2017). However, there were few (four) research institutions involved in the provision of extension and advisory services compared to government (13 providers), NGO's (61), private sector (25) and farmer organisations with nine extension providers (Masangano *et al*., 2017). Like South Africa, the participation of research institutions in the provision of extension and advisory services was low in Malawi.

In other parts of Africa, the involvement of research institutions in the provision of extension services was also reported to be low. For example, in the wheat growing regions of Ethiopia, about 0.3% of the farmers received extension services from research institutes, compared to other sources such as government, farmers' cooperative, farmer's relatives and others (Kelemu, 2017). However, in Southern Ethiopia, circumstances were different because 5% of farmers had access to agricultural extension (information) from research centres (Philipos *et al*., 2014). Studies conducted in West Africa (Ghana and Nigeria) showed that access to extension services from research institutions was also limited. In North Central Nigeria, about one-thirds (33.9%) of farmers consulted agricultural research institutions for information compared to majority (>50%) who sought information and extension services from government, radio, farmers' unions, family members, other farmers, cell phones, television, and extension posters (Soyemi, 2014). However, in some parts of Nigeria (Delta State, Imo State, Apa local government area of Benue State, South-East Nigeria, Ondo State), it found that no research institutions provided extension services to farmers (Adomi *et al*., 2003; Opara, 2008; Okwu & Umoru, 2009; Adetimehin *et al*., 2018; Fidelugwuowo, 2021). Similarly, in certain segments of Ghana (Accra, Aduamoa and Ashanti), farmers had no access to extension services and information from research institutions (Acheampong *et al*., 2017; Obeng-Koranteng *et al*., 2017; Osei *et al*., 2017; Anaglo *et al*., 2020). According to Babu *et al*. (2013), the low participation of research institutions in the provision of extension services is because of limited staff, even though such institutions have adequate technical expertise.

2.5.7 Media

Media has played an important role in providing farmers with access to information in the 20th and 21st century. For example, the prominence of telephones, mobile phone, radio, television (TV), print materials (newspaper, books, pamphlets, magazines, journals, textbooks and electronic mails) in the 20th and 21st centuries have improved access to information in the society. In agriculture, radio and television have played a significant role in the dissemination of information to rural people, thus they are educational medium to reach out people in remote areas (Bembridge, 1991). Again, the development of expert systems, interactive web interfaces, personal web portals, virtual collections and reference services, and wireless networks in the 21st century has changed how people access information across the globe (Ramzan, 2004). Because of the aforementioned methods of accessing information, global computer network (internet) has become an integral part of information and communication technology (ICT) in the new millennium.

According to Gatheru *et al*. (2021), farmers can access extension through media such as radio/TV, mobile phones, pamphlets/newspaper, and common internet group. In Turkey (Northeast Anatolia Region), it was found that about 35% of the villagers accessed agricultural extension services from TV broadcasts whereas 2% received the services from written materials such as books and brochures (Atsan *et al*., 2009). Therefore, TV was the main source of information for farmers in some parts of Turkey. A study conducted in Asia (India) by Adhiguru *et al.* (2009), discovered that most farmers received information from media such as radio, newspapers and TV were sources of information for 54.5%, 53.8% and 53.1% of farmers, respectively. Thus, most farmers had access to extension services through various media platforms. In another Asian country (Iran, Mazandaran), Soltani *et al*. (2011) reported that radio and TV were third and fourth important sources of extension for female farmers, respectively. In addition, extension brochures and magazines were used to provide information to the farmers. Similarly, in Pakistan (Khyber Pakhtunkhwa), circumstances radio, printed materials, and TV were sources of agricultural extension services to 13%, 10% and 3% of agricultural producers, respectively (Safdar & Pervaiz, 2020).

In the African continent, studies conducted in various countries showed mixed results. A study conducted in Osun State, Nigeria, Ajala *et al*. (2013) found that media such as radio, newsletter and television were sources of agricultural information for 16%, 9.6% and 1.2%, respectively. Thus, less than one-thirds farmers received extension services from various media sources. In another study conducted in Nigeria, Oyo State, the findings showed that radio and TV were sources of information for 28.3%, and 13.4% of poultry farmers, respectively (Umunna *et al*., 2012). In Ethiopia, Umeta *et al*. (2011) revealed that few (<50%) of female farmers in the selected Districts of Mid Rift Valley in Ethiopia had access to agricultural information through radio (36.6%), TV (8.6%), and extension materials (4.5%). However, in some parts of South Africa (Waterberg District, Limpopo Province), Moagi and Oladele (2012) found that most (51.8%) of the farmers had access to agricultural information from TV. In addition, newspaper, radio, pamphlets, internet and library provided information to 35.0%, 34.2%, 19.2%, 16.7% and 5% of farmers in the aforementioned study area, respectively. Again, in the Eastern Cape province of South Africa, farmers had access to climate change information from various sources; however, the order of importance (raking) was different from Limpopo province. According to Popoola *et al*. (2020), the raking of farmer's information sources through media in Amathole District Municipality was as follows TV (1), radio (2), local newspaper (4), national newspapers (7), billboards (9), cell phones (10), internet (11) and bulletins (13). In conclusion, the literature presented in this section showed that media has played an important role in the provision of agricultural information and extension services to agricultural producers in various countries. Nonetheless, the role of media in the provision of extension services varies significantly across the globe.

2.5.8 Interpersonal

It is a natural phenomenon for human beings to interact with each other; by so doing, sharing of information occurs. The same applies to farmers when they interact with their counterparts, family and friends through formal and informal settings that are conducive for sharing information. Although it often occurs informally, interpersonal communication is one of the important sources of agricultural extension and information amongst the farmers. Through interpersonal communication, agricultural producers can access extension services through field days, demonstrations, training, farmer field schools, farmer to farmer extension and farmer participatory research (Gatheru *et al*., 2021). In addition, farmers can access extension services by meeting with an extension officer; phone calls with an extension officer and community meetings (McCormack, 2018). For example, in Asia (India), a study conducted by Adhiguru *et al.* (2009), discovered that most farmers received information from other progressive farmers (85.1%), training programmes (64.5%), extension workers (62.5%), and farmers' study tours (52.3%). Therefore, farmer to farmer was the main source of information for agricultural producers in India. Again, in Iran (Mazandaran province), Soltani *et al*. (2011) reported that demonstration programmes were ranked as the sixth important source of farmer's information, whereas technical and vocational programmes, and training courses were ranked seventh and eighth, respectively. On the other hand, in Pakistan (Khyber Pakhtunkhwa province), it was found that about two-fifths (41%) of farmers received information from other farmers and 29% from friends/relatives (Safdar & Pervaiz, 2020).

Africa is no exception to access to extension services through interpersonal. According to Ajala *et al*. (2013), 56% of farmers in Osun State, Nigeria received extension and information from their family members; apart from other extension sources. In another west African country, Ghana, family and friends were preferred sources of agricultural information for 49.6% and 44.1% of farmers in Ashanti region (Acheampong *et al*., 2017). Similarly in other African countries such as Ethiopia, South Africa, Malawi and others, interpersonal communication has been identified as a source of agricultural extension and information. In Ethiopia, Umeta *et al*. (2011) revealed that about 20.8%, 16.9% and 11.4%

of female farmers in the selected Districts of Mid Rift Valley in Ethiopia had access to agricultural extension and information through training programmes, demonstrations, and field day, respectively. On the other hand, Moagi and Oladele (2012) discovered that interpersonal communications between fellow farmers and friends/relatives were sources of information for 41.7% and 31.7% of farmers in South Africa (Waterberg District, Limpopo Province), respectively. In another study conducted in the Eastern Cape province of South Africa (Amathole District Municipality), informal meetings were ranked as the third important source of climate change information for farmers (Popoola *et al.*, 2020). A study conducted in Malawi found that nearly four-fifths (79%) of farmers received information through informal communication with their family members, friends, neighbours, and community leaders (Kerr *et al.*, 2018). Family members who were sources of information includes farmer's children, grandchildren, in-laws (mother and father-in-law), spouses and siblings.

2.6 ACCESS TO EXTENSION SERVICES

2.6.1 Overview of access to extension services

Access to extension and advisory service is very crucial for resource-poor and the new generation of farmers in both developing and developed countries across the globe. Nonetheless the level of access to extension and advisory services varies from one country to the other, depending on the sources of extension and resources available to render services to the farmers or agricultural producers. Access to agricultural extension services varies significantly between developed and developing countries. According to Swanson and Davis (2014), Asian countries have the highest extension system in the world especially China, India and Indonesia with 617 706, 90 000 and 53 944 extension workers, respectively. In addition, other Asian countries such as Vietnam (34 747), Philippines (25 000), Thailand (16 986) have more than 15 000 extension agents. In Africa, Ethiopia is the country with the largest extension systems with more than 45 000 extension workers (Davis *et al.*, 2010). Table 2.1 shows the number of public extension agents by country between 2009 and 2012.

Table 2.1: Number of extension agents by country between 2009 and 2012

Country	Number
Afghanistan	600
Algeria	798
Argentina	1 500
Austria	402
Bahamas	10
Bangladesh	13 905
Barbados	6
Belize	40
Bhutan	500
Brazil	24 000
Bulgaria	141
Cambodia	1 302
Cameroon	192
Chile	215
Colombia	1 082
Costa Rica	500
Denmark	3 198
Dominican Republic	913
DR Congo	472
Ecuador	958
Egypt	7 421
Estonia	144
Ethiopia	45 812
Ghana	1 244
Greece (Directorate of Agricultural Extension (not including regional staff)	17
Guyana	80
Honduras	25
India	90 000
Indonesia	53 944
Iran	6 497
Israel	150
Jamaica	231
Japan	7 172
Jordan	84
Kazakhstan	55
Kenya	5 470

Laos 752 or 962	752
Latvia	300
Lebanon	67
Liberia	134
Lithuania	307
Macedonia	130
Malawi	2 175
Malaysia	1 355
Mexico	5 836
Moldova	900
Mongolia	1 100
Mozambique	748
Myanmar (10 947)	4 554
Nepal	2 606
Nigeria	449
Norway	267
Pakistan	19 000
Paraguay (permanent & contracted)	677
People's Republic of China	617 706
Philippines	25 000
Poland	3 800
Republic of the Sudan	656
Romania Russian Federation	860
Rwanda	1 244
Saint Kitts and Nevis	24
Saint Lucia	54
Saint Vincent and the Grenadines	24
Sierra Leone	708
South Africa	2 210
South Korea (Republic of Korea)	4 584
Sri Lanka	583
Switzerland	104
Syria	12 000
Tajikistan (at the *Jamoat* level)	420
Thailand	16 986
Timor Leste	452
Trinidad and Tobago	100
Tunisia	854
Turkey (public & private)	14 644
United Kingdom (private sector advisors)	19
United States	2 900
Uruguay	183
Venezuela	118
Vietnam	34 747

Yemen	1 210
Zambia	742
Zimbabwe	6 159
Total	**1 059 528**

Source: Swanson & Davis (2014)

Table 2.1 shows that globally there are more than one million extension agents employed to render services to the farmers, both on small- and large-scale settings. According to the result presented in Table 2.1, Asia has largest number of extension agents in the world (917 331), followed by Africa (77 488), South America (28 913), Europe (25 233) and North America and the Caribbean (10 563). The results shows a generic picture of the number of extension agents from 83 countries in the world out of 193. Again, it combines both private and public extension personnel is some instances, whereas the number of public and private extension agents are separated in other countries. Therefore, the number of both active extension agents in the world could be nearly two million if both private and public extension agents from 193 countries were included in the report.

In South Africa, the number of extension agents (officers) after the dawn of democracy in 1994 has been increasing rapidly because of the creation of an amalgamated extension delivery system. For example, Phuhlisani (2008) found that South Africa had about 2 155 extension agents in January 2007. About a year later, the number of extension officers increased to 2 800 (Williams *et al*., 2008). In the year 2012, the Department of Agriculture, Forestry and Fisheries (DAFF) reported that there were about 3 369 extension officers employed in South Africa (DAFF, 2012). However, the number of extension practitioners was reported to the 2 704 in the latest report for the Department of Agriculture, Land Reform and Rural Development (DALRRD). Table 2.2 shows the number of extension practitioners, farmers and extension ratio in the provinces of South Africa.

Table 2.2: Number of extension practitioners, farmers and extension ratio in the provinces of South African

Province	Number of staff		Total	Estimated number of farmers (000)	Extension to farmer ratio
	Managers	Practitioners			
Eastern Cape	42	488	530	518	1 061
Free State	11	116	127	145	1 250
Gauteng	5	133	138	219	1 647
KwaZulu Natal	33	752	785	544	723
Limpopo	49	445	494	619	1 391
Mpumalanga	25	172	197	374	2 174
Northern Cape	9	49	58	38	776
North-West	30	275	305	114	415
Western Cape	8	62	70	53	855
Total	**212**	**2 492**	**2 704**	**2 624**	**1 053**

Source: DALRRD (2021) cited by Davis *et al*. (2021)

Table 2.2 shows that more than two-thirds (67.6%) of extension agents (practitioners) employed in South Africa were in the three provinces, namely Eastern Cape, KwaZulu Natal (KZN) and Limpopo Provinces, of which majority were in KZN. On the other hand, Gauteng, Free State, Mpumalanga, Northern Cape and Western Cape provinces employed less than 100 extension officers each. Despite the high number of extension agents in the country, Agricultural Research Council (ARC) reported that the average ratio was 1:873, which is above government's recommended ratio (ARC, 2011). However, Table 2.2 shows that the ratio of extension to farmers has improved to 1:1 053, even though it is still high. The high extension officer to farmer ratio implies that farmers will have less access to extension and advisory services. According to the Department of Agriculture, Forestry and Fisheries (DAFF), the low extension to producer ratio is due to the rapid increase in the number of smallholder farmers accessing land through land reform programmes and lack of clear definition of the target recipients of extension services (DAFF, 2016). As a results, there is assumption that all rural people are involved in agricultural production and entitled to public extension and advisory services.

2.6.2 Level of access to extension services and extension visits

As indicated in section 2.6.1, globally there are more than one million extension agents employed by government, private sector and farmer organisations. However, adequate access to extension and advisory services is still a challenges in some countries, especially those in the developing world. According to World Bank (2010), access to extension and advisory services is limited, especially in rural regions due to challenges related to the development of technologies that are not responsive to community needs. Access to extension is often associated with extension visit, especially in areas where there is limited access to Information and Communication Technology (ICT) facilities. As a result, several studies have been conducted to determine farmer's level of access to extension services, the frequency of extension visits and the influencing factors. According to Umeta *et al*. (2011), about most (57.6%) of women farmers in the Ethiopian Districts of Mid Rift Valley had access to extension services whereas 42.2% had not access. Out of 57.6%, only 15.5% of the were visited by extension agents once a week compared to 9.6% and 11.8% who were visited once in fortnight and month, respectively. About, 19.8% were visited during plantation (9.6%), inputs provision (9.1%), credit collection (1.1%) and every time technical advised in required (1.1%). In Nigeria, it was also found that majority (83.3%) of farmers in poultry farmers in Atisbo Local Government in Oho State, Nigeria had access to extension services compared to 17.7% who did not (Umunna *et al*., 2012). In the study cited above, it was reported that more than one-thirds (35.9%) were visited once in two weeks (fortnight) by extension officers, 23.3% once per month, 17.5% once in two month, 11.6% once in three months and 5.8% once in six months and one year, separately. Thus, most farmers (59.2%) had frequent visits from extension officers as shown by the proportions of once in two week and per month combined. Another study conducted in West Africa, Ghana found that about three-fifths (63%) of farm households had access to agricultural extension services (Anang & Asante, 2020). Again, in Ethiopia, more than half (61%) of women poultry farmers had access to extension services; however, minority (39%) had no access (Atsbeha & Gebre, 2021). In the Caribbean countries (Antigua, Dominica, Grenada, St. Lucia, St. Vincent and Trinidad), an empirical study conducted by Ganpat *et al*. (2017) found that largest proportions (82%) of the farmers had access to public extension services whereas few did not (18%). Out of 82% of the farmers with access to extension services, 36%, 31, and 15% were visited by extension agents once per annum, month and fortnight/week, respectively. Similar findings were discovered in Northeast Anatolia Region of Turkey whereby more than half (55%) of the villagers had access to agricultural extension services (Atsan *et al*., 2009). On the contrary, in Nigeria it was found that minority (42%) of cassava farmers in had access to agricultural extension services whereas majority (68%) did not (Wossen *et al.*, 2017). In support, Mirani and Memon (2011), revealed that most (78%) of farmers in Hyderabad District in Pakistan had no access no access to extension services because they were not visited by extension agents. From the proportions of farmers' who received extension services, 19.5%, 2.5%, and 0.5%, respectively, were visited by extension agents once, twice and thrice per month.

In South Africa, studies conducted in the provinces such as Limpopo, KwaZulu Natal, and Eastern Cape provinces had contradicting findings about access to extension services and extension visits. A study conducted in Thorndale in Limpopo province found that less than one-thirds (32%) of the farmers had contact with extension officers; however, most (68%) had no contact (Akpalu, 2013). From extension communication perspective, 15% each had contact with extension agents once per year and month. On the other hand, 6% and 3% had contact once in every two years and once in two to three (2-3) years, respectively. Thus, most farmers had inadequate access to extension and advisory services in Thorndale. However, in another District of Limpopo Province (Sekhukhune District Municipality), majority (60%) of the farmers had contact with extension officers; thus, there was access to extension services (Diale, 2011. Again, in Uthungulu District Municipality in KwaZulu Natal province, it was revealed that most (93.2%) farmers had adequate access to public agricultural extension services (Nkosi, 2017). Another study conducted in the Eastern Cape Province found that in Ngcabasa and Phathikhala villages, 68% and 72% of the respondents had access to extension services, respectively (Loki *et al*., 2021). Nonetheless, 32% of the respondents from Ngcabasa and 28% from Phathikhala villages had no access to extension services. In Ngcabasa village, 56%, 26%, 12% and 6%, received annual, quarterly, monthly and weekly extension visits, respectively. Extension visits in Phathikhala village did not differ much because 44% were visited annually, 22% monthly, 19% quarterly and 14% weekly. The findings from both villages' shows that most farmers had frequent access to extension services because less than half of the villagers were visited weekly and monthly by extension officers. The literature presented in this section shows mixed results about access to extension and advisory services in East Africa, West Africa and Southern Africa, the Caribbean. It shows that there is adequate and inadequate access to extension services.

2.6.3 Determinants of access to extension services

Research has been widely conducted globally to determine factors influencing farmer's access to extension and advisory services or factors associated with access to extension services. It has been documented that farmer's socio-economic and demographic characteristics are some of the factors that influence access to extension services (Umunna *et al.*, 2012; Abdallah & Abdul-Rahaman; 2016; Wossen *et al.*, 2017). Table 2.3 shows some of the positive and negative factors significantly associated with farmer's access to extension services.

Table 2.3: Factors significantly correlated with access to extension services

Variable	Correlation	Source (s)
Age	Positive	Ragasa *et al*. (2012); Soltani *et al*. (2012); Wossen *et al*. (2017); Danso-Abbeam *et al.* (2018); Loki *et al*. (2021)
	Negative	Atsan *et al*. (2009); Atsbeha & Gebre (2021); Nagar *et al.* (2021a)
Gender/Sex	Positive	Ragasa *et al*. (2012); Umunna *et al.* (2012); Nagar *et al.* (2021a); Nagar *et a*l. (2021b)
Farm/plot size	Positive	Ragasa *et al*. (2012); Abdallah & Abdul-Rahaman (2016); Nagar *et al.* (2021a); Nagar *et a*l. (2021b)
	Negative	Soltani *et al*. (2012); Wossen *et al*. (2017); Danso-Abbeam *et al.* (2018); Anang & Asante (2020); Atsbeha & Gebre (2021)
Education	Positive	Atsan *et al*. (2009); Umunna *et al.* (2012); Wossen *et al*. (2017); Nagar *et al.* (2021a); Nagar *et al*. (2021b)
	Negative	Soltani *et al*. (2012); Loki *et al*. (2021)
Income	Positive	Danso-Abbeam *et al.* (2018)
Farming experience	Positive	Soltani *et al*. (2012); Danso-Abbeam *et al.* (2018); Anang & Asante (2020)
	Negative	Abdallah & Abdul-Rahaman (2016); Nagar *et al*. (2021b)
Household size	Positive	Soltani *et al*. (2012); Atsbeha & Gebre (2021); Nagar *et al.* (2021b)
	Negative	Anang & Asante (2020)
Access to credit	Positive	Wossen *et al*. (2017); Danso-Abbeam *et al.* (2018); Gatheru *et al.* (2021); Nagar *et al.* (2021); Nagar *et a*l. (2021b)
Distance to extension office	Negative	Nagar *et al*. (2021b)
Extension visits	Positive	Atsbeha & Gebre (2021)
Distance to input source	Positive	Abdallah & Abdul-Rahaman (2016); Wossen *et al*. (2017)
Knowledge of fertilizer	Positive	Abdallah & Abdul-Rahaman (2016);
Group membership (farmers organisation)	Positive	Umunna *et al.* (2012); Abdallah & Abdul-Rahaman (2016); Danso-Abbeam *et al.* (2018); Anang & Asante (2020); Gatheru *et al*. (2021); Nagar *et al*. (2021b)
Time spent on farm	Positive	Abdallah & Abdul-Rahaman (2016)
Agricultural outputs	Positive	Atsan *et al*. (2009); Ragasa *et al*. (2012); Danso-Abbeam *et al.* (2018)
Training	Positive	Atsbeha & Gebre (2021); Nagar *et al.* (2021a)
Information	Positive	Atsbeha & Gebre (2021)

The literature presented in Table 2.3 indicate that the following group of farmers: male, high income earners from agricultural activities, access to credit, located closer to extension offices, receiving frequent extension visits, knowledgeable about fertilizers, affiliated to farmer organisation, spending more time on farms, achieving higher agricultural outputs, located further from inputs stores, accessing information and receiving training had high probabilities of accessing extension and advisory services compared to their counterparts. On the other hand, there is high degree of polarization regarding farmer's access to extension service and the socio-economic and demographic characteristics such as age, household size, farmland size, education and farming experience. Thus, both older and younger, large and small-scale, farmers with small and big families (households), highly and less educated, experience and less experienced farmers had better access to extension and advisory services, depending on the area. The variation could be because the studies cited in Table 2.3 were not conducted in the same area (country, state, province, district, region, county and others), had different samples size and data collection methods. Moreover, data was analysed data using different types of regression and other inferential statistics.

2.6.4 Challenges associated with access to extension services

In section 2.6.2, literature from studies conducted in various countries showed that farmer's access to extension and advisory services was both adequate and inadequate. Again, various factors that are negatively and positively associated with farmer's access to extension services were widely explored in the previous section. Some of those factors associated with access to extension services can be categorized as challenges that inhibit farmer's from accessing agricultural extension and advisory services adequately whereas other factors are not. Apart from the predictors (associated factors) of access to extension services identified through inferential statistics, scholars have investigated challenges that prevents farmers from having adequate access to extension services in various countries. In one of Nigerian State, it was found that some of the challenges encountered by women farmer's in accessing extension services were unavailability of extension agents, lack of transport and time to attend extension meeting, rift between farmer and extension agent, poor communication skills, lack of cooperation amongst the farmers, cultivation on small-scale farmland, lack of finance to purchase inputs, lack of improved varieties (Adekunle, 2009). It shows that institutional factors, poor relationship between farmers and extension agents, lack of resources and scale of operation prevented farmers from receiving extension services. Again, low number of extension officers, lack of proper coordination, poor transportation and road networks, lack of demonstration field, cultural problems, lack of teaching materials, lack of regular training opportunities for extension agents, inadequate ICT (Information and Communication Technology) facilities and lack of incentives for field personnel were identified as some of extension challenges in Nigeria (Segunna *et al*., 2020).

Rural women in Khyber Pakhtunkhwa, Pakistan had no access to agricultural extension services due to hijab, illiteracy, lack of mobility, language barrier and unavailability of information sources (Safdar & Pervaiz, 2020). In this instance, culture (religion and language), farmer's personal attributes and lack of resources were the inhibitors of access to extension services. Nagar *et al*. (2021b) found that lack of awareness about sources of extension (government, Agriculture Universities/Colleges, private extension agents, NGO and Media (Radio/TV/Newspaper/Internet) available in western Uttar Pradesh, India, prevented farmers from accessing extension services. Farmer's lack of awareness could emanate from failure to create awareness, lack of information and farmer's ignorance. In Europe, farmer's affordability was one of the main challenges presenting small-scale farmer's from accessing extension services due to the privatisation of agricultural extension; as a result, agricultural productivity and income of resource poor farmers was low (Labarthe & Laurent, 2013). In South Africa, the Department of Agriculture, Forestry and Fisheries (DAFF, 2016) reported that some of the challenges associated with limited access to agricultural extension and advisory services were poor linkage between research, extension and producers, low extension to producer ratio, disintegrated efforts from different extension support agencies, lack on a national policy and regulatory framework and limitations in the extension education system and narrow service focus. One of the aforementioned sentiments is echoed by Akpala (2013) who revealed in Thorndale, Limpopo Province, some farmers did not access extension services due to unavailability of extension officers.

2.7 EXTENSION DELIVERY SYSTEMS AND APPROACHES

2.7.1 Extension delivery system

Agricultural extension is about rendering various services to the farmers or agricultural producers; hence it is often referred to as extension and advisory services. To render services to the customers or recipients, there is a delivery system that is should be followed to ensure that services are rendered using defined procedures and protocols. According to Ramaswamy (1996) service delivery system refers to the processes and facilities employed to render services. Service delivery system is about how the services will be delivered to the customers. When designing a services delivery system, the focus should be on the structure, infrastructure, and integration (Roth & Menor, 2003). Therefore, extension delivery system is the framework employed by extension organisations to reach out to the farmers to deliver extension and advisory services. So, the focus is about the procedures that farmers will follow to access extension and advisory services for extension officer and/ how extension officers will render services to the farmers. For example, the common extension delivery system is when extension officers reach out to the farmer by visiting them in the farming areas, through meetings, workshops, discussion, and training sessions (Albert, 2014). The aforementioned delivery system has been adopted by various extension organisations across the globe because it is perceived as the traditional extension delivery system. Agricultural extension service delivery system is important because it provide guidance about approaches and processes that should be followed to transfer knowledge and skills to the farmers, and access information (Mekuriaw, 2022). Various extension organisations have developed systems that are appropriate for the delivery of extension and advisory services to their clients. Hence, extension delivery systems include ministry-based or public, private sector, NGOs, farmer organisations, university-based, farmer to farmer and others.

Extension delivery system is consisting of the following key elements: structure, financing and delivery of services and partnerships (Rivera & Qamar, 2003). The structure is about the participation of various spheres of an organisation and their level of authority, whereas financing and delivery focuses on the funding and personnel responsible for extension services, respectively. For example, in ministry or public-based extension delivery system, government is responsible for the payment of extension services through revenue collection (Birkhaeuser *et al*., 1991; Cary, 1993; van den Ban, 2003; Qamar, 2005). As a result, public extension services in most countries have been rendered freely (van den Ben, 2003). The structure of authority ranges from national ministry to province/state/region/district/county, province to region/district, and district/region to local government. Partnership includes the collaboration between national governments, international, and private organisations in the planning and execution activities, payment of services and risk sharing (Habtom, 2019).

In a private sector extension system, farmers pay for services received (Feder *et al*., 2011). Thus, private sector extension is a cost recovery system. This is because private agricultural extension is demand- and profit-driven. By paying for extension services received, farmers contribute to the salaries, pension fund, allowance, transport, office space and furniture, research, ICT, and other resources (human, material, financial and intellectual) require by private organisations to render extension services. In pluralistic extension delivery systems, various organisations are collaboratively involved in the provision of extension and advisory services to the farmers whereby responsibilities are shared. The arrangements for the delivery of services and financing mechanism for pluralistic extension varies from one area to the other. For examples, in a demand-driven system the clients will pay for extension services, whereas in a supply-side the service provider will pay for the services (FAO, 2016). However, in some instances government can subsidize private organisations to render extension services freely to the farmers (Ramírez & Lee, 2007). In a pluralistic extension delivery system in the USA, universities and colleges are mandated to carry their research findings to the farmers because the state provide funding for cooperative extension services (Boyer, 1990; Anderson &

Feder,2004; McLean, 2007). Table 2.4 shows extension models adopted in selected sub-Saharan African (SSA) countries.

Table 2.4: Extension models adopted in selected SSA countries

Country	Extension model
Angola	Rural Development and Extension Programme, Farmer Field School
Benin	Participatory Management Approach, Farmer Field School
Burkina Faso	Farmer Field School
Cameroon	National Agricultural Extension and Research Programme Support Project
Ethiopia	Participatory Demonstration and Training Extension System, Farmer Field School
Ghana	Pluralistic Extension System including, Ministry, Private Companies, NGOs and Farmer Field School
Kenya	Pluralistic Extension System including, Ministry, Private Companies, NGOs and Farmer Field School
Malawi	Pluralistic Extension System including, Farmer Field School
Mali	Participatory Demonstration and Training Extension System, Farmer Field Schools, Modified Training and Visit Extension System
Mozambique	Farmer Field School, Government led Pluralistic Extension System
Nigeria	Unified Agricultural Extension System, Pluralistic Extension System including Ministry, Private Companies, NGOs and Farmer Field School
Rwanda	Farmer Field School, Pluralistic Extension System
Senegal	Farmer Field School, Pluralistic Extension System
Tanzania	Farmer Field School, University-based Extension System and Pluralistic Extension System
Uganda	Pluralistic Extension System, National Agricultural Advisory Services and Farmer Field School
Zambia	Participatory Extension System, Farmer Field School
Swaziland	Participatory Extension System, Farmer Field School
Lesotho	Unified Agricultural Extension System, Pluralistic Extension System including Ministry, private companies, NGOs
South Africa	Ministry-Based, University-based, Commodity-Based, Community Extension and Cyber Extension System

Botswana	Farming Systems Approach, National Master Plan for Arable Agriculture and Dairy Development
Côte d'Ivore	Ministry of Agriculture led Pluralistic Extension System and Farmer Field School
Namibia	Ministry-based, Commodity-based, Community Participation
Madagascar	Ministry-based, Training and Visit Extension System, Commodity-based
Zimbabwe	Ministry-based, Commercialized Extension System, Community Participation
Mauritius	Ministry-based, Training and Visit Extension, Community-based, The Community Extension Type

Source: Oladele (2011)

Table 2.4 shows that ministry-based extension, farmer field school and pluralistic extension systems are practised in most (>50%) SSA countries. Although, it not clearly indicated whether South Africa has a formal pluralistic extension system, the involvement of government, universities, commodity organisations and communities in an indication that pluralism exist in the country. In support, Koch and Terblanché (2013) reported that South Africa has a pluralistic extension system involving government, private organisations, commodity organisations (sugar, wine, wool industries, and others), NGO and other organisations. The South African national extension policy is also in support of a pluralistic integrated approach (DAFF, 2016).

2.7.2 Extension approaches

Extension approach is about the style of action found within an extension system (Axinn, 1988). Therefore, in an extension delivery system, service providers may employ various extension approaches (models). For example, Mapiye *et al*. (2021) reported that in revolutionizing extension using ICT, various approaches such as ministry-based, training and visit (T&V), farmer field school (FFS), project/integrated, farming systems research, cost-sharing and education institution can be used. However, in some literature, approaches such as training and visit (T&V), farming systems, farmer field schools and agricultural innovation systems are classified as extension delivery system. Even though there is a clear difference between an extension delivery system and extension approach.

According to Hagmann *et al*. (2000), an approach is a method whereby various principles are applied to achieve the objectives in a specific situation. Furthermore, extension approaches are developed based on dichotomies with two possibilities that can be chosen from. In the dichotomous of extension approaches, the choice is between top-down approach and bottom-up approaches that are participatory by nature (Düvel, 2000). Figure 2.1 shows dichotomous of extension approaches.

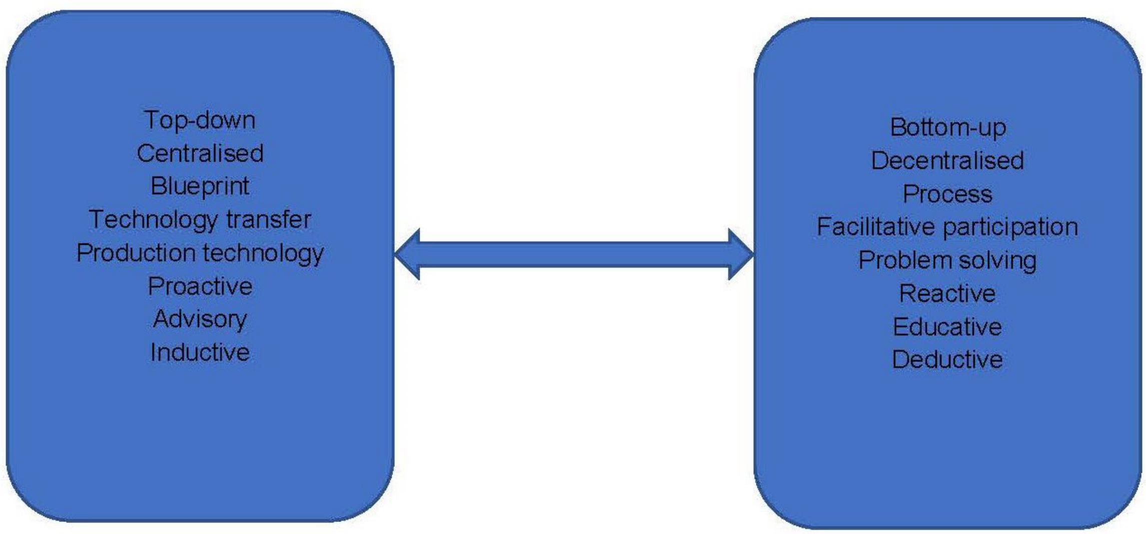

Figure 2.1: Dichotomous of extension approaches (Düvel, 2000)

Since, the formalisation agricultural extension in the 19th century, various extension approaches have been developed across the globe. According to Olayemi *et al*. (2021), extension approaches use the following classification: top down, participatory, demand-led; group versus individual targeting; private sector and free/paid extension services. According to FAO (2008), some of the prominent extension approaches are transfer of technology (TOT), training and visit (T&V), participatory approaches, farming systems, farmer field school (FFS) and agricultural innovation systems (AIS). In most African and Asian countries, the main extension approaches used are cost-sharing, education institution, participatory extension, specialized approach, technology transfer and commodity approaches (Mapiye *et al*., 2021). In the past two decades or so, the world has witnessed the change from transfer of technology and government-dominated extension approaches to pluralistic extension approaches that involves various stakeholders such as private and civil society sectors (Sulaiman & Davis, 2012). Moreover, participatory approaches that are bottom-up have also gained popularity in the late 20th and beginning of 21st century. Table 2.5 shows top-down (conventional) and participatory extension approaches.

Table 2.5: Top-down (conventional) and participatory extension approaches

Top-down/conventional approaches	Participatory approaches
Transfer of Technology (TOT)	Farmer Field School (FFS)
Training and Visit (T&V)	Farming Systems Research (FRS)
Problem Solving Approach	Agricultural Knowledge and Innovations Systems (AKIS)
Commodity Approach	Knowledge Information System
Project Approach	Community-Based Approach
Educational Institution Approach	Participatory Technology Development (PTD)
	Participatory Rural Appraisal (PRA)
	Participatory Learning and Action Approach
	Participatory Cost-Sharing Approach
	Participatory Research and Extension

Source: Own compilation based on Fleischer *et al*. (2002); Ellis-Jones *et al*. (2005); Secretariat of the Pacific Community (2008); Ozcatalbas *et al*. (2011); Fernandaz and Kumar (2014)

Table 2.5 depict that participatory extension approaches are dominant compared to conventional approaches. It shows that more participatory approaches have been emanated since the shift towards non-conventional approaches became prevalent due to the disadvantages of top-down approaches. According to Bahçeli (2018), conventional approaches or top-down approaches is about transferring researcher's thoughts and ideas to the farmers without. Thus, top-down approaches prioritises the transfer of research innovations, and results, and information to the farmers to improve agricultural productivity and change farmers behaviours. Conventional approaches has played a significant role in spreading innovations, especially in developing countries (Ponniah *et* *al*., 2008). However, top-down approaches failed because their focus was to disseminate technologies without proper understanding of diversity of farming systems; farmer's problems, and potentials (Düvel, 2000). Because of that, top-down approaches became unpopular in countries where they have failed. For example, Training and Visit (T&V) approach achieved disappointing results in many countries because it was not appropriate for local conditions (Anderson *et al*., 2006). Thus, T&V does not recognize the local environment and needs of the communities because it is too uniform.

From 1980's, participatory extension approaches emerged because most governments started reducing their investments in extension services (Baig & Aldosari, 2013). Furthermore, the participatory extension approaches emerged after the failure of some top-down approaches (Hagmann *et al*., 1999). Participatory approaches became prominent because they enable poor people to participate in the identification of their problems and determine possible solutions and allow extension personnel to facilitate development plans and implementation mechanisms (Kaur & Kaur, 2018). In addition, participatory approaches create a learning partnership between farmers, researchers and extension officers; enable farmers to develop and adapt appropriate innovations; establish an experimental learning environment between farmers through knowledge generation; and recognise farmers as heterogenous group of people with life dynamics such as conflicts, differences, interests, power and capabilities (Hagmann *et al*., 1999). The assumption was that conventional approaches failed because they did not involve people (farmers) in the conceptualisation of research and development of innovations aimed at improving agricultural production. Table 2.6 shows some of the characteristics of conventional and participatory extension approaches.

Table 2.6: Characteristics of conventional and participatory extension approaches

Variable	Conventional approach	Participatory approach
Objective	Increase agricultural production by transforming the farming system toward use of modern technologies	Achieve sustainable development through increase of farmers' management skills and empowerment
Underlying hypothesis on development problem	Inefficiency of farm management due to a lack of technology adoption, insufficient infrastructure, or unavailable inputs	Non-sustainability of farming practices due to a lack of understanding of agronomic and ecological principles and socio-economic conditions
Specific problem in problem management	Lack of knowledge on modern farming techniques, under-use of external inputs	Over-reliance on external inputs and under-utilization of self-regulating ecological factors and community action
Type of extension strategy	Technical recommendations, usually in 'packages', and subsidies on modern inputs	Strengthen farmers' planning, analytical and testing skills and facilitate institutional and attitudinal changes
Assessment of impact	Adoption of externally delivered technologies, effect on production and income	Increase in technology-generating and -adapting self-help capacity, its effects on financial, human and social capital, environment and health

Source: Fleischer *et al*. (2002)

2.8 FUNDING FOR EXTENSION SERVICES

2.8.1 Extension funding

In most countries, agricultural extension services are highly funded by government through revenue collection (Birkhaeuser, Evenson & Feder, 1991; Cary, 1993; Van den Ban, 2003; Qamar, 2005). Because of that, extension services offered by government in most countries have been free (van den Ben (2003). The reason is that government is the main source of extension services for farmers in most countries (Qamar, 2005; Magoro & Hlungwani, 2014; Maoba, 2016; Nkosi, 2017; Rohit *et al*., 2017). However, in recent years agricultural extension services have been rendered by producer organisations, farmer organisations, non-governmental organisations, and private institutions (Neuchatel Group, 1999; Van den Ban, 2000; Koch & Terblanché, 2013; Nkosi, 2017). Therefore, agricultural extension services can be considered as both public and private services. According to Van den Ban (2000) factors such as target groups, goals, extension methods and others, influences the financing of agricultural extension services. For example, Van den Ben (2000) reported that government funded agricultural extension services are justifiable if the public domain benefit more compared to the extension clients. However, the financial viability of government funded agricultural extension services has been brought into scrutiny in since the late 20th century and 21st century (Cary, 1993; Kidd *et al*., 2000; Van den Ben, 2003; Afful & Lategan, 2014). This has resulted in the reduction of fiscal allocation for agricultural extension services in many countries (Farrington, 1994; Rivera and Alex, 2004; Anderson & Feder, 2007; Afful & Lategan, 2014). The high reduction of government financial support for agricultural extension services has been very common in developed countries compared to developing countries (Anderson & Feder, 2004; Davis, 2008). As a result, agricultural extension services are predominantly rendered by private sectors in most developed countries (Qamar, 2005).

Funding of agricultural extension services varies between countries. This includes full withdrawal of public funding, cost recovery approach (through collection of levies, fees charged for public extension services, or contracting extension services from government) and generating income by selling inputs, surplus land and sales of information materials (Kidd *et al*., 2000). Other types of agricultural extension privatisation systems include partial privatisation, outsourcing and contracting out (Qamar, 2005). There have been suggestions that agricultural extension services should be totally privatized because they are ineffective and irrelevant in the 21st century. The main argument is that government funded agricultural extension services have failed and are not satisfactory to the farmers' needs (Kidd *et al*., 2000; Qamar, 2005; Afful & Lategan, 2014; Magoro & Hlungwani, 2014; Kabir *et al.*, 2020; Kassem *et al.*, 2021). However, other scholars have disputed this notion and argued that full privatisation of agricultural extension services can only be beneficial to large-scale commercial farmers and neglect poor farmers (Kidd *et al*., 2000; Anderson & Feder, 2007). For example, Davis (2008), reported that privatisation systems such as fee for services have failed in many developing countries. The reason could be that most farmers in developing countries are not willing to pay for extension services (Anderson & Feder, 2004; Foti *et al*., 2007; Ali *et al*., 2008; Oladele, 2008). In conclusion, there is degree of polarization about funding model suitable for agricultural extension services.

2.8.2 Payment of extension services by farmers and influencing factors

According to van den Ben (2003), extension services offered by government in most countries have been free. However, because of extension reform initiatives that led to the reduction of public extension funding in many countries, various scholars have conducted research to explore the feasibility of fee for service extension systems and farmer's willingness to pay for extension services rendered by different organisations, including government. There is a degree of polarization about farmer's willingness to pay for extension services across the globe. Several studies have found that most farmers in developing countries are willing to pay for extension services (Anderson & Feder, 2004; Ozor *et al*., 2013; Afful *et al*., 2014; Uddin *et al*., 2016; Loki *et al*., 2019). In KZN province of South Africa, it was found that significant majority (60%) of farmers were willing to pay for multiple sources of extension compared to 27% and 14%, respectively, who were willing to pay for public and private extension (Loki *et al.*, 2020). On the contrary, Foti *et al*. (2007); Ali *et al*. (2008); Oladele (2008) found that most farmers were not willingness to pay for extension services. Although there are farmers who are willing to pay for extension services, income is one important factors that will determine whether farmers can afford to pay for extension services or not. According to Ozor *et al*. (2013); Uddin *et al*. (2016), farm income has a positive and significant relationship with farmers' willingness to pay for extension services. Thus, farmer earning more income from farming are more willing to pay for extension services.

Other significant factors that influence farmer's willingness to pay for extension services have been identified using various data analytical methods such as regression (Logit, Tobit and Probit), correlation, Mann-Whitney U Test, Analysis of Variance (ANOVA), Chi-square test and Contingent Valuation Method (CVM). According to Ajayi (2006), farmer's willingness to pay for extension services is positively and significantly influenced by annual income, years of farming experience, literacy level, cosmopoliteness, ability to pay and assessment of extension services. It implies that farmers' earning more income, highly experienced and literate, capable of paying and able to assess extension services were willing to pay for extension services. However, in the study cited above, it was found that sex and organisational participation were negative and significant predictors of farmers willingness to pay for extension services. On the other hand, Budak *et al.* (2010) found that herd size, type of breed, production for market and distance from extension service were significant factors influencing farmer's willingness to pay for extension services. Thus, farmers with more livestock, cross breed, producing for market, and locate further from extension office were more willing to pay for extension services. Ozor *et al*. (2013) found that farmer's likelihood to pay for extension services was positively and significantly correlated with states of origin, number of schooling years, sale of farm produce, items farmers originally paid for, farmer's major and minor occupation. Nonetheless, most farmers were willing to pay the minimum amount required for agricultural extension services.

In another study, it was found that younger farmers, highly educated farmers and producers farming on bigger farms were more likely to pay for extension services (Oladele, 2008). However, the author cited above discovered that gender, farming experience and proportion of crops sold were negative and significant predictors of farmer's willingness to pay for extension services. Thus, highly experienced farmers and producers who sold most of their crop produce were less likely to pay for extension services. Similarly, education level, income and age were positively and significantly correlated with farmer's willingness to pay for extension services (Shausi *et al*., 2019) However, the findings of year in farming experience contrasted with other authors cited earlier because experience was a positive and significant predictor of willingness to pay for extension services. In contrast to other scholars cited earlier in this section, Loki *et al*. (2019) found that age, income, response of extension officers and change in farm practices were negative and significant factors influencing farmer’s willingness to pay for extension services. On the other hand, type of farmer, farming season, farm goas achieved, land size, access to extension and privatisation of extension services had positive and significant association with farmer’s likelihood to pay for extension services. Similar to the literature presented in this section, Charatsari *et al*. (2011) found that gender and education have positive and significant association with farmer’s willingness to pay for extension services, whereas age and farming experience had negative association. In addition, the author cited above found that availability of information on innovation, increase in economic returns, increased knowledge on the natural environment, information on modern technology in agriculture and satisfaction of curiosity influenced willingness to pay for extension services. The findings by Uddin *et al*. (2016) were consistent with that most scholars with regards to education, income and farming experience. They found that education, agricultural income, farming experience and proportion of crops sold had significant influence on farmer’s willingness to pay for extension services.

2.9 QUALITY AND EFFECTIVENESS OF EXTENSION SERVICES

Most research conducted about the quality of extension and client satisfaction has focused on public extension and advisory services because government is the main provider of extension services in most countries, especially developing. In addition, there are studies that compared the quality of public and private extension services. Makapela (2015) found that public agricultural extension services were ineffective in prioritising development programmes that alleviate poverty; implementing short and medium-term goals; providing resources; and the ratio of extension officers to farmers. Maoba (2016) also reported that public extension services were ineffective in facilitating workshops, sharing information through printed material; and communicating through telephones. The quality of public extension services is one of the challenges that have also been raised by some of the farmers (Sharmin, 2012). For example, Mmbengwa *et al*. (2012) reported that nearly half of the farmers in the West Coast District Municipality in South Africa considered the quality of public extension services poor. Furthermore, Agholor *et al*., (2013) reported that more than half (>50%) of male farmers in the Amathole District in South Africa were not satisfied with the quality of timelines of delivery and the accuracy of extension services rendered by government. Kabir *et al*. (2020) reported that most farmers were not satisfied with the quality of public extension services, with specific reference to content offered, accuracy and relevance, timelines, efficiency, and feedback provided. Kassem *et al*. (2021) also discovered that farmers in Egypt were dissatisfied with the quality of some of the services rendered by government extension officers. Most of the farmers in the aforementioned studies were not satisfied with services rendered based on their needs and reliance on solving their problems. This is a concern because the quality of extension services influences agricultural productivity on the farms. If farmers do not receive extension services of good quality, their agricultural outputs are more likely to be lower, and they become food insecure due to loss of production and income.

According to Moradi and Poorsaeid (2014), satisfaction with extension services is positively and significantly influenced by age, farm size, income, and use of extension services. Furthermore, gender, literacy level, number of visitations and number of farm parts significantly influence satisfaction with extension services (Ganpat *et al*., 2017). In some instances, family size, number of family members involved in agriculture and other occupations, and financial security positively and significantly influenced satisfaction with government extension services (Joshi & Narayan 2019). In some parts of South Africa, it was found that the quality of extension services rendered by government was poor due to transformation that favoured the employment of inexperienced extension officers (Conradie, 2016). Moreover, the high ratio of extension officers to farmers is one of the factors that have a negative impact on the quality of public extension services. According to Phiri (2009); Raidimi and Kabiti (2019), South Africa’s public extension services are not coping with the demand for the services because the support provided to small-scale and resource-poor farmers is limited. For example, large numbers of smallholder farmers receiving public extension services are allocated few extension personnel compared to large-scale farmers who are allocated more (Department of Agriculture, Forestry and Fisheries 2011). According to the Agricultural Research Council (2011), the average ratio of extension officers to farmers in South Africa is about 1:873. This is above the ratio recommended in the norms and standards for extension and advisory services in South Africa. The ratios recommended for extension officers to farmers in South Africa range between 1:250 and 1:500 for different group of farmers, such as subsistence, semi-commercial and commercial large-scale farmers (Worth, 2012). Because of the high ratio of extension officers to farmers, there is poor access to extension and advisory services amongst the farmers who rely on public extension services.

The imbalance in the ratio of extension officers to farmers in South Africa is more likely to affect the quality and effectiveness of public extension services. This is because extension officers will not give priority to all the farmers and visit them as required by high demand. In support of the above supposition, Davis and Terblanché (2016) reported that human resources is one of the fundamentals that influence the effectiveness of extension services. For example, Elias *et al*. (2015) and Ganpat *et al*. (2017) found that farmers constantly visited by extension officers are more satisfied with the quality of the services – meaning that if the ratio of extension officers to farmer is high, extension officers will not visit the farmers as required. Therefore, extension services will be perceived as ineffective if farmers are not satisfied because the services rendered will be of poor quality. Several studies have been conducted to determine the effectiveness and quality of public extension services in South Africa. Maoba (2016) measured the effectives of ten extension methods (training, demonstrations, study groups, farmers days, farm visits, on-farm trails and research, workshops, print materials, office and telephone call) used by agricultural advisors in the Germiston region in the Gauteng province of South Africa. Moreover, Makapela (2015) focused on the effectiveness of extension services by interviewing extension practitioners. In terms of the quality of extension services, the study conducted by Agholor *et al*. (2013) measured effectiveness using accuracy of service, timeliness of delivery, relevance of situation, ease of understanding, and opportunity to use. Although several studies have been conducted to measure the quality and effectiveness of public extension services in South Africa, none of them have used the norms and standard of extension and advisory services developed by the National Department of Agriculture in South Africa. The sample size in studies conducted by Maoba (2016); Makapela (2015); Mmbengwa *et al*. (2012) was less than 100.

In Ngcabasa and Phathikhala villages in the Eastern Cape Province of South Africa, it was found that more than 70% of the villagers perceived the quality of extension services as poor and very poor (Loki *et al*., 2021). In Pakistan, Mirani and Memon (2011) used five-point Likert scale to measure farmer's perceived effectiveness of public and private extension services using the following variables: farms visits, methods of conducting farmer's meetings, conducting demonstrations, explaining procedures for carrying out improved practices, treating farmers fairly, planning, knowledge of faming problems, timely meetings, allowing farmers to discuss, providing opportunity to understand and demonstrate learning, and general performance in disseminating agricultural practices. In their study, they found that services offered by agricultural extension agents were poor in all the variables measured; thus, extension services were perceived as ineffective.

2.10 PLURALISTIC EXTENSION SYSTEM

2.10.1 Definition and overview of pluralistic extension

The term "pluralistic" is about bringing together different institutions that provide extension services and financial support to agricultural advisory services (Birner *et al*., 2006). Thus, pluralistic extension refers to the provision of extension services by different sources of extension (Okorley *et al*., 2010). Pluralistic extension is also referred to as public-private partnership (PPP) by other scholars, government, farmers, and other agricultural extension stakeholders. In pluralistic extension systems, different organisations such as the government, the private sector and non-profit organisations are involved in the provision of extension services (Zwane, 2009; Klerkx & Proctor, 2013; Koch & Terblanché, 2013; Phillipson *et al*., 2016; Rohit *et al.*, 2017). In addition, pluralistic extension system includes the participation of universities, agricultural research institutions and farmers' organisations (associations) in the provision of agricultural extension services (Jadallah *et al.*, 2011). In South Africa, the pluralistic extension system includes stakeholders such as government through the Ministry of Agriculture, agricultural cooperatives, commodity organisations and the private sector (Zwane; 2009; Koch & Terblanché, 2013). In addition, research organisations, academic institutions, farmers' unions, and non-governmental organisations provide extension services to the farmers in South Africa (Zwane, 2009). Therefore, pluralistic extension implies that different organisations provide extension and advisory services to the farmers collaboratively. As a result, pluralistic public-private partnership has been proposed as a viable complementary to public agricultural extension services in many countries (Kidd *et al.*, 2000; Qamar, 2005; Anderson & Feder, 2007). The partnership implies that extension programmes/projects should be planned, implemented, and evaluated jointly by all service providers and farmers receiving the services (Rivera & Qamar, 2003). Thus, a healthy relationship between all the stakeholders is important to enable the pluralistic system to achieve positive results. Figure 2.2 shows a framework for pluralistic extension system involving government, private sector, and NGOs.

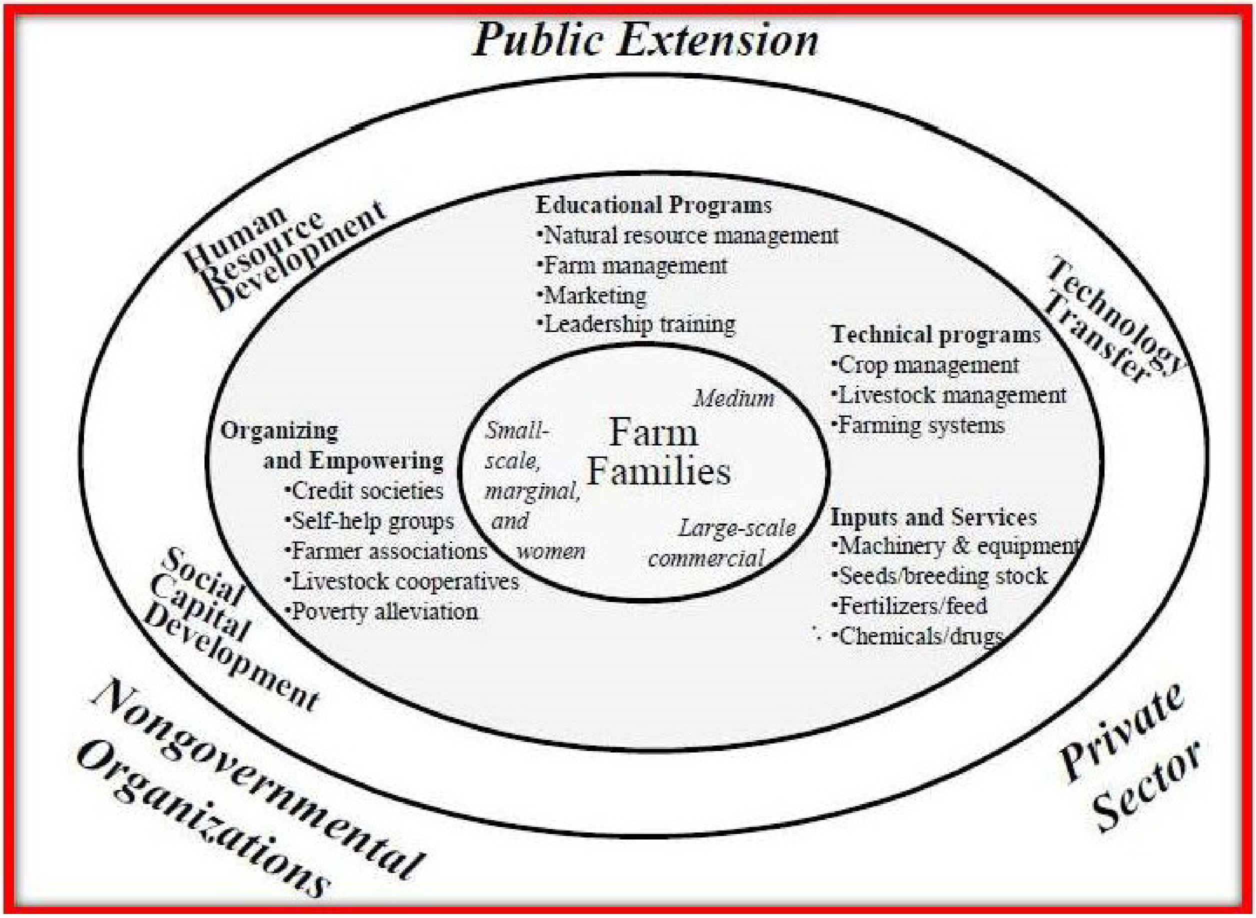

Figure 2.2: Framework for pluralistic extension system involving government, private sector and NGOs (Source: Olayemi *et al*., 2021 as adopted from Swanson & Samy, 2003).

Pluralistic extension became popular after the Green Revolutions when there were widespread perceptions that public extension and advisory services had become ineffective, inefficient, and fiscally unsustainable (Birner *et al*., 2006). As a result, different institutions started providing extension and advisory services in collaboration with government and/ separately. In some instances, organisations that were providing extension services prior to the negative widespread perceptions about public extension services expanded their services. Pluralistic extension system also occurred because of the paradigm shift towards extension approaches and systems that favoured the participation of multiples stakeholders in the provision of extension and advisory services. For example, the emergence of agricultural innovation systems approach in the 21st century. An agricultural innovation system is an on-going framework aimed at strengthening the capacity to innovate agricultural production and marketing systems whereby all potential public and private sectors are brough together in the creation, diffusion, adoption, and use of all types of agricultural knowledge relevant to production and marketing of produce (Scoones & Thompson, 2009). As a result, agricultural extension reforms in the new millennium have shifted towards pluralistic extension delivery systems in many countries across the globe (Nahdy *et al*., 2002; Rivera & Alex, 2004; Gemo *et al*., 2013; Knierim *et al*., 2017; Masangano *et al*., 2017; Alimirzaei *et al*., 2019).

In Europe, pluralistic extension became more popular when government (public) extension services were partially- and fully replaced by pluralist advisory services that was in favour of the provision of extension services by private sector, commodity-based organisations and other institutions (Labarthe & Laurent, 2013). Pluralistic agricultural advisory system is slowly becoming dominant in most of the Eastern European countries, of which Poland is a leading nation with more sources of extension services (Swanson & Davis, 2014). In Africa and Asia, many countries have tried to change their extension systems from supply-driven to demand-driven and pluralistic extension system, but they had few successes (Düvel, 2000; Meena & Singh, 2013). In Africa, pluralistic extension was introduced towards the end of the 20th century in the early 1990's (Catling, 2008). The system can be found in African countries such as Kenya, Mozambique, Uganda, Tanzania and Zambia (Swanson & Samy, 2001). Also in Malawi, Nigeria and South Africa pluralistic extension system can be found (Umunna *et al*., 2012; Chowa *et al*., 2013; Koch & Terblanché, 2013; Masangano *et al*., 2017). For example, in South Africa pluralistic extension include government, private organisations, commodity organisations (sugar, wine, wool industries and others), NGO and others (Koch & Terblanché, 2013). Other commodity organisations such as Grain SA, Potato SA and Fruits SA render extension services to the farmers affiliated to them. Pluralistic extension system is slowly gaining momentum in South Africa because the new extension policy is in favour of pluralist extension and advisory services. *The country's extension policy stipulates that "the policy commits South Africa to a pluralistic integrated approach that optimises and harmonises* *the extension and advisory roles and contributions of government, the private sector, NPOs and producers. This will ensure combined extension and advisory services capacity through partnership, collaboration and integration between actor"* (DAFF, 2016).

2.10.2 The role of government in pluralistic extension

In pluralistic extension the role of the government changed because the system is a multi-institutional activity driven by different interests and support structures. For example, Rivera & Alex (2001) reported that the role of government in a pluralistic extension system is to implement public policy, collect information, deal with emerging concerns, respond to emergencies, provide information, regulate, quality control and enhancement, coordinate systems and promote reform. According to van den Ban (2000), in a pluralistic extension system, government can act as a facilitator for various organisations involved in the provision of extension and advisory services. Therefore, government should play a leading role to ensure that pluralistic extension system is aligned with the goals and aspirations of the country.

2.10.3 Advantages and strength of pluralistic extension

Since pluralistic extension has gained popularity, various scholars have explored the advantages of the system on the farmers, governments and other extension service providers. According to Gemo *et al*. (2013); Abdu-Raheem and Worth (2016), pluralistic extension system acknowledges the necessity to employ various approaches to resolve farmer's challenges because the diversity of the farming system. The system enables farmers to receive information, innovations, resources, and support from different stakeholders involved in the provision of extension and advisory services. As a result, pluralistic extension system improve access to funding, provide additional personnel and solutions for farmers needs and tailor services aligned to the requirements for a region or sub-sector (Birner *et al*., 2006). In addition, farmers benefit from pluralistic extension by having improved access to quality extension services (Abdu-Raheem & Worth, 2016). From government perspective, the pluralistic extension is perceived as a mechanism form capacity building of farmers and extension personnel; provision of networking and learning opportunities; provision of technical and financial support; and creation of a platform for sharing new ideas and technologies that enhance the development extension agents and farmers (Ngaka & Zwane, 2018). Therefore, pluralistic extension benefits both farmers and extension agents. On the farmers side, Kau *et al*. (2019) reported that some of the strengths of multiple (pluralistic) extension services are as follows:

- access to free extension services and products from various agencies;
- provision of complementary services;
- application of different extension models;
- inclusive participation and farmer's involvement; and
- enable farmers to cultivate a variety of commodities.

Chowa *et al*. (2013) found that pluralistic extension increased farmers agricultural productivity due to access to information, knowledge, and technologies from various sources. In addition, pluralism enhanced social learning amongst farmers and other stakeholders involved in the system.

2.10.4 Challenges of pluralistic extension

Coordination of pluralistic extension system is one of the main challenges because there are various stakeholders involved in the provision of extension and advisory services (Rivera & Alex, 2004; Christoplos, 2010; Kau *et al*., 2019). Because of poor coordination, vulnerable farming groups may have poor access to extension services even in the presence of various extension agencies. In addition, parallel structures may be created especially where there is poor interaction with farmers (Chowa *et al*., 2013). Therefore, there would be duplication of efforts if pluralistic extension delivery system is not properly coordinated. According to Kau *et al*. (2019), that lack of joint and common exit strategies among extension service providers, and lack of implementation for existing partnership at operational level could impede pluralistic extension delivery system. The main problem with unclear exist strategies is that projects become unsustainable when there is abrupt exit by extension organisations without adequate notices to the beneficiaries of the extension services (Chowa *et al*., 2013).

2.11 CHAPTER SUMMARY

According to some scholars in the literature reviewed in this chapter, agricultural extension started in 1785 in the USA by agricultural societies that were formed to share information. On the other hand, other scholars argued that in China and Greece, sharing of agricultural information can be dated back to 2nd A.D. and 221 BCE, respectively. However, there is general perception that agricultural extension originated in Britain because it was labelled and popularized by two British universities towards the middle of the 19th century. Literature review presented in this chapter has shown that the definition of agricultural extension has changed over time since extension was formalized in the 19th century. Because of that, extension approaches introduced in the 19th century and most part of the 20th century followed top-down (linear approach) whereas new approaches (late 20th to 21st century) are mostly participatory in nature. Therefore, there is a degree of polarization regarding the history and definition of agricultural extension. The same sentiments echo the role of agricultural extension because it varies. Literature reviewed has shown that the role of extension is about improving agricultural development and decision-making, facilitating access to innovations and information, and improving agricultural production.

Government has been the main source of extension and advisory services in many countries because the services are rendered freely. Because of free public extension services, documented literature has shown that most farmers in developing countries are not willing to pay for extension services; although, the findings from other studies showed otherwise. It has been discovered that some of the positive and significant factors associated with farmer’s willingness to pay for extension services are annual income, years of farming experience, literacy/education level, cosmopoliteness, ability to pay, assessment of extension services, herd size, type of breed, production for market and distance from extension service, sale of farm produce, items farmers originally paid for, farmer’s major and minor occupation, farm size, farming season and type of farmer. As a result, most farmers have access to extension and advisory services from government (public extension). Access to extension services is significantly associated with age, gender, farmland size, education, income, farming experience, household size, access to credit, distance to extension office and input sources, extension visits, knowledge of fertilizer, group membership (farmers organisation), time spent on farm, agricultural outputs, training and access to information. There have been negative perceptions about the quality and effectiveness of public extension services in many countries. As a result, public extension services have been completely and/ partially withdrawn in some countries because of reduction in public funding and political interference. In addition, access and delivery of public extension services has been hampered by challenges such as unavailability/low number of extension agents, lack of/ poor transport, rift between farmers and extension agents, poor communication skills, lack of cooperation amongst the farmers, cultivation on small-scale farmland, lack of proper coordination, and road networks, lack of demonstration field, cultural problems, lack of teaching materials, lack of regular training opportunities for extension agents, inadequate ICT and other factors.

Because of challenges associated with public extension, pluralistic extension system involving the collaborations of various organisations (government, private companies, NGO’s, research institutions, farmer organisations and institutions of higher learning) has emerged as an alternative extension delivery system. The introduction of pluralistic extension system has promoted the integration of various sources and collaboration between organisations. Pluralistic extension system in preferred in the new millennium because it acknowledges the necessity to employ various approaches to resolve farmer’s challenges, enable farmers to receive support from different organisations, improves access to extension services, create an inclusive participation platform for farmers and promote learning. Nonetheless, some of the challenges on pluralistic extension are poor coordination and duplication of efforts. The main hypothesis is that significant majority of farmers receiving public extension and advisory services in Gauteng province would accept the inclusion of university agricultural extension in a pluralistic extension system.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION

Research methodology refers to systematic procedures employed by researchers from problem conceptualization until the finalization of the research (Singh, 2006). This chapter provide information about the procedures and methods that were employed to conduct the study in order to achieve the objectives listed in chapter one. In the first section, the description of the study area is outlined, followed by study design and sampling procedures followed to select the participants. In addition, the conceptual framework indicating the structure of the study; and data gathering procedures are presented. Thereafter, the summary of data analytical methods employed to achieve research objectives, study limitations and delimitations are illustrated. The summary of chapter three is presented in the last section.

3.2 DESCRIPTION OF THE STUDY AREA

The study was conducted in the Gauteng province of South Africa. The Gauteng province is the smallest of the nine provinces in South Africa with an estimated size of 18 179 km^2 (Statistics South Africa, 2011). However, it is the most populous province with an estimated population of 15.4 million (Statistics South Africa, 2020). The province is subdivided into three metropolitan municipalities and two district municipalities, namely City of Johannesburg Metropolitan Municipality, City of Tshwane Metropolitan Municipality, City of Ekurhuleni Metropolitan Municipality, Sedibeng District Municipality, and West Rand District Municipality. Gauteng is the economic hub of South Africa because it contributes 35% of the gross domestic product (GDP) in the country, and 11% in the African continent (Gauteng Enterprise Propeller, 2020). As a result, the province is highly urbanised due to influx of labour migrants from other provinces of South Africa and the Southern African region. About 25.5% of 57.7 million people in South Africa reside in Gauteng (Gauteng Provincial Treasury, 2019). The key economic drivers in the province are government services, manufacturing, trade, mining, transport, finance, electricity, construction, personal services and agriculture. Although agriculture is one of the economic sectors in Gauteng, it contributes 1% of the GDP in the province (Gauteng Enterprise Propeller, 2020). Agriculture in the province mainly consists of livestock and crop production; and fishery at both small- and large-scale farming. According to the Department of Agriculture, Land Reform and Rural Development (2020) there are 2 291 commercial farming units in Gauteng that create about 16 420 skilled and unskilled employment opportunities. Figure 3.1 below shows the map of Gauteng Province where the study will be conducted:

Figure 3.1 Map of Gauteng province where the study was conducted (Mkhize & Kanyile, 2020)

3.3 RESEARCH PROCESS

Research process is about the steps followed to conduct the research. Steps followed to conduct the research can be classified as the elements of the research process. **Figure 3.2** shows the elements of the research process followed in the study.

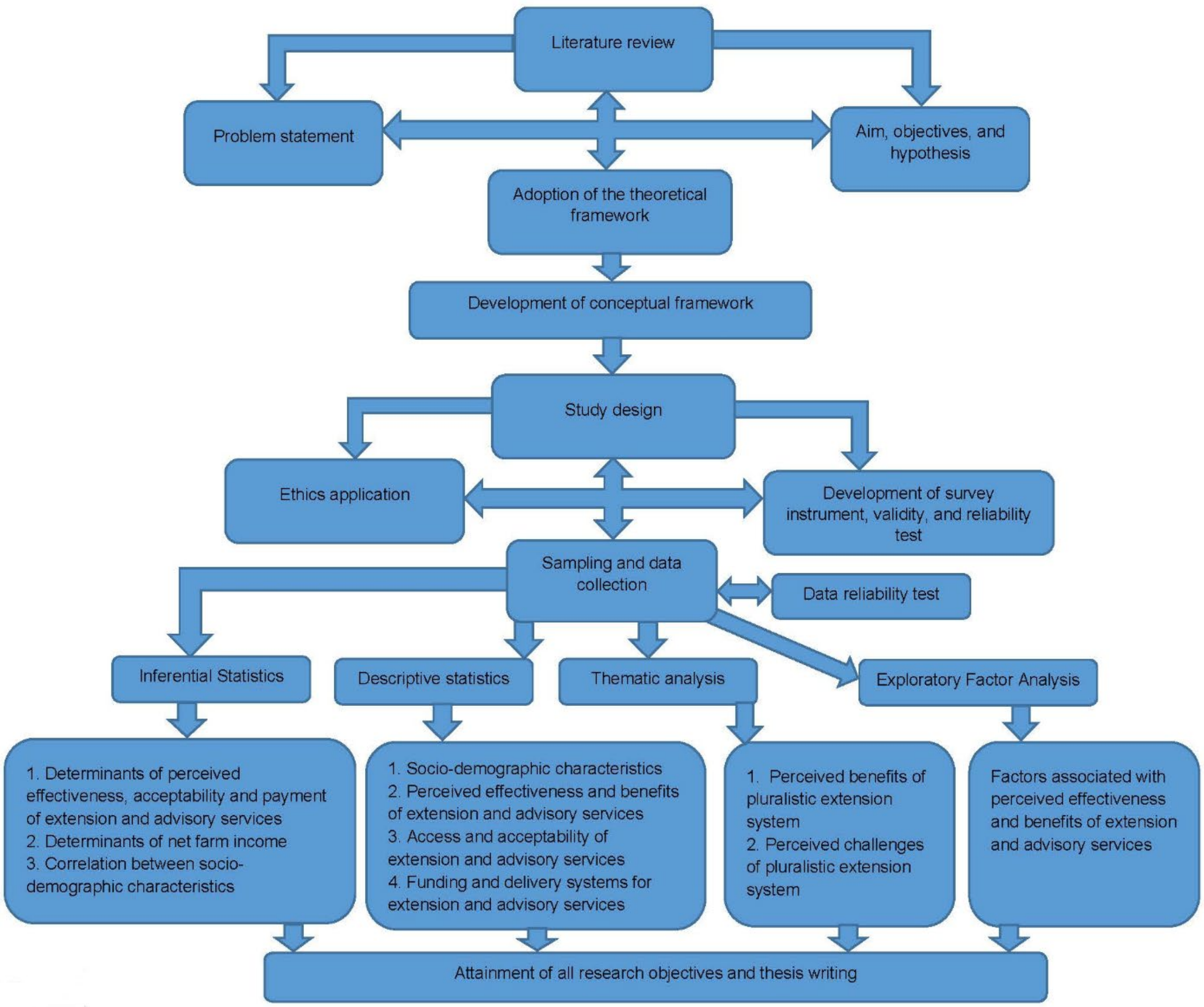

Figure 3.2: Elements of the research process followed in the study

3.4 STUDY APPROACH AND DESIGN

A survey design was employed whereby a quantitative research approach was used to conduct the study. Quantitative research approach enables collection, capturing and analysing of numerical data; hence, it was chosen (Lau, 2016). A survey was chosen because it describes how the perceptions of the respondents is associated their characteristics (McMillan & Schumacher, 2014).

3.5 STUDY POPULATION

The study population was farmers receiving agricultural extension and advisory services from Gauteng provincial government. The participants were farmers in community gardens, on agricultural plots and on large-scale farms. Again, the targeted participants were those involved in farming to feed their families only (produce food for home consumption), earn income to sustain their livelihoods and for both reasons (produce food for home consumption and income generation). The participants were from various local and metropolitan municipalities in the province. According to Stats SA (2017), there are about 9 000 farmers in the Gauteng province of South Africa. Therefore, 9 000 was considered as the study population from which a sample was drawn from.

3.6 SAMPLING TECHNIQUES

According to Krejcie and Morgan (1970), a sample size of 368 is appropriate for a population of 9 000 to achieve a margin error of 5%. However, 442 participants were sampled because more farmers expressed interest to participate in the study during data collection. Most of the interested participants were found in community gardens where they are farming in groups. Although simple random sampling was used to select the targeted participants (368), an additional group of 74 farmers who showed interest were included in the study. To mitigate the error that could be created by the respondents who showed interest to participate in the study (self-selected participants), first preference was given to those who were randomly selected. Thereafter, the other participants who showed interest were interviewed. The voluntary participation shown by non-selected farmers was accepted because it increased the sample size of the study. Therefore, it reduced the risk of bias and margin error.

3.7 DATA GATHERING AND SURVEY INSTRUMENT

A semi-structured survey instrument found in appendix 1 was used to collect data from the selected participants in the year 2018. The researcher completed the questionnaire during face-to-face interviews with the participants. The survey instrument was constructed by the researcher and reviewed by experts in the field of agricultural extension and rural development in the Department of Agriculture and Animal Health at the University of South Africa. It consisted of various groups of questions that enabled the researcher to collect information about the socio-demographic characteristics of the participants, access to extension services, the quality and efficiency of public extension and advisory services and acceptability of university agricultural extension. In addition, the survey instrument included the questions that enabled the collection of information concerning farmer’s perceptions about extension delivery system and funding model (s) suitable for university agricultural extension. Three types of five-point Likert-scales were used to collect information related to each objective. Table 3.1 shows the description of types of Likert scales in the survey instrument used to collect data:

Table 3.1: Description of types of Likert scales in the survey instrument used to collect data

Description of Likert-scale	Purpose of data collection
1=Very poor; 2=Poor; 3=Average; 4=Good; 5=Very good	Perceived quality of public extension services
1=Very ineffective; 2=Ineffective; 3=Average; 4=Effective; and 5=Very effective	Perceived effectiveness of public extension and advisory services
1=Strongly disagree, 2=Disagree, 3=Uncertain, 4=Agree, 5=Strongly agree	Perceived benefits of university agricultural extension

To measure perceived effectiveness of public extension and advisory services, the questions were informed by the guiding principles for extension support and advisory services developed by the National Department of Agriculture in the Republic of South Africa (DoA, 2005). The measurements of the effectiveness of public extension and advisory services were quality of extension services; relevance of extension approaches used; rendering of demand-driven, good quality services and goods (Batho Pele); promoting equity; flexibility in responding to farmers' changing needs; effectiveness in monitoring and evaluation tools; prioritising the needs of the beneficiaries; focusing on human and social capital development; use of participatory approaches; facilitating access to technology and services that sustain income generation; improving planning and decision-making; sustainability of agricultural production; agricultural skills development; and strengthening institutional arrangements. A dichotomous question was asked about the acceptability of university agricultural extension as a complement to public extension, possible funders for extension services and farmer's willingness to pay for extension services. The possible responses to the question were "No" and "Yes", denoted by zero (0) and one (1), respectively. Open-ended questions collected information about perceived the reasons why farmers preferred specific extension delivery system. Detailed information about the type of data collected to answer each research objective is contained in chapter four to nine.

3.8 VALIDITY AND RELIABILITY

The survey instrument was developed by the researcher and validated by the supervisors and other subject experts in the field of agricultural extension and sociology. To ensure the validity and reliability of the survey instrument, a pilot study involving 30 farmers was conducted. Thereafter, the survey instrument was adjusted accordingly based on the information gathered during the pilot study. The participants selected in the pilot study were excluded from the main research; thus, their data was not presented in the thesis. All the research assistants were trained before they assisted the researcher with data collection. After training, the research assistants had to observe the researcher collecting data through interviews and completing the questionnaire. The purpose of the above activity was to familiarise the research assistants with the data collection process. The research assistants started with data collection under the supervision of the researcher until it was satisfactory that there would not be bias if they collected data alone. To ensure internal consistency of the survey instrument, quantitative data collected during pilot study was subjected to Cronbach's alpha coefficient analysis. Cronbach's alpha coefficient analysis was also performed after primary data was collected (Refer to the details provided in chapters six to seven.

3.9 ETHICS

Before the data collection started, permission and ethical clearance were obtained from the Gauteng Department of Agriculture and Rural Development (Appendix 4) and the College of Agriculture and Environmental Sciences (CAES) Research Ethics Review Committee of the University of South Africa (Unisa), respectively. The ethics reference number for the project is 2016/CAES/073 (Appendix 3). Data was collected through face-to-face interviews with the participants at their plots, farms and community gardens. Before interviews were conducted, the purpose and objectives of the study and the rights of the participants were clearly explained to the interviewee. Thereafter, all the participants were required to sign an informed consent form before interviews were conducted (Appendix 2). Declaration about the preservation of their identity (right to anonymity) and confidentiality of the information they provide with throughout the study will be granted.

3.10 DATA ANALYSIS

Primary data collected in the study was both quantitative and qualitative. Quantitative data was collected from closed questions whereas qualitative data emanated from open-ended questions that enabled the respondents to express themselves freely. Quantitative data was analysed using different analytical methods found in the IBM Statistical Package for the Social Sciences (SPSS) version 27. On the other hand, thematic analysis was applied on qualitative data. Detailed descriptions of data analytical methods employed in the study are included in chapters four to nine where the results are presented. Considering the number of statistical methods utilised in the study and specifications for inferential statistical models, it was appropriate to include detailed analysis chapters four to nine. Table 3.2 below presented the summary of data analytical methods employed in the study.

Table 3.2: Summary of data analytical methods employed to achieve the objectives of the study

Objective	Data analysis method
To profile the socio-demographic characteristics of farmers receiving public agricultural extension and advisory services	Descriptive statistics, Multiple Linear Regression (MLR) and Kendall's tau correlation
To determine farmers' perception of public agricultural extension and advisory services with specific reference to: o perceived quality of extension services and influencing factors; and o frequency of access to public extension services and its determinants	Descriptive statistics and Ordered Logistic Regression (OLR)
To ascertain farmers' access to sources of extension services	Descriptive statistics
To determine farmers' perceptions of effectiveness of the existing public agricultural extension and advisory services with specific reference to: o the perceived effectiveness and influencing factors; and o exploratory factors associated with the perceived effectiveness	Cronbach's alpha, Descriptive statistics, Principal Axis Factoring (PAF) and OLR
To ascertain farmers' acceptability of university agricultural extension in a pluralistic extension system with specific reference to: o willingness to accept and the perceived benefits of university agricultural extension; and o factors influencing the acceptability of university agricultural extension.	Descriptive statistics, Cronbach alpha's coefficient, Binomial Test, PAF and Binary Logistic Regression (BLR)
To determine university agricultural extension delivery system (s) preferred by farmers and factors influencing their choice	Descriptive statistics, Multinomial Logistic Regression (MLR)
To identify the reasons why farmers preferred different university extension delivery systems	Descriptive statistics, Multinomial Logistic Regression (MLR)
To ascertain farmers' perceptions about funding model suitable for university agricultural extension services	Thematic analysis and descriptive statistics
To determine farmers' willingness to pay for university agricultural extension services and factors influencing their choice	Descriptive statistics, Cochran's Q Test and McNemar Test.

3.11 STUDY LIMITATIONS AND DELIMITATIONS

The limitation of the study is that data was collected through interviews; thus, it relied on farmer's recollection to answer questions about socio-demographic information (age, education level, farm size, income, and others), types of crops and fruits cultivated, types of livestock kept and access to extension services. The respondents were not required to provide certificates for their educational records, identification documents, income statements, records for their land size and ownership and registration forms for extension visits. Again, information about the quality and effectiveness of public extension services was based on the perceptions of the respondents. Nonetheless, the study limitations do not affect the credibility of the results and have no implications on the use of the results. The reason is that all the farmers interviewed were accessed through government agricultural advisors (extension officers); therefore, the level of trust was built with the farmers to ensure that they provided reliable information about their socio-demographic information. In some cases, verifications were done with the agricultural advisors. Again, the types of crops and fruits cultivated, and livestock kept by the respondents were observed during face-to-face interviews conducted in the farming places of the respondents. With regards to perceived quality and effectiveness of public extension and advisory services, the findings are also credible because the sample size of 448 was adequate to make a conclusion based on farmer's perceptions. Perception studies are often used to determine people's views about services rendered to them by organisations in order to improve service delivery and/ introduce new services or innovations. Determining farmer's perceptions about the quality and effectiveness of public extension services through a survey instrument is widely accepted in agricultural sociology, marketing and related disciplines; thus, the results are reliable because the research methodology is credible.

The delimitation of the study is that it was only limited to the farmers receiving most of agricultural extension services from government through Gauteng Department of Agriculture and Rural Development (GDARD). The selection of the participants was based on the list of farmers obtained from government extension officers; thus, random sampling was applied in the number of farmers in the government records. The effectiveness of public agricultural extension services was limited to the principles outlined in the norms and standards for extension and advisory services in agriculture developed by the South African National Department of Agriculture. However, the study delimitations do not affect the credibility of the study findings. Moreover, they have no implications on the use of the results. Firstly, majority of farmers receiving public extension and advisory services are resource poor farmers who receive various support services from government. Gauteng Department of Agriculture and Rural Development (GDARD) was the reliable source of information for the list of farmers who receive public extension services and needed pluralistic extension services. Again, effectiveness of extension services can be measured using different variables, depending on the objectives of the study. The credibility and use of the results of the perceived effectiveness of public extension services is limited to the variables measured in the study (principles outlined in the norms and standards for extension and advisory services in agriculture developed by the South African National Department of Agriculture). Therefore, the results are credible and can be used to influence policies, decision-making and future research initiatives.

3.12 CHAPTER SUMMARY

In brief, the study was conducted in Gauteng province of South Africa though a survey involving 442 farmers who were randomly selected from the list of farmers obtained from government extension officers. Permission and ethical clearance to conduct the study were obtained from Gauteng Department of Agriculture and Rural Development (GDARD) and College of Agriculture and Environmental Sciences (CAES) Research Ethics Review Committee of the University of South Africa. Primary data was collected through physical interviews using a semi-structured survey instrument. Descriptive and inferential statistical methods and exploratory factor analysis found in SPSS version 27 were employed to analyse quantitative data. In addition, qualitative data was analysed using thematic analytical methods involving themes, codes and indicators.

CHAPTER 4: SOCIO-ECONOMIC AND DEMOGRAPHICS OF THE RECIPIENTS OF PUBLIC EXTENSION AND ADVISORY SERVICES IN GAUTENG PROVINCE

4.1 BACKGROUND AND INTRODUCTION

Demography is defined as the study of human population with specific reference to development, size and structure (Scheidel, 2001). Demographics include socio-economic information such as age, employment status, ethnicity, gender, home ownership, income, and interest access (French, 2014). Moreover, demographic data include births, deaths, migration and spatial distribution (ACAPS, 2014). In some instances, demographic information is referred to as social and demographic information, hence, the word socio-demographic information is commonly used. According to Stone (2018), socio-demographic characteristics refer to the sociological and demographic factors such as religion, gender, age, marital status, family size, racial affiliation, heritage, education and income. In most agricultural extension studies, information about the socio-demographic characteristics of the participants is collected and analysed using descriptive statistics (Ragasa *et al*., 2016; Ijatuyi, Omotayo & Mabe, 2017; Majokweni, 2018; Mahlangu *et al*., 2020; Somanje *et al*., 2021). Several studies have shown that farmers' demographic and socio-economic characteristics influence access to extension services (Lipton, 1972; Phuhlisani, 2008; Ragasa *et al*., 2013; Baloch and Thapa, 2014). For example, in South Africa before the end of apartheid government in 1994, ninety thousand white farmers were allocated about 3 000 agricultural extension officers, whereas 600 000 black farmers had less than 1 000 extension officers allocated to them (Lipton, 1972; Phuhlisani, 2008). This description shows that access to extension services was influenced by farmers' racial affiliation (race). Ragasa *et al*. (2013) reported that female farmers were less likely to access good quality extension services compared with male farmers. In support, World Bank and IFPRI (2010); Lamontagne-Godwin *et al*. (2018) found that women farmers did not have equitable access to extension and advisory services. As a result, women participated less in extension-related meetings. Again, gender determined the level of access to extension services in some farming communities. Furthermore, Ofuoku and Ekorhi-Robinson (2018) indicated that married farmers were more likely to benefit from extension services. According to Baloch and Thapa (2014), access to extension services was positively and significantly influenced by farmers' age and education level (literacy). Thus, socio-demographic characteristics such as race, age, education, gender and marital status are some of the demographic characteristics that influence access to extension services and farmers' participation in extension related activities.

In addition, farmers' perceptions about the quality of extension services are influenced by their socio-demographic characteristics (Agholor *et al*., 2013; Gwala, 2013; Al-Zahrani *et al*., 2019). Satisfaction with extension services is influenced by farmers' demographic and socio-economic characteristics (Ganpat *et al*., 2017; Moradi & Poorsaeid, 2014; Joshi & Narayan, 2019). Agricultural productivity, net income and adoption of innovations are also influenced by socio-demographic characteristics of the farmers. For example, Zhengfei and Lansink (2006); Mwaura (2014) reported that productivity for older farmers was higher; meaning that with age increase, their productivity increased. However, in the study by Mwaura (2014) the findings showed that age had a negative relationship with maize, beans and cassava production. Farmers' age positively and significantly influenced the adoption of Genetically Modified (GM) crops; meaning when age increase, farmers were more likely to adopt GM crops (Keelan *et al*., 2009). Okunlola *et al.* (2011) found that farmers' education level had a positive and significant relationship with the adoption of new technology. In support, Adeola and Ayoade (2009) reported that access to technologies was significantly influenced by farmers' socio-demographic characteristics such as age, education, marital status and land acquisition method. However, in their study, it was found that farming experience and farm size had an insignificant relationship with access to technologies. On the other hand, Rakoena (2019) found that age had a positive and significant relationship with net farm income; meaning that older farmers made more profit from farming.

The background provided in section 4.1 above shows that farmers' socio-demographic characteristics were associated with agricultural productivity, net farm income, access to extension services, perceived quality of extension services and satisfaction with extension services. Consequently, it was necessary to profile the socio-demographic characteristics of farmers receiving public agricultural extension and advisory services in Gauteng province where the study was conducted. Therefore, the purpose of this chapter is to present the results of the socio-demographic characteristics of the research participants. In the first section, research objective is presented, followed by hypothesis, data analysis methods, and results and discussion. Thereafter, conclusions are presented in section 4.6.

4.2 RESEARCH OBJECTIVE

The research objective was to profile the socio-demographic characteristics of farmers receiving public agricultural extension and advisory services in Gauteng province.

4.3 TYPE OF DATA AND ANALYTICAL METHODS

Quantitative data was collected (using structured questionnaire) to profile the socio-economic and demographic characteristics of the farmers receiving public extension and advisory services in Gauteng province. It comprised of both numerical and categorical data. Numerical data collected included annual net farm income, farming experience and farm/plot size. The categorical data collected included gender, age group, education level, marital status, race, home language, farming category, main source of income and land acquisition methods. Data was analysed by means of descriptive statistics (frequencies, percentages, standard deviation of the mean, standard error of the mean, and coefficient of variation). The following formula described by Canchola *et al.* (2017) was used to calculate the coefficient of variation (CV%):

$$CV\% = \frac{\sigma}{\mu} \times 100$$

Whereby, σ is standard deviation and μ is the arithmetic mean of the sample. The correlation of the socio-demographic characteristics was also determined. The data for socio-economic characteristics of the respondents consisted of continuous, nominal and ordinal data. As a result, Kendall correlation was used appropriately to measure the association between the variables. Kendall's tau correlation was considered because it is suitable for ordinal-continuous and ordinal-ordinal variables (Khamis, 2008).

In addition, Multiple Linear Regression (MLR) model was used to analyse data for factors influencing annual net farm income of the respondents. In the current study, data for the dependent variable (annual net farm income) was continuous. As a result, annual net farm income earned by the respondents in the previous year was modelled using the Multiple Linear Regression (MLR) Model that is based on Ordinary Least Square (OLS) principles. The OLS estimates are generally linear, unbiased, with minimum variance, consistent and normally distributed (Gujarati, 2009). According to Gujarati (2009), the model may be specified as:

$$Y_i = \beta_0 + \beta_i X_i + \varepsilon_i \qquad (1)$$

Where,

Y_i = Annual net farm income in the previous year, β_0 is a constant and X_i are the independent variables namely; socio-demographic characteristics and other factors which influence annual net farm income as depicted in Table 4.1. The Ordinary Least Squares principle states that the sum of the squares of the deviation for all values of population Y_i and sample $\hat{Y}_i$ is to be a minimum.

i.e. $$\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2 \qquad (2)$$

Where,

n = the number of data points comprising of the sample. Since Y is dependent upon more than one variable, then,

$$Y_j = \alpha + \beta_1 X_{1j} + \beta_2 X_{2j} + \beta_3 X_{3j} + \cdots + \beta_m X_{mj} + \varepsilon_j \quad (3)$$

or, more succinctly,

$$Y_j = \alpha + \sum_{i=1}^{m} \beta_j X_{ij} + \varepsilon_j \quad (4)$$

The model estimation:

The sample regression equation containing the statistics used to estimate the population parameters when there are *m* independent variables, would be:

$$\hat{Y}_j = \alpha + b_1 X_{1j} + b_2 X_{2j} + b_3 X_{3j} + \cdots + b_m X_{mj} \quad (5)$$

$$\hat{Y}_j = \alpha + \sum_{i=1}^{m} b_i X_{ij} \quad (6)$$

From equation (6), *b* can be determined as:

$$bi = \frac{\sum xy}{\sum x^2} = \frac{\sum(X_i - \bar{X})(Y_i - \bar{Y})}{\sum(X_i - \bar{X})^2} = \frac{\sum X_i Y_i - \frac{(\sum X_i)\sum Y_i)}{n}}{\sum X_i^2 - \frac{(\sum X_i)^2}{n}} \quad (7)$$

Then,

$$\bar{Y} = \alpha + \beta\bar{X} \quad (8)$$

and $$\alpha = \bar{Y} - \beta\bar{X} \quad (9)$$

The best estimate of the population parameter α = is the sample statistics

$$\alpha = \bar{Y} - b\bar{X} \quad (10)$$

To ensure the validity of the model, the assumptions of linearity, normality, homoscedasticity and independent of error were determined, and then all the endogenous variables were removed. Autocorrelation and multicollinearity were determined using Durbin-Watson statistic and the VIF values, respectively. MLR model and the parameter estimates provided included the following: Regression coefficients βi, constant, standard error, R^2, adjusted R^2, VIF, Residual analysis, Durbin-Watson, t-values and the F-test. Table 4.1 below presents definitions and explanations of variables used in the MLR model.

Table 4.1: Independent and dependent variables included in the MLR model

Type of variable	Variable description	Expected sign	Interpretation of signs
Independent variable	Gender (0=Female; 1=Male)	Negative	Females have low annual net farm income
	Age group (1=< 35 yrs; 2=35 – 45 yrs; 3=46 – 55 yrs; 4=56 - 65 yrs; 5= > 65 yrs.)	Positive	Annual net farm income of older farmers is high
	Education level (1=No formal education; 2=Primary education; 3=Secondary education; 4=ABET education; 5=Diploma; 6=Bachelor Degree; 7=Honour Degree/BTech; 8=Master Degree; 9=Doctoral Degree	Positive	Highly educated farmers earn more income/annum
	Farm/plot size (Ha)	Positive	Large scale farmers earn more income/annum
	Farming experience (Years)	Positive	Experienced farmers will earn more income/annum
	Number of visits by extension agent/officer (Number)	Positive	Frequently visited farmers earn more income/annum
	Distance from farm/plot to the extension office (Number)	Negative	Farmers located close to extension office have high annual net income
Dependent variable	Annual net farm income (Amount in ZAR)	-	-

Data pertaining to the socio-demographic information, access to extension services, and perceptions about the quality of agricultural extension and advisory services was analysed by means of descriptive statistics (frequencies, percentages, standard deviation of the mean, standard error of the mean, and coefficient of variation). The correlation of the socio-demographic characteristics was determined by using Spearman correlation. The data for socio-economic characteristics of the respondents consisted of continuous, nominal and ordinal data. As a result, Kendall correlation was used appropriately to measure the association between the variables. Kendall's tau correlation was considered because it is suitable for ordinal-continuous and ordinal-ordinal variables (Khamis, 2008).

4.4 RESULTS AND DISCUSSION

The results and discussion of the socio-demographic characteristics of the respondents and types of agricultural commodities are presented in section 4.4.1 and 4.4.2, respectively.

4.4.1 Socio-demographic characteristics of the respondents

The socio-demographic characteristics of farmers receiving extension and advisory services from government were not static. Thus, they varied in association with the study and population of the farmers. Literature has shown that government renders extension services to people of different gender, age, education (literacy) level, racial affiliation, and other demographic characteristics that define them. In this study, information collected about the socio-demographic characteristics of the respondents included gender, age group, level of education, marital status, race, home language, farm size, land occupation methods, net farm income, farming experience, farming category and sources of income. The results of demographic characteristics of the respondents are presented in section 4.4.1.1 to 4.4.1.10.

4.4.1.1 *Race and home language*

South Africa is a multiracial country with more than ten official languages. According to Chapter six (6) of the Constitution of the Republic of South Africa, the country has eleven official languages namely, Afrikaans, English, Sepedi (Northern Sotho), Sesotho, Setswana, IsiZulu, IsiXhosa, IsiNdebele, IsiSwati, Xitsonga and Tshivenda. Moreover, indigenous languages such as Khoi, Nama and San languages are also recognized by the constitution even though they are not classified as official languages in the constitution. In recent years, the Constitutional Review Committee of the South African Parliament has recommended that South African sign language should be added as the twelfth official language in the country (Reagan, 2020). Gauteng province, which is the study area, is a multiracial province because it is the economic hub of the country. Thus, the farming in the province consists of people from various racial and ethnic compositions. Because of the above background, racial composition of the farmers receiving public extension and advisory services in the study area was profiled. Table 4.2 below shows the results of racial affiliation and language composition of the respondents.

Table 4.2: Racial affiliation and language composition of the respondents (n=442)

Variable	Status	Frequency	Percentage
Race	Black African	429	97.0
	Coloured	11	2.5
	White	2	0.5
Home language	Sesotho	119	26.9
	IsiZulu	101	22.9
	Sepedi	51	11.5
	Setswana	49	11.1
	IsiXhosa	48	10.9
	Ndebele	27	6.1
	Xitsonga	13	2.9
	Tshivenda	12	2.7
	Afrikaans	11	2.5
	Swati	8	1.8
	English	3	0.7

The results of racial affiliation in Table 4.2 show that a large proportion (97%) of the farmers who had access to public extension and advisory services were Black Africans compared with other races (Whites and Coloured). The current findings are aligned with the racial demography of agricultural households in Gauteng province, where more than three quarters (79.8%) are Black Africans and coloured people are less than five percent (Stats SA, 2016). The findings showed that public extension services in Gauteng province were now accessible to black African farmers who were previously neglected by the apartheid government. According to Phuhlisani (2008), Black African farmers had limited access to extension services before the dawn of democracy in 1994. Thus, the democratic government in South Africa has improved access to extension and advisory services amongst previously disadvantaged group of people. In the current study, Black Africans were dominant in agreement with various studies conducted in Gauteng, which showed that most farmers were Black Africans (Modibedi, 2018; Nkgudi, 2019; Rakoena, 2019). Therefore, access to extension and advisory services in Gauteng province was proportional to the racial composition of the farmers.

From language perspective, Southern Sotho (Sesotho) was the most spoken language (26.9%) followed by IsiZulu (22.9%) and other languages as shown in Table 4.2**.** The least spoken language was English with 0.7% of the respondents. The findings show that Sotho languages (Southern Sotho, Sepedi and Setswana) were spoken by 45.5% of the farmers; meaning that they were dominant compared with the Nguni (IsiZulu, IsiXhosa, IsiNdebele and IsiSwati) which were home languages to 41.7% of the respondents. According to Statistics South Africa (2011), IsiZulu is the most spoken language in Gauteng province, followed by English, Afrikaans and Sesotho, respectively. The study findings implied that Zulu people were less involved in farming in Gauteng province even though they were the majority. In comparison with other studies, the current findings are in contrast to Nkosi (2017) who found that a large proportion (99.9%) of the farmers receiving extension and advisory services spoke IsiZulu. It is worth mentioning that the aforementioned study was conducted in KwaZulu Natal province where IsiZulu is more prevalent (Stats SA, 2011), hence, there was a high variation between the two studies.

4.4.1.2 *Gender*

There are several agricultural studies across the world that have explored gender issues. For example, gender participation in agricultural production (Taj *et al*., 2009; Mohammed

& Abdulquadri, 2012; Raidimi, 2014; Olowa & Olowa, 2015; Joshi & Kaluani, 2018; Sigdel & Silwal, 2018); gender role in agricultural decision-making (Nosheen *et al*., 2008; Raidimi, 2014); and marketing of agricultural produce (Uzokwe & Ofuoku, 2006). Moreover, in agricultural extension, gender access to extension services has also been documented. Literature has shown that women do not have equitable access to extension services (World Bank & IFPFI, 2010; Ragasa *et al*., 2013; Lamontagne-Godwin *et al*., 2018). The literature shows that exploring gender participation in agricultural activities is imperative; hence, information about gender access to public extension and advisory services was gathered in the current study. The purpose was to ensure that the perceptions of male and female farmers receiving public extension services and their acceptability of university-based agricultural extension system are documented. The results of the gender of the respondents in the study area are presented in Figure 4.1.

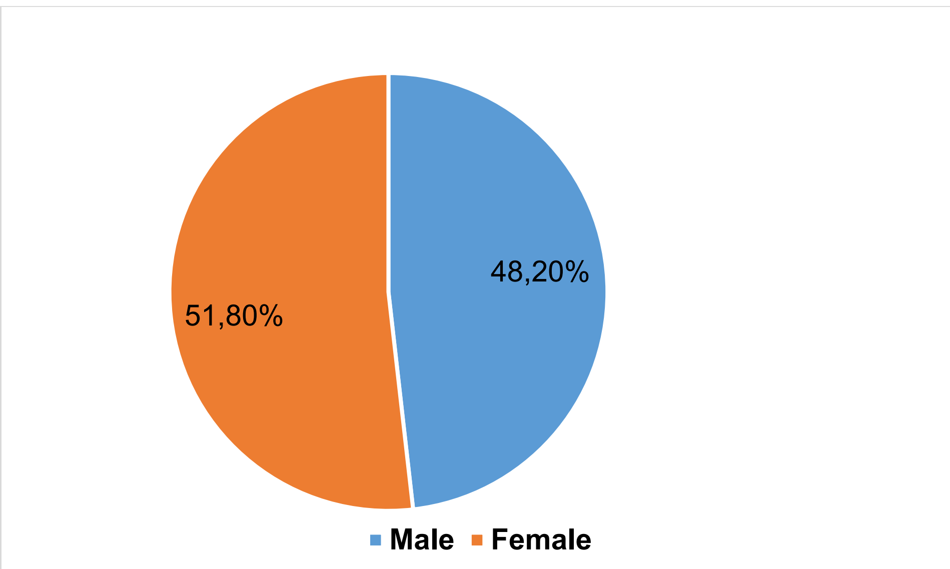

Figure 4.1: Gender of the respondents in the study area (n=442)

The findings in Figure 4.1 shows that more than half (51.8%) of the respondents were females (women), whereas 48.2% were males (men). The results of the binomial test showed that the proportion of males (N_m = 213, 48.2%) was not significantly different from the proportion of females (N_f = 229, 51.8%), p=0.476. Thus, statistically women were not the majority even though they constituted large proportion of the respondents. In support, Akpalu (2013) also reported that the majority (>50%) of farmers who had access to extension services in Limpopo province were female. In contrast, Mmbengwa *et al*. (2012); Gwala (2013); Nkosi (2017); Loki *et al*. (2021) found that the group of farmers who received public extension and advisory services were predominantly men (male farmers). The fact that most farmers were female implied that extension and advisory services were accessible to women; therefore, there was gender equity. This contrasts with the findings by World Bank and IFPRI (2010), who found that women farmers had no equitable access to extension and advisory services in India, Ethiopia and Ghana. Thus, this study showed that women had equitable access of extension and advisory services in Gauteng province of South Africa.

4.4.1.3 *Marital status*

In Africa, marital status is important because in some communities, there are customary laws that prioritize married people in the allocation of resources. For example, Clemens *et al*. (2011) reported that in some parts of Kenya, customary laws do not allow women to inherit land. In some parts of South Africa, Tshuma (2013) found that widowed women had no collateral to access resources because their assets were registered in their late husbands' names. Moreover, marital status may affect good agricultural practices especially when there are conflicts that arise because of hierarchy (Yamano and Deininger, 2005). The literature presented above shows that marital status is one of the important demographic characteristics that should be measured in agricultural sociology studies. Hence, information about the marital status of farmers receiving extension and advisory services in the current study was gathered. The findings of marital status of the respondents in the study area are presented in Figure 4.2.

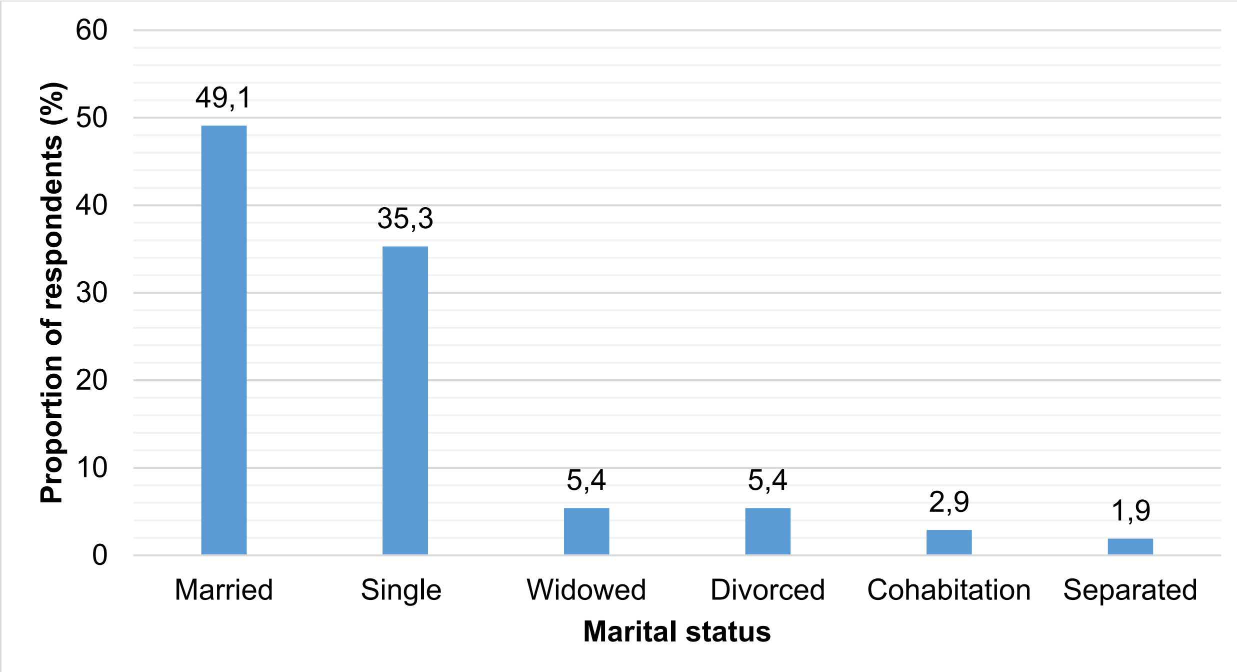

Figure 4.2: Marital status of the respondents in the study (n=442)

The results of marital status in Figure 4.2 shows that nearly half (49.1%) of the respondents were married, followed by more than one-third (35.3%) who were single, while less than 20% were widowed, divorced, cohabitating or separated. In agreement with the current study findings, Gwala (2013) also reported that less than half (46%) of the recipients of extension services were married. On the contrary, Nkosi (2017) found that more than four-fifth (83%) of the farmers who had access to public extension and advisory services were married. In that study, it was also found that less than 7% were single, which contrasted with the current study where more than one-third (35.3%) of the respondents were single. Also, in contrast to the current study findings, in Raymond Mhlaba Local Municipality in the Eastern Cape province it was reported that more than half of the farmers receiving extension services were married, whereas less than a quarter (22%) were single (Loki *et al*., 2021). In general, it showed that more than half (52%) of the respondents had spouses as shown by the amalgamation of farmers who were married or cohabitating. The current findings implied that in the study area, a large proportion of the farmers who had spousal support (married or cohabitating) received extension and advisory services from government. In support, Ofuoku and Ekorhi-

Robinson (2018) indicated that married farmers were more likely to benefit from extension services.

4.4.1.4 *Age*

Documented agricultural extension literature has shown that access to extension and advisory services has a correlation with farmers' age (Umunna, 2012; Baloch & Thapa, 2014; Abdallah & Abdul-Rahaman, 2016; Wossen *et al*., 2017; Atsbeha & Gebre, 2021; Loki *et al*., 2021). For example, access to extension services was found to be positively and significantly influenced by farmers' age (Baloch & Thapa, 2014; Wossen *et al*., 2017; Loki *et al*., 2021). It implied that older farmers were more likely to access extension services. Furthermore, Abdallah and Abdul-Rahaman (2016) found that age square (Proxy for old age) had a positive and significant relationship with access to agricultural extension services. Thus, the likelihood of older farmers to access extension services was higher up to a certain age. On the contrary, the findings by Atsbeha and Gebre (2021) indicated that age had a negative and significant relationship with farmers' access to extension services; meaning that, younger farmers had better access to agricultural extension services. On the other hand, age has a positive and significant correlation with famers' satisfaction with extension services (Moradi & Poorsaeid, 2014; Ganpat, 2017). Therefore, older farmers were more satisfied with the quality of extension services rendered to them. The study respondents had access to public extension and advisory services. Moreover, the respondents were expected to share their perceptions about the quality and effectiveness of public extension services. The aforementioned explanation and literature about the correlation that existed between extension services and farmers' age made it necessary to document the age of the respondents and subject the data to descriptive and inferential statistical analysis. The results of age group of the respondents are presented in Figure 4.3.

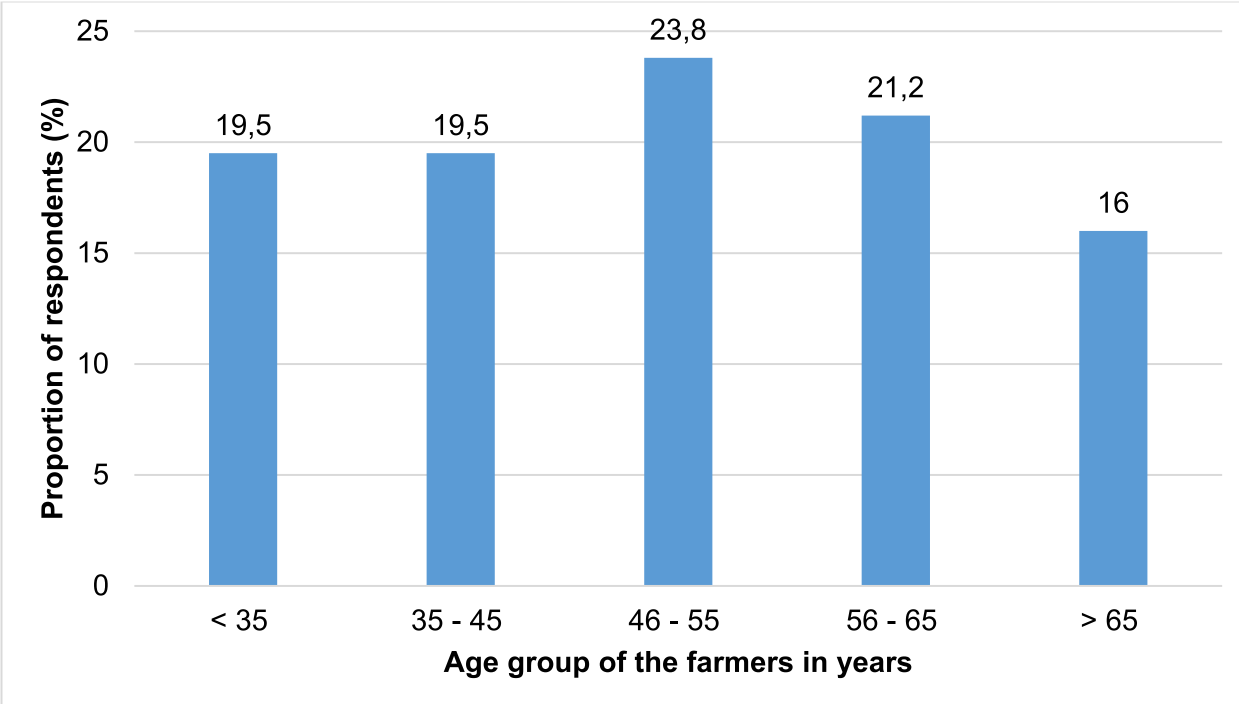

Figure 4.3: Age group of the respondents in the study (n=442)

Figure 4.3 shows that most (23.8%) of the respondents were between 46 and 55 years, followed by 56-65 years old group at 21.2%. The results also showed that about four-fifth (80.5%) of the respondents were above 35 years old. This was an indication that young people were not involved in farming to a large extent in Gauteng province, hence, very few of them received extension and advisory advised from government. This could be attributed to the fact that less than one quarter of the farmers in selected study areas in Gauteng province were <35 years old (Nkgudi, 2019; Rakoena, 2019; Modibedi *et al*., 2021). Moreover, about 15% of agricultural households in Gauteng province were less than 35 years old (Stats SA, 2016). Thus, the proportions of the respondents were aligned with the age group of the farmers in Gauteng province where the study was conducted. In contrast to the current study findings, Nkosi (2017) found that more than two-thirds (73%) of the farmers who received public extension and advisory services were above 65 years old. Also in contrast, it was reported that in Oyo State, Nigeria, the majority (>50%) of the farmers who had access to extension services were less than 35 years old (Umunna *et al.,* 2012). Moreover, the current study found that more than one-third (37.2%) were 56 years old and above; meaning that more than one-third of the farmers had reached the retirement age which starts at 55 years in some South African economic sectors. Therefore, most (62.8%) of the farmers had the necessary strength to perform agricultural activities because they were still in their active years (18-55 years old).

4.4.1.5 *Education*

Farmers' education (literacy) level is one of the important socio-economic factors that have a correlation with various aspects of agricultural extension services. Education has a positive and significant relationship with farmers' access to extension services (Umunna *et al*., 2012; Gwala, 2013; Wossen *et al*., 2017). It means that highly educated farmers are more likely to access extension services. On the contrary, education level could also influence access to extension services negatively in an insignificant or significant manner (Abdallah & Abdul-Rahaman, 2016; Atsbeha & Gebre, 2021; Loki *et al.*, 2021). Thus, education has a positive and negative relationship with farmers' access to extension services. Furthermore, Gwala (2013); Joshi and Narayan (2019) reported that education had positively and significantly influenced farmer's satisfaction about the quality of public agricultural extension services. On the other hand, Zahrani *et al*. (2019) found that education had a negative relationship with perceived quality of agricultural extension services. Thus, highly and less educated farmers have different perceptions about the quality of extension services offered to them. The above background showed that access to extension services and perceived quality of the services were influenced by farmers' education level. It was against this background that information about the education level of farmers receiving public and advisory services in the study area was collected and analysed statistically. The results of education level of the respondents are presented in Table 4.3.

Table 4.3: Educational background of the respondents in the study (n=442)

Level of education	Frequency	Percentage
No formal education	61	13.8
Primary education	72	16.3
Secondary education	219	49.5
Abet education	31	7.0
Diploma	16	3.6
Bachelors degree	19	4.3
Honour degree/BTech	10	2.3
Masters	12	2.7
Doctorate	2	0.5

Table 4.3 shows that nearly half (49.5%) of the respondents had secondary education whereas only 13.4% had tertiary level qualifications ranging from Diploma to Doctoral degrees. Overall, the results showed that 72.8% of the farmers receiving public extension and advisory services in the study had basic education (primary, secondary and abet). The findings agreed with those reported by Stats SA (2016), where more than 70% of agricultural households in Gauteng province had basic education (Grade 1 to Grade 12 or primary and secondary education). Also in agreement, Modibedi (2018); Nkgudi (2019); Rakoena (2019) found that more than half of the farmers in selected areas of Gauteng province had basic education. Regarding access to extension services, similar findings were reported by Agholor *et al*. (2013); Loki *et al*. (2021) where the proportion of farmers with basic education was more prevalent (>60%) amongst the recipients of extension and advisory services. On the contrary, Mengal *et al.* (2012) found that less than half (49%) of the farmers receiving public extension services in Pakistan had formal education, and 50.6% were illiterate. The findings by Nkosi (2017) were also in contrast because in Uthungulu District Municipality in KwaZulu Natal province, 93% of the farmers who received extension and advisory services from government had no formal education, and only 6.2% had basic education. In comparison with Pakistan and Uthungulu District Municipality, a large proportion (85%) of the respondents in the current study could read and write because they had formal education (Primary, Secondary, Abet, Diploma, Bachelors Degree, Honour Degree/BTech, Masters Degree and Doctorate). Therefore,

they were more likely to understand the messages delivered by extension agents (agricultural advisors).

4.4.1.6 *Land acquisition and farm size*

In South Africa, farmers occupy (acquire) land through various methods because of Land Settlement Act of 1912 and land reform programmes (restitution and redistribution) that were initiated by the democratic government after 1994. The types of land occupation methods in South Africa are trust tenure, traditional tenure, leasehold, quitrent, and freehold (Manona *et al*., 2010). Again, in South Africa, white people own 53% of the land, while Africans, Coloured, Indians and other tribes owned 22%, 9%, 12% and 4%, respectively (Department of Rural Development and Land Reform, 2017). In farming, land ownership is important because it gives farmers collateral that enables them to access credit (loans) from financial institutions. Moreover, land ownership has several benefits for the farmers. According to Aha and Ayitey (2017), land ownership improves agricultural investment, technical efficiency, and productivity. Again, the size of the farmland is important because it is associated with income, productivity, viability and much more. Koirala *et al*. (2016) reported that farm size has a significant influence on farming viability and economic performance. Farm size has a significant relationship with agricultural productivity (Helfand & Taylor, 2019). It implies that an increase in farm size is more likely to increase farm outputs. Regarding farmers perceptions, Moradi and Poorsaeid (2014) found that farm size was positively and significantly correlated with satisfaction with extension services. The background about land ownership (land occupation or acquisition method) and farm/plot size has shown that they play a pivotal role in agricultural sustainability. As a result, it was found necessary to collect information about land acquisition methods and farmland size of the respondents in the current study. The results presented in Figure 4.4 shows the land acquisition methods of the respondents.

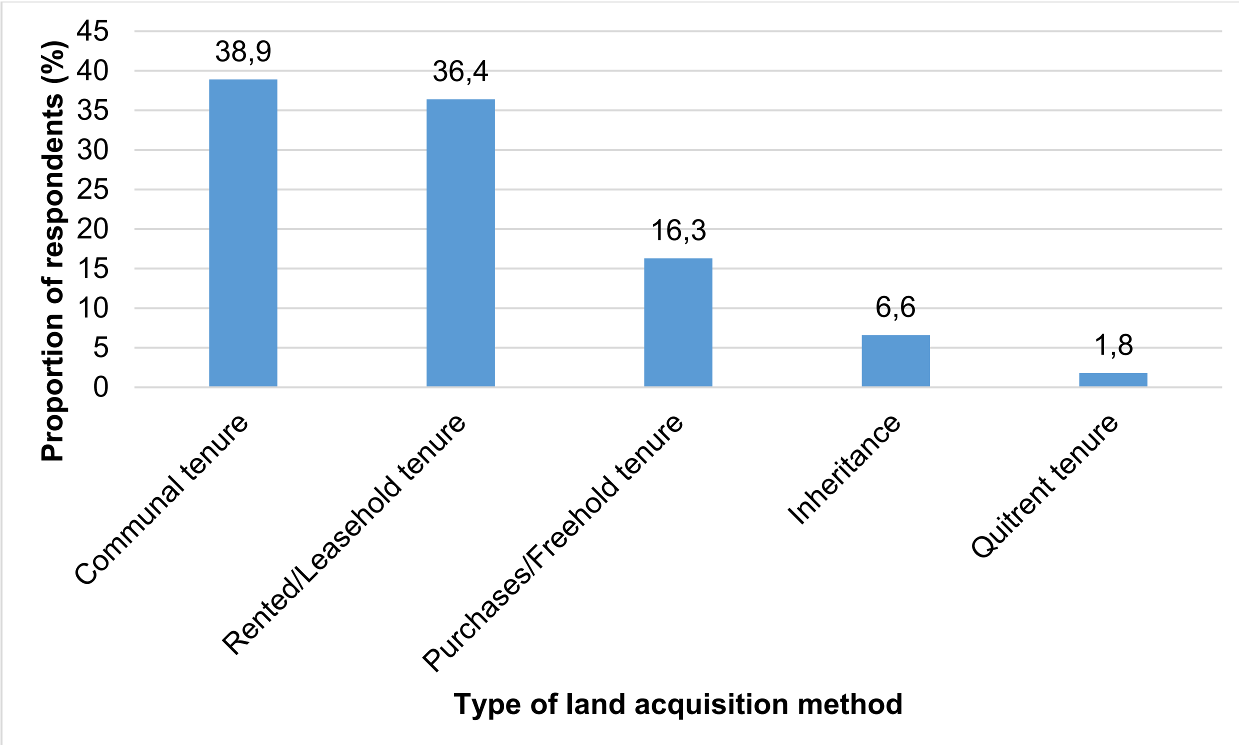

Figure 4.4: Land acquisition methods of the respondents (n=442)

The results in Figure 4.4 depict that more than one-third (38.9%) of the respondents acquired their farming land through communal/commonage; thus, their farmland belonged to the municipality or national/provincial government. The other third (36%) rented their farmland, and less than a quarter (16.3%) purchased or occupied their land through freehold tenure. A very small proportion (<10%) inherited their farmland through quitrent tenure. The results showed that about three quarters (75.3%) of the farmers in the study area had no title deeds for their farmland because they occupied it through communal tenure and leasehold tenure. The findings were aligned with Akinyemi and Mushunje (2019) who reported that more than three quarters of the farmers in Gauteng province did not own their agricultural land. The land audit report also showed low ownership of agricultural land amongst Black Africans in Gauteng province (Department of Rural Development and Land Reform, 2017). This is evident in the current study, which showed that most (97%) of the farmers in Gauteng province were Black Africans; hence there were similarities found between the two studies. Also in support, Mpandeli and Maponya (2014); Matsane and Oyakele (2014); Nkosi (2017); Rakoena (2019) found that most farmers in South Africa had no title deeds for their agricultural land because they were farming on government land allocated through communal land tenure and/or Proactive Land Acquisition Strategy (PLAS) and rental. This is not surprising because it has been reported that a large proportion of agricultural land in rural areas of South Africa is communally owned (Thamaga-Chitja & Morojele, 2014). In contrast, about two-fifths (43.4%) of the farmers in Emfuleni Local Municipality in Gauteng province privately owned their agricultural land (Nkgudi, 2019). The fact that a large proportion of the respondents did not own their agricultural land implied that most farmers in the study area could not use their farmland as collateral to access funding from financial institutions. Moreover, farmers were unlikely to invest in farm infrastructure required to improve productivity and net income because they do not own the farmland. Aha and Ayitey (2017) reported that land ownership improves agricultural investment, and productivity. Thus, farmers in the current study were most likely to achieve low production efficiency and poor economic viability of agricultural production due to lack of land ownership.

On average, farm/plot size of the respondents was 4.55 ha with a minimum of 0.001ha and a maximum of 72 ha. The standard deviation and standard error of mean achieved were 8.17 and 0.39, respectively. The Coefficient of Variation (CV) percentage achieved was 179.6%, which showed that the variation in the farm/plot size occupied by the respondents was extremely high. According to Mucha (1994), CV% above 150% was considered extremely high. It implied that there were farmers who occupied very small farms/plots while others had large-scale farms. Most of the farmers with plot/farm size of less than one hectare (<1 ha) were found in community gardens located near schools, open spaces in the community, clinics and municipal land. Community gardens are located in urban areas where land is limited because of high population density. As a result, groups of farmers share small pieces of land for farming purpose. In support to the current study findings, Majokweni (2018); Nkgudi (2019); Abedunge *et al*. (2020); found that the average farm/plot size of farms in their respective studies was less than five hectares. On the contrary, an average farm/plot size of 195.44ha was reported in Gauteng province amongst the beneficiaries of Recapitalisation and Development Programme (Rakoena, 2019). The variation was because Recapitalisation and Development

Programme support small and large-scale farmers on farms and plots, while extension services are rendered to all types of farmers including those in community and backyard gardens where access to land is limited. Also in contrast, farmers in the study conducted by Matsane and Oyakele (2014) occupied farms of about 50.9 ha on average. That study was conducted in North-West province, which is predominantly rural with bigger farmlands allocated for agricultural activities compared with Gauteng province (study area).

Further analysis was done to determine the proportion of the respondents who occupied different farm/plot sizes. Figure 4.5 presents the results of the category of farm/plot size occupied by the respondents.

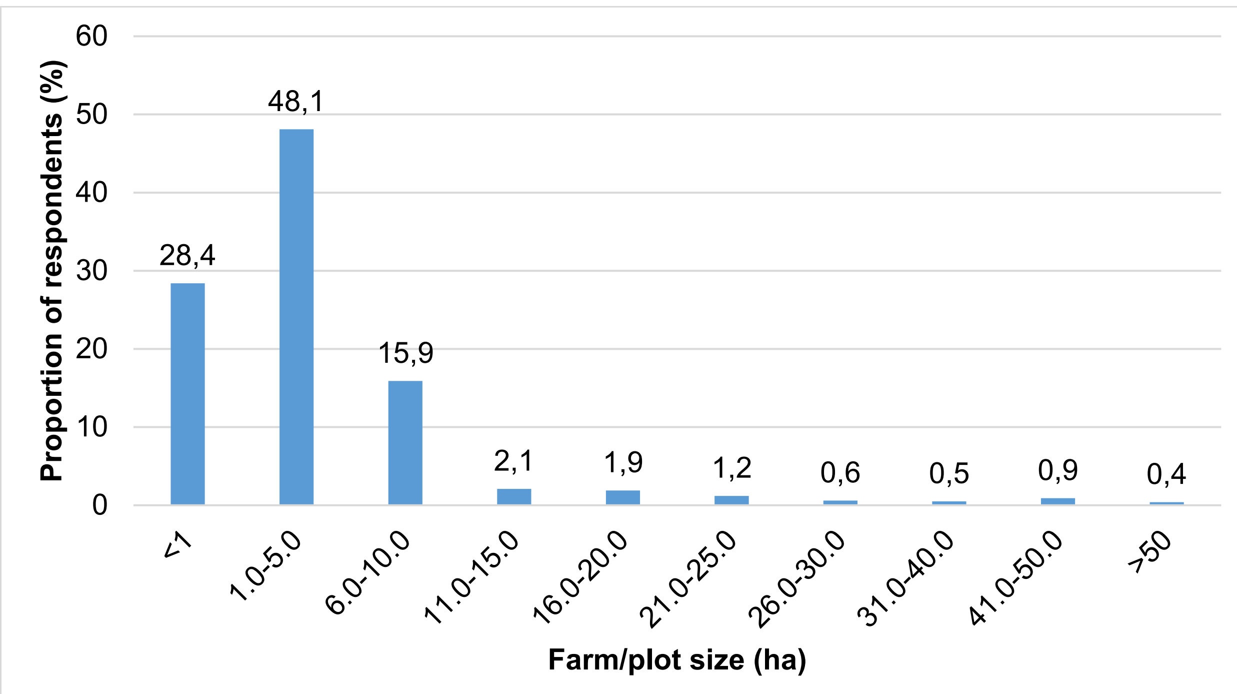

Figure 4.5: Category of farm/plot size of the respondents (n=442)

The results in Figure 4.5 depicts that more than three quarters (76.5%) of the respondents were farming at a small-scale because their plot/farms sizes ranged between 0.001 and 5 ha. About 7.6% of the farmers had farms/plots above 10 ha, and only 1.8% of farmers had more than 30 ha. In support, Moloi (2008); Myeni et al. (2019); Mva (2019; reported that in some parts of South Africa, the farm size for most farmers was less than 5 ha. On the contrary, the findings by Khapayi and Celliers (2016) showed that the majority (>50%) of farmers in Eastern Cape province of South Africa occupied farmlands above 50 ha. The reason why most of the farmers in the current study area were farming at a small-scale was that a large proportion of them were community gardens where land is a limited resource. It showed that a large proportion of farmers in the area were smallholder (small-scale) farmers. Thus, the government in Gauteng province renders extension and advisory services mostly to smallholder (small-scale) farmers.

4.4.1.7 *Farming experience and category*

Farming experience is about the number of years the respondents have been involved in farming or agricultural activities. Various scholars have documented the correlation that exists between farming experience and factors such as adoption of innovations (Asafu-Adjaye, 2008; Gbolagade & Ayoade, 2009; Ajewole, 2010; Obasi *et al*., 2013); net income (Asafu-Adjaye, 2008; Onuk *et al*., 2017); technical efficiency (Ayaz & Hussain, 2011); agricultural productivity (Obasi *et al*., 2013; Onogwu *et al*., 2017); access to market (Zivenge & Karavina, 2012; Maziku, 2015). Moreover, in agricultural extension, farming experience influences access to extension services (Abdallah & Abdul-Rahaman, 2016); perceived quality of extension services (Kassem *et al*., 2021); effectiveness of extension services (Komba *et al*., 2018; Ramesh *et al*., 2019) and payment of extension services (Ozor *et al*., 2013; Uddin *et al*., 2016; Loki *et al*., 2019). The literature presented above shows that farming experience is one of the important socio-demographic factors that warrant exploration in agricultural sociology studies. As a result, the current study determined the farming experience of the respondents.

The currentt study found that on average, farmers who received public extension and advisory services in Gauteng province have been farming for six years (actual is 6.3). The minimum and maximum farming experience of the farmers was 0.2 years (two months) and 34 years, respectively. A standard deviation of 5.35 and standard error of mean of 0.25 were achieved. The variation of farming experience was high because the CV% obtained was 84.9%. A Coefficient of Variation (CV%) between 40 and 80% is considered high (Mucha, 1994). On the contrary, Kassem (2014); Abdallah & Abdul-Rahaman (2016); Majokweni (2018); Sylla *et al*. (2019); Kassem *et al*. (2021) reported that on average, farmers who received extension services have been farming for ≥10 years. It the current study the findings implied that the study area consisted of both newcomers and highly experienced farmers. Generally, the recipients of public extension and advisory services have been farming for less than a decade; thus, farmers might have high expectations of extension officers. Figure 4.6 shows the categories of farming experience of the respondents.

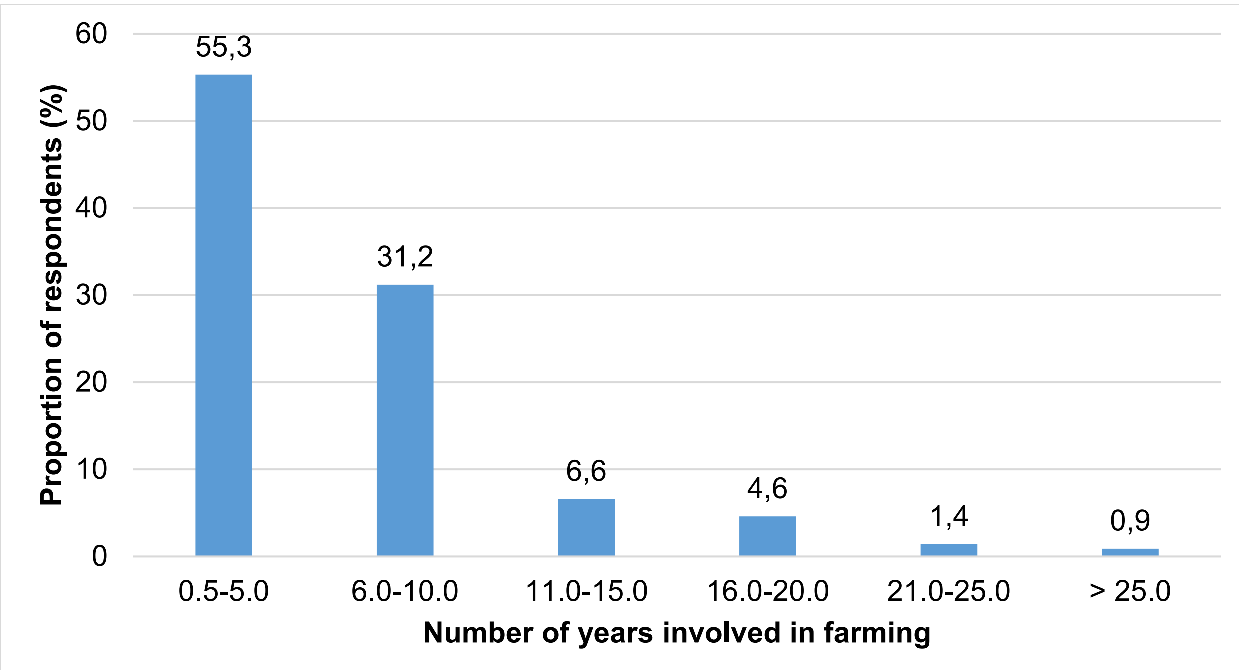

Figure: 4.6: Category of farming experience of the respondents (n=442)

Figure 4.6 illustrates that more than half (55.3%) of the respondents had farming experience of ≤ 5 years, whereas more than a quarter (31.2%) had five to ten years' experience. It implied that more than three quarters (86.5%) of the farmers who received public extension and advisory services were involved in farming for ≤ 10 years. Very few farmers (2.3%) had been involved in farming for more than 20 years. In support, Antwi and Chagwiza (2019) reported that low proportion of farmers have been involved in farming for more than ten years. In contrast, Al-Zahrani *et al*. (2019); Sylla *et al*. (2019);

Kassem *et al*. (2021) found that farming experience of most farmers receiving extension services was more than 10 years. In general, the current findings indicated that most of the respondents started farming in the new millennium. Moreover, a large proportion of the farmers in the study area were less experienced because they have been involved the farming for less than ten years. Therefore, most farmers required support from government extension officers because they were less experienced.

Farming is an important source of income and food for most of the farmers. Farmers who are involved in farming for income to sustain their livelihoods are normally classified as commercial farmers, while those farmers who sell and consume their surplus agricultural produce are non-commercial. In South Africa, there are commercial and non-commercial farmers. Commercial farmers are mostly white farmers operating on a large scale (Kirsten & van Zyl, 1998). Non-commercial farmers operate on a small-scale for sale and home consumption. These farmers have different expectations from government extension services. Hence, it was necessary to collect information about the category of the farmers who receive public extension and advisory services in the study area. The study found that 68.1% of the respondents were non-commercial farmers and 31.9% commercial farmers. Therefore, more than two-thirds of the farmers who receive public extension and advisory services did not sell all their produce for income generation to sustain their livelihoods. This may be due the fact that most farmers owned community gardens where sharing of produce and selling were common. In such settings, the purpose of farming is to sell some of the produce to earn income, while saving some of it for home consumption. Therefore, such farmers cannot categorize themselves as commercial farmers because they do not sell all their produce. Similarly, Stats SA (2011, 2016), found that most agricultural households in Gauteng province were involved in farming to produce food for home consumption.

4.4.1.8 *Sources of income*

In South Africa, research has shown that smallholder farmers have various sources of income apart from farming (Gwala, 2013; Modibedi, 2018; Myeni, 2019). Smallholder farmers often earn additional income from non-farming activities to make up their net farm income. This made it necessary to collect information about income sources of the respondents in the current study. The main purpose was to determine whether the majority of farmers in the study area depended on farming as the main source of income or otherwise. The study found that 67.6% of the respondents depended on farming as their main source of income whereas 32.4% did not. Farmers who did not depend on farming as their main source of income had other businesses; they were employed part-time or received social grant (pension and child grants). Mcharo (2013); Matsane & Oyakele (2014); Modibedi (2018); Myeni *et al*. (2019); Mva (2019); Nkgudi (2019); Rakoena (2019) also found that farming was the main source of income for more than two-thirds of the farmers in Africa; thus, their studies agree with the current study findings. Moreover, social grants and businesses were also additional income sources for selected groups of farmers in South Africa and Saudi-Arabia (Gwala, 2013; Modibedi, 2018; Al-Zahrani *et al*., 2019; Myeni *et al.*, 2019; Olofsson, 2020). In contrast, Mva (2019); Zantsi *et al*. (2019) reported that farming was not the main source of income for smallholder farmers in the Eastern Cape province of South Africa. The fact that most farmers relied on farm income to sustain their livelihoods is an indication that smallholder farming contributed to poverty alleviation and food security amongst agricultural households in Gauteng province. Public extension and advisory services are mostly rendered to farmers who depend on farming to make a living. According to National Planning Commission (NPC, 2011), effective agricultural extension services have the potential to create jobs in the agricultural sector. Therefore, it is important to ensure that extension and advisory services are effective because most farmers in the study area were employed on farms.

The study measured the annual farm income and found that the average annual farm net income of the respondents in the previous year was R21 387.56 with a minimum of R0 and a maximum of R410 000. Farmers who had R0 as their farm net income in the previous year were mostly from vegetable gardens and those who lost their products because of drought that year. Some of the farmers in community gardens shared vegetables rather than selling them to earn an income, hence, their income was zero from farming activities. The standard error of the mean and standard deviation was 2404.61 and 50553.95, respectively. On the contrary, other studies conducted in South Africa showed that farmers' annual net income was R1 218.36 (Nkosi, 2017); R4 080. 28 (Modibedi, 2018); R347.18 (Mva, 2019); R47 513.59 (Nkgudi, 2019); R45 200 (Zantsi *et al*., 2019). In general, the study revealed that the annual net farm income of the recipients of public extension and advisory services was below the minimum wage of R42 000/annum (R3 500/month) which was regulated by South African government in 2018/2019 when data was collected.

Further statistical analysis was performed to group annual net farm income of the respondents in different categories. Figure 4.7 presents the results of the categories of annual net farm income of the respondents.

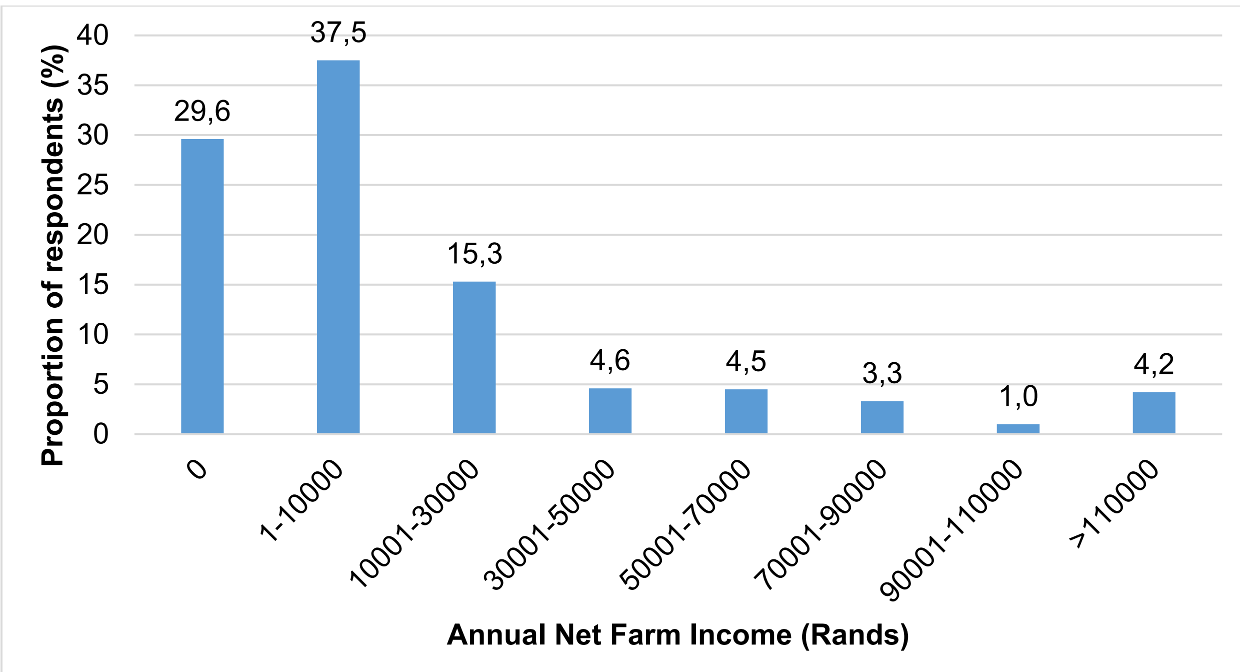

Figure 4.7: Category of annual net farm income of the respondents (n=442)

The results in Figure 4.7 show that more than one-third (37.5%) of the respondents earned annual net income between R1 and R10 000 from farming activities in the previous year, while nearly 30% had no income at all. About one-fifth (19.9%) of the respondents had an annual net farm income between R10 001 and R50 000 in the previous year, whereas 13% had income above R50 000. Furthermore, the results depict that more than

50% of the respondents earned ≤R10 000 per annum from farming. The findings by Selaledi *et al*. (2021) were in support because most of the small-scale farmers (>50%) earned annual net income of ≤R10 000 from their farming activities. On the other hand, Myeni *et al*. (2019) showed that most of smallholder farmers in Free State province of South Africa had no income at all; thus, their findings disagreed with the current findings. In general, the study revealed that 82.4% of the farmers in Gauteng province who received public extension and advisory services earned an annual net farm income below a minimum wage of R42 000/annum (R3 500/month). Therefore, most farmers in the study area found it difficult to sustain their livelihoods from net farm income only. This is not surprising because more than a third (32.4%) of the respondents depended on business and social grants as their main sources of income. Such farmers are more likely to own community gardens where they normally produce for home consumption and/or income generation. Considering that more than three quarters of the respondents earned income below the minimum wage, inferential statistical analysis (multiple linear regression) was done to identify some of the factors influencing net farm income of the respondents. Table 4.4 presents multiple linear regression results of the factors influencing annual net farm income of the respondents.

Table 4.4: Results of the Multiple Linear Regression analysis of the factors influencing annual net farm income of the respondents (n=442)

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	8449.557	8915.123		0.948	0.344		
Gender	-1473.330	3666.895	-0.015	-0.402	0.688	0.981	1.020
Age	-760.577	1527.702	-0.020	-0.498	0.619	0.773	1.294
Education level	3987.097	1236.660	0.125	3.224	0.001	0.857	1.167
Farm size	3442.441	243.046	0.556	14.164	<0.001	0.836	1.196
Farming experience	-258.302	394.724	-0.027	-0.654	0.513	0.740	1.352
Number of visits by extension officer	-6390.213	1045.691	-0.225	-6.111	<0.001	0.950	1.052
Distance from farm/plot to the extension office	97.944	92.835	0.039	1.055	0.292	0.950	1.052

Dependent variable: Annual net farm income in the previous year; $R=0.663^a$, $R^2=0.440$, Adj. $R^2=0.431$, DW=1.879, Std. error of the estimates=38145.630, F=48.652, VIF=1.020 – 1.352.

The results of model fit summary presented below in Table 4.4 indicate that the value co-efficient of determination of R^2=0.440. It implies that 44.0% of the variation in the dependent variable (Net farm income in the previous year) was accounted for by the independent variables. The value of R-square (0.440) was close to Adjusted R-Square (0.431); therefore, the number of independent variables added in the regression analysis were adequate. On the other hand, the results of ANOVA were as follows: $F(7, 434) = 48.652$, $p<0.001$. It meant that the regression model is a good fit of the data because p-value is statistically significant. Therefore, the independent variables added in the regression model significantly predicted the dependent variable. The Normality was checked and found to be appropriate. The results of Durbin-Watson statistic (DW=1.879) showed that there was no autocorrelation identified in the sample. The Variance Inflation Factors (VIF) values were all <2 with a minimum of 1.020 and a maximum of 1.352. which meant that there was no multi-collinearity between the variables.

Table 4.4 shows that out of the seven independent variables added in the regression model, only three (Education level, farm size and number of visits by extension agent/officer) were statistically significant at 1%. The effect of the other four independent variables was statistically insignificant. The distance from the farm/plot to the extension office influenced the annual net farm income of the respondents positively, but the influence was not significant statistically. On the other hand, gender, age and farming experience had a negative effect on annual net farm income; but the effects were statistically insignificant. The results in Table 4.4 also indicate that education level had a positive (β=0.125) and statistically significant relationship (p=0.001) with the annual net farm income of the respondents in the previous year, with all other factors held constant. This meant that a unit increase in the education level of the farmers increased the annual net farm income by 12.5%, with all things being equal. Therefore, highly educated farmers earned more income from farming compared to those who were less educated. This might have been because highly educated farmers could easily access information about best production practices and lucrative markets. The findings by Ibekwe *et al*. (2010); Mabe *et al.* (2010); Onuk *et al*. (2017) also revealed a positive and significant correlation between income and farmers' education level. However, Rakoena (2019) found a negative and insignificant relationship between income and education level. Also in disagreement, Kanyua *et al*. (2015), reported a positive, but insignificant correlation that existed between education and farm net income.

Again, farm/plot size had a positive ($\beta=0.556$) and significant effect ($p<0.001$) on annual net farm income of the respondents with all other factors held constant. This implied that an increase in farm/plot size increased annual net farm income by 55.6% when all other factors were held constant. Thus, large-scale farmers earned more income compared with small-scale farmers. This could be because large-scale farmers had adequate land to produce more; meaning that additional income was earned by selling a large quantity of products. In support, Emerole *et al*. (2006); Ibekwe *et al*. (2010); Onuk *et al*. (2017) revealed that net farm income was positively and significantly influenced by farm size. On the contrary, Rakoena (2019) reported a positive and insignificant correlation between income and farm size.

The coefficient value of the number of visits by extension agent/officer showed that the number of visits had a negative ($\beta=-0.225$) and statistically significant ($p<0.001$) relationship with annual net farm income of the farmers in the previous year, with all things being equal. It meant that, an increase in the number of visits by the extension officer decreased annual net farm income by 22.5%, when all other factors were held constant. Therefore, regular visits by extension officers did not guarantee that farmers would earn more income. The reason could be that farmers received wrong advise from extension officers or they did not follow advise given and/or failed to utilise information given by extension officers that could have improved the production and ultimately increased net farm income. The findings by Kanyua *et al*. (2015) disagreed because extension visits had a positive, but insignificant relationship with farmers' net income.

4.4.1.9 *Correlation of selected socio-demographic characteristics*

In addition to the descriptive statistics of the socio-demographic characteristics presented above, the correlation of the selected demographics and socio-economic characteristics was performed. Table 4.5 presents the results of the correlation of the socio-economic characteristics.

Table 4.5: Correlation of the selected socio- economic and demographic characteristics of the farmers in the study (n=442)

Variable	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Gender	1							
2. Age	**0.104***	1						
3. Education level	-0.060	**-0.292****	1					
4. Farming category	-0.087	**-0.175****	**0.137****	1				
5. Farm size	0.050	**-0.114****	**0.124****	**0.201****	1			
6. Farming experience	**0.094***	**0.292****	-0.021	**-0.127****	**0.206****	1		
7. Main source of income	0.009	-0.054	0.032	0.089	0.074	0.018	1	
8. Annual net farm income	0.015	**-0.087***	**0.133****	0.039	**0.420****	**0.227****	-0.053	1

* Correlation is significant at the 0.05 level; ** Correlation is significant at the 0.01 level

The results in Table 4.5 indicate that the socio-economic characteristics of the respondents were both negatively and positively related. Age and gender were positively correlated (r=0.104) at 5% significance level (p<0.05). This meant that older farmers were more likely to be men. The relationship between education and age was negative (r=-0.292) and statistically significant at 1% interval level. This implied that younger farmers were highly educated compared to the older ones. In support, education and age were found to have a negative correlation (Davidson & Ahmad, 2002; Asafu-Adjaye, 2008; Alant & Bakare, 2021). On the contrary, the findings by Olusola (2011) illustrated a positive and significant correlation between education and age. Farming category had a positive and negative correlation with education level and age, respectively at 1% significance level. Therefore, commercial farmers who were highly educated were mostly females (women). On the other hand, farm size had a positive and significant correlation with education level and farming category at 1% significance level. The findings by

Jerumeh and Omonona (2020) were in contrast because education and farm size had a negative and statistically significant correlation. The relationship between farm size and age was also negative ($r=-0.114$) and statistically significant ($p<0.01$). Thus, in Gauteng province, large farms were occupied by highly educated, younger and commercial farmers. The findings were consistent with what Jeremeh and Omonona (2020) reported in their study, where a negative and significant relationship between farm size and age were established. Again, there was a positive and statistically significant ($p<0.01$) correlation between farming experience and gender, age, farm size and net income. Similarly, Asafu-Adjaye (2008); Olusola (2011); Alant and Bakare (2021) reported a positive correlation between farming experience and age. Asafu-Adjaye (2008) concurred that farming experience and farm size were positively correlated. However, the relationship between farming experience and farming category was negatively correlated ($r=-0.127$) and significant at 1% confidence interval. It meant that highly experienced farmers were older men and were the ones who occupied larger farms. On the other hand, highly experienced farmers did not farm for commercial purposes (non-commercial farmers). Net farm income had a positive and significant relationship with education level, farm size and farming experience. Thus, highly educated farmers, farmers occupying larger farms and more experienced farmers made more profit from their farming enterprises. Onuk *et al*. (2017) also reported that farming experience had a positive and significant correlation with net income, while net farm income had a negative, but significant correlation with farmers' age. Thus, older farmers earned less profit from farming. On the contrary, Rakoena (2019) found that older farmers made significant profit from farming.

4.4.2 Types of agricultural commodities

Gauteng province is the smallest of the nine provinces in South Africa with an estimated size of 18 179 km^2 (Stats SA, 2011). According to Dyson (2009), the climatic conditions in Gauteng province are Central Bushfield and Moist Highveld Grassland with average maximum temperature of about 22°C in the southern and 25°C in the northern parts of the province, respectively. Therefore, the climatic conditions in the province are suitable for diverse agricultural commodities. Mpandeli and Maponya (2014) reported that agricultural productivity is determined by the climatic conditions of the environment. In Gauteng province, topographic data, field and GIS survey data has illustrated that the province is suitable for poultry, livestock, and horticultural and field crops (Nesamvuni *et al*., 2016). Therefore, is it expected that farmers receiving extension and advisory services in Gauteng province would have different agricultural commodities suited to their climatic conditions. According to Loki *et al*. (2021), farmers involved in livestock production and the cultivation of field crops were more likely to access extension services. As a result, the agricultural commodities of the recipients of public extension and advisory in the study area were profiled. Figure 4.8 presents the results of agricultural commodities in the study area.

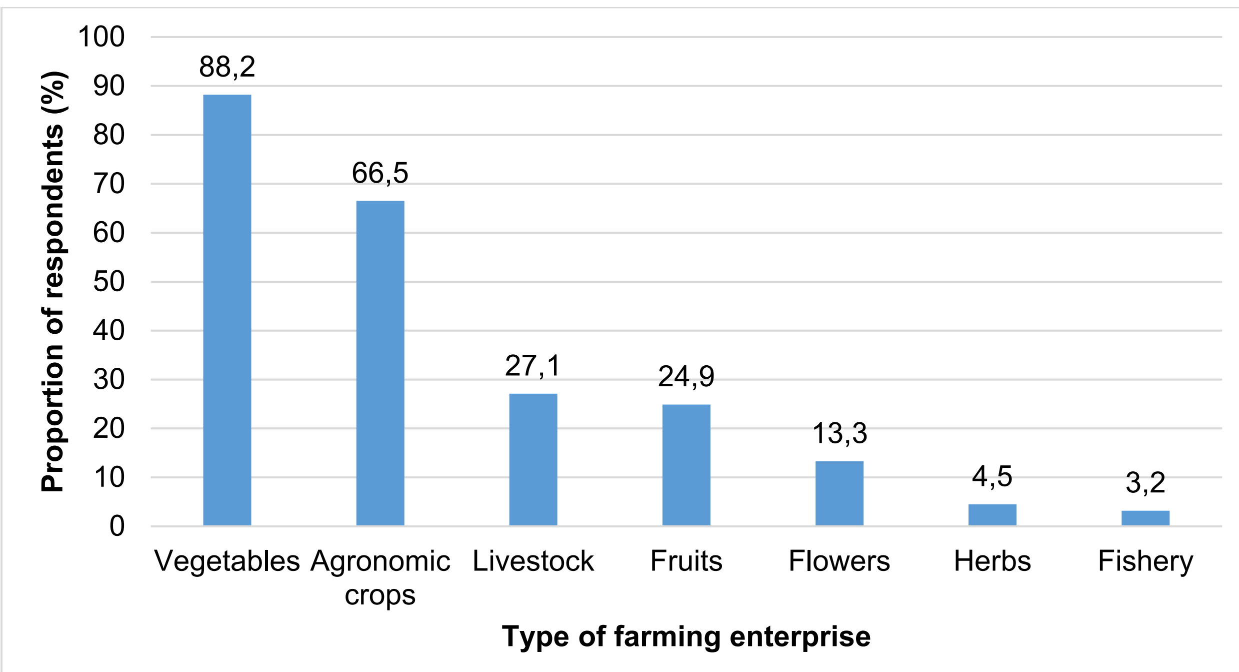

Figure 4.8: Agricultural commodities of the respondents (n=442)

Figure 4.8 shows that more than four-fifth (88.2%) of the respondents cultivated vegetables, followed by field crops (66.5%), livestock (27.1%) and other commodities as presented in the Figure 4.8. In agreement, Nesamsuvi *et al*. (2016); Rakoena (2019) found that in Gauteng province, agricultural commodities such as poultry, field crops, vegetables and livestock were common. Similarly, Statistics South Africa (Stats SA, 2016) reported that most of the farmers in Gauteng province cultivated vegetables, while less than half (38.2%) cultivated field crops. Thus, the proportion of farmers who cultivated field crops was contradictory. The farmers in the study area cultivated field crops such as maize, potatoes, sunflower, beans, soya beans and groundnuts, while the types of vegetables cultivated in the study area were cabbage, spinach, onion, carrots, Swiss chard, beetroots, Chinese cabbage and chomolia. Modibedi (2018); Malatsi (2019) also concurred that in Gauteng province, the cultivation of the aforementioned vegetable types was common. Vegetables were mostly cultivated in community gardens compared with field crops that were cultivated in large farms and smallholder plots (farms). These findings agreed with other scholars who documented similar crop production activities in the Gauteng province (Nasamvuni *et al*., 2016; Department of Agriculture, Land Reform and Rural Development, 2020).

The results also indicated that between 24% and 27% of the respondents were involved in livestock and fruit production, while less than 20% produced flowers, herbs and fish as their commodities. The respondents reared various livestock types such as cattle, goats, pigs, sheep and poultry (broilers and layers). Similarly, Statistics South Africa (Stats SA, 2016) reported that more than a quarter (29%) of agricultural households in Gauteng province reared livestock such as goats, cattle, pigs, sheep and poultry. Furthermore, fruits such as peaches, lemons, mangos and oranges were produced, at a small-scale for home consumption.

4.5 CHAPTER SUMMARY AND CONCLUSIONS

This chapter examined the socio-demographic characteristics and agricultural commodities of the farmers in the study area. The main objective was to determine the socio-demographic characteristics of the farmers receiving public agricultural extension and advisory services in Gauteng province. The results of the socio-demographics showed that more than four-fifth (97%) of the respondents were Black Africans, of which

51.8% were female and 48.2% were male. However, there was no statistical difference ($p>0.05$) between female and male participants who were profiled in the study; thus, the null hypothesis was accepted. Gender had a positive and significant correlation with age ($r=0.104$) and farming experience ($r=0.094$). The results implied that male respondents were older and highly experienced farmers. Moreover, respondents who were the recipients of public extension and advisory services spoke eleven South Africa languages, of which Southern Sotho (Sesotho) was the most spoken language by 26.9% of the respondents, followed by IsiZulu at 22.9%. The results implied that government is rendering extension services to a multiracial group of farmers of South African descent. The findings of relationship status illustrated that married farmers were dominant at 49.1%, followed by those who were single (35.3%) and other types of relationships (widowed, divorced, cohabitation and separated). Therefore, it was concluded that most (52%) of the respondents had spousal support because they were married or cohabitating. The study also found that most (43.3%) of the respondents were between 35 and 55 years old, followed by 56-65 years age group (21.2%), whereas only 19.5% were less than 35 years old. The results showed that about four-fifth (80.5%) of the farmers receiving extension services from government were above 35 years old. Age and farming experience had a positive ($r=0.292$) and significant correlation ($p<0.05$); thus, older farmers were more experienced. However, age had a negative and significant correlation with the following socio-demographic variables: education, farming category, farm size, and annual net farm income. It was concluded that older farmers were less educated, mostly non-commercial, occupied smaller farms and made less profit (net income) from farming. From education level perspective, more than three quarters (86.2%) of the farmers had formal education (primary to doctoral degree) of which secondary education was dominant at 49.5%, followed by primary education (16.3%). However, older farmers were less educated compared to the young ones as shown by the correlation findings. On the other hand, education level had a positive and significant ($p<0.05$) relationship with farm size ($r=0.124$), farming category (0.137) and annual net farm income ($r=0.133$) of the respondents. The results suggested that highly educated farmers were large-scale commercial farmers who made more profit from farming.

The results of farming experience indicated that on average, the respondents have been farming for six years, of which the majority (55.3%) had 0.5 (six months) to five years' experience. Farming experience was positively and significantly correlated with gender, age, farm size and net income. The findings implied that more experienced respondents were older large-scale male farmers who earned more net income per annum from their farming activities. Moreover, more than two-thirds (68.1%) of the respondents were not commercial farmers; thus, the majority were subsistence or emerging farmers. Farming category (commercial or non-commercial) had a positive and significant relationship with two socio-demographic characteristics, namely education level (r=0.137) and farm size (r=0.206). However, the relationship with age (r=-0.1750 and farming experience (r=-0.127) was negative and significant. Therefore, commercial farmers were highly educated and occupied bigger farms. They were also younger and less experienced. The study found that about three quarters (75.3%) of the respondents had no title deeds for their farmland because they occupied it through communal or leasehold tenure (renting). Therefore, they could not invest in farm infrastructure or use their land as collateral to access finance. The average plot/farm size was 4.55 ha, of which the majority (76.5%) occupied farm size between 0.001 ha and 5 ha. It meant that small-scale farmers were dominant. Farm size had a positive and significant ($p<0.05$) relationship with education level, farming category, farming experience and annual net farm income. The conclusion was that bigger farms/plots were occupied by highly educated commercial farmers who were well experienced and earning more income.

Regarding income sources, the study revealed that the majority (67.6%) of the respondents depended on farming as their main source of income. Furthermore, they earned additional income from social grants, businesses and part-time employment. On average, the respondents generated profit of about R21 387.56 per annum from farming. A large proportion (82.4%) of the respondents made profit of <R42 000 per annum, while 29.6% did not make any profit from farming. It implied that most farmers receiving extension services from government could not sustain their livelihoods from farming, only because their annual income was less than R42 000 prescribed by government as the

minimum wage in South Africa. Annual net farm income had a positive and significant relationship with education level and farm size. It implied that large-scale and highly educated farmers earned more income from farming. However, farmers who were frequently visited by extension officers did not make more profit from their agricultural commodities (farming). The results of agricultural commodities showed that vegetables (cabbage, spinach, onion, carrots, Swiss chard, beetroots, Chinese cabbage and chomolia) and field crops (maize, potatoes, sunflower, beans, soya beans and groundnuts) were cultivated by the majority (>50%) of the respondents. In conclusion, the government in Gauteng province rendered extension and advisory services to most farmers involved in plant production (crops and vegetables).

CHAPTER 5: ACCESS TO EXTENSION AND PERCEIVED QUALITY OF PUBLIC AGRICULTURAL EXTENSION AND ADVISORY SERVICES AMONG FARMERS IN THE STUDY AREA

5.1 BACKGROUND AND INTRODUCTION

Agricultural extension is one of the pioneers of agricultural development and food security in most developing countries across the world. This is because access to agricultural extension services enables farmers to acquire skills and adopt innovations that improve agricultural productivity, and subsequently improve the livelihoods of the farmers (Christoplos, 2010; Nnadi *et al*., 2012). Furthermore, extension services provide farmers with appropriate information that enables them to make decisions that improve their farming and solves problems (Davis & Heemskerk, 2012). Governments have been the main providers of agricultural extension services in many countries (Kidd *et al*., 2000; Anderson & Feder 2004; Maoba, 2016). However, government (public) agricultural extension services have been criticised (Olusola, 2011) for being ineffective, and unresponsive to the needs of the farmers and communities (Kidd *et al*., 2000; Qamar, 2005; Mutimba, 2014). The quality of public extension services is one of the challenges that have been raised by some of the farmers (Sharmin, 2012). For example, Mmbengwa *et al.* (2012) reported that nearly half of the farmers in the West Coast District Municipality in South Africa considered the quality of public extension services to be poor. Agholor *et al.* (2013) reported that more than half (>50%) of male farmers in the Amathole District in South Africa were not satisfied with the quality of timelines of delivery and the accuracy of extension services rendered by government. Kabir *et al.* (2020) reported that most farmers were not satisfied with the quality of public extension services, with specific reference to content offered, accuracy and relevance, timelines, efficiency, and the feedback provided. Kassem *et al*. (2021) also found that farmers in Egypt were dissatisfied with the quality of some of the services rendered by government extension officers. Most of the farmers in the aforementioned study area were not satisfied with services rendered based on their needs and reliance on solving their problems. This is a concern because the quality of extension services influences agricultural productivity on the farms. If farmers do not receive extension services of good quality, their agricultural outputs are more likely to be lower, and they become food insecure due to loss of production and income.

According to Moradi and Poorsaeid (2014), satisfaction with extension services is positively and significantly influenced by age, farm size, income, and use of extension services. In addition, gender, literacy level, the number of visitations and the number of farm parts (portions) significantly influence satisfaction with extension services (Ganpat *et al*., 2017). In some instances, family size, number of family members involved in agriculture and other occupations, and financial security positively and significantly influenced satisfaction with government extension services (Joshi & Narayan, 2019). In some parts of South Africa, it was found that the quality of extension services rendered by the government was poor due to political transformation that favoured the employment of inexperienced extension officers (Conradie, 2016). Moreover, the high ratio of extension officers to farmers is one of the factors that have a negative impact on the quality of public extension services. According to Phiri (2009); Raidimi and Kabiti (2017), South Africa's public extension services cannot cope with the demand for the services because the support provided to small-scale and resource-poor farmers is limited. For example, large numbers of smallholder farmers who receive public extension services are allocated few extension personnel compared with large-scale farmers who are allocated more extension personnel (Department of Agriculture, Forestry and Fisheries, 2011). The Agricultural Research Council (2011) reported that the average ratio of extension officers to farmers in South Africa is about 1:873. This is above the ratio recommended in the norms and standards for extension and advisory services in South Africa. The ratios recommended for extension officers to farmers in South Africa range between 1:250 and 1:500 for different groups of farmers, such as subsistence, semi-commercial and commercial large-scale farmers (Worth, 2012); and because of the high ratio of extension officers to farmers, there is poor access to extension and advisory services amongst the farmers who rely on public extension services.

The imbalance in the ratio of extension officers to farmers in South Africa affect the quality and effectiveness of public extension services, and because of that, those extension officers cannot give priority to all the farmers by visiting them as often as required. In support of the above supposition, Davis and Terblanché (2016) reported that human resource is one of the fundamentals that influence the effectiveness of extension services. For example, Elias *et al*. (2015); Ganpat *et al*. (2017) found that farmers who were constantly visited by extension officers were more satisfied with the quality of their services, confirming that when the ratio of extension officers to farmer is high, extension officers cannot visit the farmers as often as required. Therefore, extension services were perceived as ineffective when farmers were not satisfied because the services rendered would be of poor quality. However, although several studies have been conducted to measure the quality of public extension services in South Africa, none of them has used the norms and standards of extension and advisory services, which were developed by the National Department of Agriculture in South Africa. Again, all the studies cited above were conducted at district or regional level, meaning that the findings did not reflect the status at provincial level. It is against this background that the current study was conceptualised. Thus, the aim of this chapter was to investigate how farmers in Gauteng province perceived the quality of public agricultural extension and advisory services.

In this chapter, the research objectives are presented followed by the hypotheses. Thereafter, the type of data and analytical methods used to achieve the research objectives are presented in their respective order. The results and discussions are presented together before the summary and concluding remarks are provided in the last section of the chapter.

5.2 RESEARCH OBJECTIVES

This chapter aimed at achieving the following objectives:

- To determine farmers' perception of public agricultural extension and advisory services in Gauteng province with specific reference to:

    - perceived quality of extension services and influencing factors; and
    - frequency of access to public extension services and its determinants.
- To ascertain farmers' access to sources of extension services.

5.3 TYPE OF DATA AND ANALYTICAL METHODS

5.3.1 Type of data

The type of data collected to achieve the research objectives was numerical and categorical. Categorical data included both ordinal and nominal data which was collected using five-point Likert and nominal scale, respectively. The Likert scale for measuring farmers' perceptions about the quality of public extension and advisory services was structured as very poor, poor, average, good and very good with scores of 1, 2, 3, 4 and 5, respectively. The perceived effectiveness of public extension services in the study was limited to the guiding principles for advisory services in agriculture in South Africa. Numerical data used was for the number of monthly visits by extension officers and the distance from extension office to the farm/plots.

5.3.2 Data analysis

Categorical and numerical data collected to achieve the research objectives for this chapter were subjected to descriptive and inferential statistical analyses. The descriptive statistical analysis included the mean, standard deviation, standard error of mean, coefficient of variance, frequencies and percentages. The type of inferential statistics performed was Ordered Logistic Regression (OLR). Ordered Logistic Regression (OLR) model was used to analyse data of the factors influencing farmers' perceptions of the quality of public agricultural extension and advisory services. The perceived quality of public extension and advisory services was categorised as 1=Very poor; 2=Poor; 3=Average; 4=Good; and 5=Very Good. Ordered Logistic Regression uses ordinal response as a dependant variable (Harrell Jr, 2015). In the current study, the five-point

Likert scale used to collect information for a dependant variable was ordinal; hence, OLR was employed for the inferential statistical analysis. In OLR, a polychotomous-ranked dependant variable is predicted as a function of explanatory factors describing an individual or unit characteristics (Gray & Kinnear, 2012). According to Gujarati (2012), the basic principle of estimating OLR is as follows:

$$Pr(Y_i \le j) = Pr(\beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki} + u_i \le \alpha_j)$$

In the equation, the probability is that Y_i (dependant variable) is within category j and below. Therefore Y_i is in category 1, 2, ..., or j), whereas u_i is the error term. In the current study, the empirical model estimated using OLR is as follows:

$$Pr(\text{PQPEAS} \le 5) = Pr(\beta_1\text{G} + \beta_2\text{A} + \beta_3\text{ED} + \beta_4\text{FC} + \beta_5\text{FS} + \beta_6\text{FE} + \beta_7\text{ANFI} + \beta_8\text{NVEO} + \beta_9\text{AOSE} + \beta_{10}\text{CBP} + \beta_{11}\text{PESSFWDC} + \beta_{12}\text{FPCT} + \beta_{13}\text{FPASDA} + u_i \le \alpha_5)$$

Whereby,

PQPEAS = perceived quality of public extension and advisory services

G = gender

A = age

ED = education level

FC = farming category

FS = farm size

FE = farming experience

ANFI = annual net farm income

NVEO = number of monthly visits by extension officer

AOSE = access to other sources of extension

CBP = compliance of extension services to the Batho Pele principle when dealing with people and planning activities

PESSFWDC = promote equity through subsistence small-scale farmers, women, disabled and commercial farmers

FPCT = facilitate and provide access to technology

FPASDA = provide and facilitate advice on skills development in agriculture
U = error term

The independent variables fitted in the regression model were socio-demographic characteristics of the participants and perceived effectiveness of public extension and advisory services. The variables of the perceived effectiveness of public extension and advisory services were selected from the results of Exploratory Factor Analysis (EFA) presented in chapter six. The variables with the highest loading factor were included in the OLR model. As a result, the variables selected were perceived as the effectiveness of public extension and advisory services in the following:

- promoting equity through subsistence small-scale farmers, women, disabled and commercial farmers (factor loading=0.80);
- compliance of extension services to the Batho Pele (rendering good quality services and goods) principle when dealing with people and planning activities (factor loading=0.80);
- facilitating advice on skills development in agriculture (factor loading=0.74); and
- facilitating and providing access to technology provider (factor loading=0.69).

Detailed explanation of PAF analysis and results are presented in sections 6.4.2 and 6.5.2 in chapter six. The description of the independent variables used in OLR model used to analyse factors influencing perceived quality of public extension and advisory services are presented in Table 5.1. The other type of inferential statistics performed was Multiple Linear Regression (MLR) analysis. The purpose of the analysis was to determine factors influencing the number of visits by extension officers. The equation and model estimation for MLR presented in chapter four was also used to analyse data of the factors influencing monthly extension visits. However, the groups of independent and dependent variables fitted in the model were different. Table 5.2 depicts the list of independent and dependent variables fitted in MLR model used to determine factors influencing the number of visits by extension officers.

Table 5.1: The description of the independent variables used in OLR model determining factors influencing the perceived quality of public extension and advisory services

Variable description	Valuation	Expected sign/influence	Interpretation of signs
X_1=Gender	0=Female; 1=Male	Negative	Male farmers would be less satisfied with the quality of extension services
X_2=Age	1=<35 years; 2=35–45 years; 3=46–55 years; 4=56–65 years; 5=>65 years	Positive	Older farmers would be satisfied with the quality of extension services
X_3=Education Level	1=No formal education; 2=Primary education; 3=Secondary education; 4=Abet education; 4=Diploma; 5=Bachelor's degree; 6=Honours degree/BTech; 7=Masters; 8=Doctorate	Negative	Highly educated farmers would be less satisfied with the quality of extension services
X_4=Farming category	0=Non-commercial; 1=Commercial	Positive	Commercial farmers would be less satisfied with the quality of extension services
X_5=Farm/plot size	Ha	Negative	Large-scale farmers would be less satisfied with the quality of extension services
X_6=Farming experience	(Years)	Negative	Experienced farmers would be less satisfied with the quality of extension services
X_7=Number of visits by extension officer	Number	Positive	Farmer visited frequently would be satisfied with the quality of extension services
X_8=Distance from farm to extension office	Kilometers (km)	Negative	Farmers located further from extension office would be less satisfied with the quality of extension services
X_9=Annual net farm income	Amount in rand (ZAR)	Positive	Farmers earning more profit would be satisfied with the quality of extension services
X_{10}=Access to other sources of extension	0=No; 1=Yes	Positive	Farmer with access to multisource source of extension would be satisfied with the quality of extension services

X_{11}=Compliance of extension services to Batho Pele principle when dealing with people and planning activities	1=Very ineffective; 2=Ineffective; 3=Average; 4=Effective; 5=Very effective	Positive	Farmer who perceives extension service as effective would be satisfied with the quality of extension services
X_{12}=Promote equity through subsistence small-scale farmers, women, disabled and commercial farmers	1=Very ineffective; 2=Ineffective; 3=Average; 4=Effective; 5= Very effective	Positive	Farmer who perceives extension services as effective would be satisfied with the quality of extension services
X_{13}=Facilitate and provide access to technology	1=Very ineffective; 2=Ineffective; 3=Average; 4=Effective; 5=Very effective	Positive	Farmer who perceives extension services as effective would be satisfied with the quality of extension services
X_{14}=Provide and facilitate advice on skills development in agriculture	1=Very ineffective; 2=Ineffective; 3=Average; 4=Effective; 5=Very effective	Positive	Farmer who perceives extension services as effective would be satisfied with the quality of extension services

Table 5.2: The description of dependent and independent variables fitted in MLR model used to determine factors influencing the number of visits by extension officers

Type of variable	Variable description	Valuation	Expected sign/influence	Interpretation of signs
Independent variable	X_1=Gender	0=Female; 1=Male	Positive	Male farmer would be visited frequently
	X_2=Age	1=<35 years; 2=35–45 years; 3=46–55 years; 4=56–65 years; 5=>65 years	Positive	Older farmer would be visited frequently
	X_3=Education Level	1=No formal education; 2=Primary education; 3=Secondary education; 4=Abet education; 4=Diploma; 5=Bachelor's degree; 6=Honours degree/BTech; 7=Masters; 8=Doctorate	Negative	Highly educated farmers would be visited seldom
	X_4=Farming category	0=Non-commercial; 1=Commercial	Positive	Commercial farmers would be visited frequently
	X_5=Farm/plot size	Ha	Positive	Large-scale farmers would be visited frequently
	X_6=Farming experience	(Years)	Negative	Highly experienced farmers would be visited seldom
	X_7=Main source of income	0=Non-farming; 1=Farming	Positive	Farmers who rely on farming as their main income source would be visited frequently
	X_8=Annual net farm income	Amount in rand (ZAR)	Positive	Farmer earning more profit would be visited frequently
	X_9=Distance from farm to extension office	Kilometers (km)	Negative	Farmer located further from extension office would be visited seldom
	X_{10}=Perceived quality of public extension and advisory services	1=Very poor; 2=Poor; 3=Average; 4=Good; 5=Very good	Positive	Farmers satisfied with the quality of extension services will be visited frequently

	X_{11}=Access to other sources of extension	0=No; 1=Yes	Negative	Farmer who access extension services from different source would be visited seldom
Dependent variable (Y_i)	Number of monthly visits by extension officer	-	-	-

5.4 RESULTS AND DISCUSSIONS

In this section, the results and discussions related to the research objectives outlined in section 5.2 are presented. The results and discussions of access to other sources of extension and public extension services are presented in section 5.5.1 and 5.5.2, respectively. In section 5.5.3, the findings and discussions of the perceived quality of public extension and advisory services and influencing factors are presented.

5.4.1 Access to other sources of extension

All the respondents were the recipients of public extension and advisory services in Gauteng province; meaning that 100% of them received free extension services from the government. Furthermore, it was determined whether the respondents had access to extension and advisory services from other sources. The current study found that 48.6% of the respondents has access to extension and advisory services from other institutions apart from the government, whereas 51.4% did not. The results of the proportions implied that less than half (<50%) of the farmers who received public extension and advisory services in Gauteng province had access to additional services from other institutions. The assumption (alternative hypothesis) was that 51% (majority) of the farmers had access to other sources of extension services. On other hand, the null hypothesis was that less than 51% (<0.51) of the farmers had access to other sources of extension. The results of Binomial test used to examine the hypothesis are presented in Table 5.3.

Table 5.3: Results of Binomial test used to examine the null and alternative hypothesis (n=442)

Variable	Group	Category	N	Observed Prop.	Test Prop.	Exact Sig. (1-tailed)
Access to other source of extension and advisory services	1	Yes	215	0.49	0.51	0.173[a]
	2	No	227	0.51		
	Total	**-**	**442**	**1.00**		

The results in Table 5.3 indicate that the observed proportions of 0.49 and 0.51 were obtained for the respondents with access and those without access to other sources of extension services, respectively. Nonetheless, the observed proportions of respondents with access to other sources of extension services (0.49) and those without access to other sources of extension services (0.51) were not statistically different (p=0.173). Therefore, accept the null hypothesis that <51% of the farmers in the current study area had access to other sources of extension and advisory services, and the alternative hypothesis is rejected. To identify the types of institutions rendering extension and advisory services to the farmers, a follow-up question was added to collect such information. Figure 5.1 shows the types of institutions rendering additional extension and advisory services to the farmers in Gauteng province.

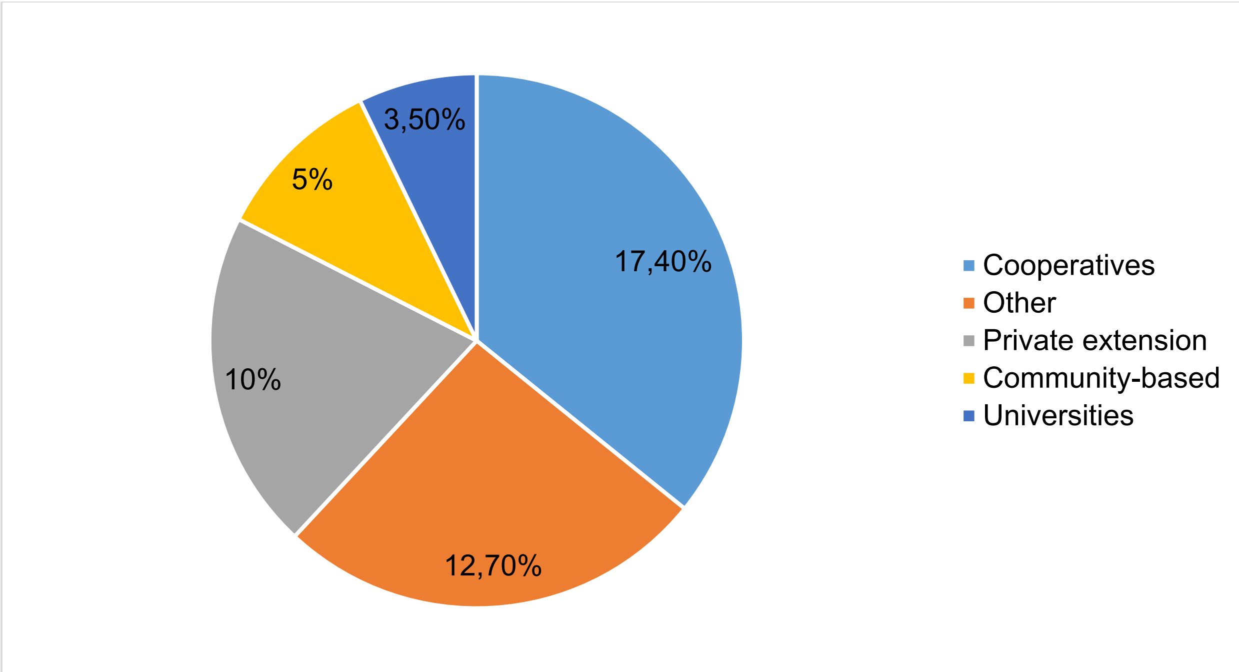

Figure 5.1: Types of institutions rendering additional extension and advisory services to farmers in the study area (n=422)

The results in Figure 5.1 indicate that cooperatives rendered extension services to most (17.4%) farmers followed by 12.7% from other institutions (commodity organisations, mines, local municipalities, and NGO's). University-based agricultural extension was the least additional source of extension services because their services were only rendered to 3.5% of the respondents. Similarly, Koch and Terblanché (2013); DAFF (2016) reported that private institutions, commodity organisations and agricultural cooperatives provide extension services to South African farmers. The low participation by universities implied that higher education institutions which offer agricultural programmes (qualifications) in Gauteng province did not share their knowledge with the local farmers adequately, through the provision of extension services. The low participation of non-government institutions on the other hand, was also a worrying factor because Gauteng province has the second lowest number of extension personnel in South Africa (Ngaka & Zwane, 2018); even though there are about 242 954 agricultural households in the province (Stats SA, 2016). Lack of a national framework and regulatory policy in the provision of extension services could be one of reasons why there is low participation of non-government institutions in the delivery of extension services (DAFF, 2016). Therefore, it is not surprising that few farmers in Gauteng province had access to extension services from non-government institutions because it is not mandatory for institutions such as Universities, commodity organisations and others to render extension services.

5.4.2 Access of public extension services

The variables used to measure farmers' access to public extension and advisory services were the distance from extension office to the farmer's location (farm/plot/community garden) and the number of monthly visits by extension officers. The results and discussions are presented in section 5.5.2.1 and 5.5.2.2.

5.4.2.1 *Number of visits by extension officers*

In Gauteng province most of extension officers render services by visiting farmers on their farms (farm/plot/household/community gardens). For extension officers to render good quality and effective extension services, physical interactions with the farmers are important. Face-to-face interactions can be achieved when extension officers visit farmers whenever there is a need or vice versa. In most cases, extension officers visit farmers because they are allocated travel allowances in order to render services to the farmers. Therefore, the number of visits by extension officers plays a critical role in the provision of extension services to the farmers. For example, Amare *et al*. (2012) reported that the number of visits by extension agents has a positive and significant correlation with the adoption of innovations. Thus, farmers who are more visited frequently by extension agents are more likely to adopt innovations. Again, farmers visited frequently by extension agents have better access to extension services (Atsbeha & Gebre, 2021). Farmers' satisfaction with extension services is also influenced by the distance from the extension office (Ganpat *et al.*, 2017). This background shows that collecting information about the frequency of visits to farmers who receive public extension and advisory services is important. The results of the monthly visits by extension officers are presented in Table 5.4.

Table 5.4: Monthly visits by extension officers in the study area (n=422)

Variable	Information
Mean	2.3
Minimum	0
Maximum	8
Standard deviation	1.78
Standard error of mean	0.09
Coefficient of Variance (CV%)	77.4

The findings presented in Table 5.4 indicate that on average, the respondents were visited about twice per month (actual is 2.3) by public extension officers/agents. In respective order, a standard deviation and CV% of 1.78 and 77.4% were achieved. According to Mucha (1994), CV% between 40 and 100% is considered high. Thus, the variation of the number of monthly visits by extension officers was high. It was not a surprise because there were farmers who did not receive monthly visits from extension officers. Additional statistical analysis performed showed that 16.1% of the farmers were not visited by extension officers on monthly basis. There was a clear indication that government extension officers did not visit farmers regularly as expected. Figure 5.2 presents the results of the category of the number of monthly visits by extension officers.

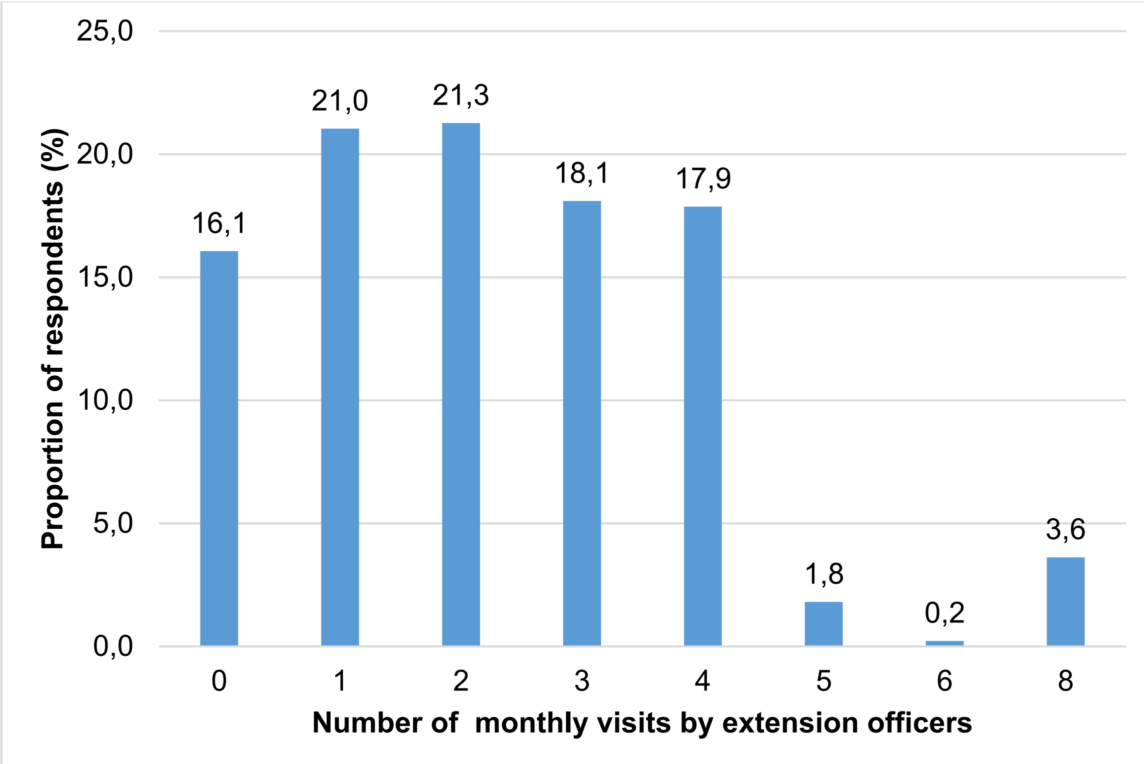

Figure 5.2: Category of the number of monthly visits by extension officers (n=442)

The results in Figure 5.2 depict that about 21.3% of the respondents were visited by extension officers twice a month and 21% were visited once a month. Generally, the findings indicate that the majority (83.9%) of farmers had access to extension services monthly. Moreover, public extension officers visited 62.9% of the farmers at least twice a month. On the contrary, it has been reported elsewhere that most farmers had no monthly visits from public extension personnel (Mirani & Memon, 2011; Khan & Akram, 2012; Akpalu, 2013). In the study by Mirani & Memon (2011), Umunna *et al*. (2012), the similarities were that 19.5-23.3% of farmers were visited once a month by extension officers, which is comparable with 21% which was observed in the current study. Maoba (2016) also concurred that less than fifty per cent (<50%) of farmers in Gauteng province were visited once a month by public extension officers. However, Onwuka *et al*. (2017) found that most farmers who received extension services from the government were visited once a month. The similarities and differences in the number of extension visits observed in the current study and what has been documented in the literature may be influenced by the ratio of extension officers to farmer and other factors that are not constant. The fact that more than four-fifth (83.9%) of the farmers received monthly visits from government extension personnel implied that most farmers had regular access to public extension and advisory services. However, the frequency of access to extension services it was unequal. The positive impact was that most farmers were likely to be informed about new farming innovations due to regular access to extension services.

Further analysis was performed using Multiple Linear Regression (MLR) to determine factors influencing the number of monthly visits by extension officers in the study area. Table 5.5 presents MLR results of the factors influencing in the number of monthly visits by extension officers. The results of model fit summary presented showed that the value co-efficient of determination of R^2=0.256 was achieved. It implied that 25.6% of the variation in the dependent variable (Number of extension visits per month) was accounted for by the independent variables. The number of independent variables added in the regression analysis was adequate because the value of R-square (0.256) was close to Adjusted R-Square (0.237). On the other hand, the results of ANOVA were as follows: $F(11,430) = 13.479$, $p<0.01$. It implied that the regression model was a good fit of the data because p-value was statistically significant at 1% significance level ($p<0.01$). Therefore, the independent variables added in the regression model significantly predicted the dependent variable. Normality was checked and found to be appropriate. The results of Durbin-Watson statistic (DW=1.212) showed that there was a positive autocorrelation identified in the sample. The Variance Inflation Factors (VIF) values were all <2 with a minimum of 1.026 and maximum of 1.842. Thus, there was no multi-collinearity between the variables.

Table 5.5: Results of the Multiple Linear Regression analysis of the factors influencing number of monthly visits by extension officers (n=442)

Model	Unstandardized Coefficients		Standardized Coefficients	T	P-value	Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
(Constant)	1.182	0.406	-	2.912	0.004	-	-	-	-	-
Gender	-0.039	0.150	-0.011	-0.263	0.793	-0.016	-0.013	-0.011	0.975	1.026
Age	-0.071	0.064	-0.054	-1.116	0.265	-0.005	-0.054	-0.046	0.738	1.355
Education level	-0.079	0.053	-0.070	-1.495	0.136	-0.135	-0.072	-0.062	0.778	1.286
Farming category	-0.153	0.172	-0.040	-0.888	0.375	-0.023	-0.043	-0.037	0.848	1.179
Farm size	0.020	0.012	0.091	1.614	0.107	-0.182	0.078	0.067	0.543	1.842
Farming experience	-0.014	0.016	-0.043	-0.881	0.379	-0.108	-0.042	-0.037	0.712	1.405
Main source of income	0.533	0.162	0.140	3.293	0.001**	0.185	0.157	0.137	0.954	1.048
Net farm income in the previous year	-9.736E-6	0.000	-0.276	-5.055	<0.001**	-0.340	-0.237	-0.210	0.579	1.726
Distance from farm to the extension office	-0.005	0.004	-0.051	-1.167	0.244	0.004	-0.056	-0.049	0.915	1.093
Perceived quality of public extension and advisory services	0.494	0.067	0.335	7.346	<0.001**	0.413	0.334	0.305	0.829	1.206
Access to other source of agricultural extension and advisory services	0.086	0.165	0.024	0.520	0.603	-0.035	0.025	0.022	0.807	1.239

Dependent variable: Annual net farm income in the previous year; R=0.506[a], R^2=0.256, Adj. R^2=0.237, DW=1.212, Std. error of the estimates=1.556, F=13.479, VIF=1.026 - 1.842. **Where** * and ** shows significant at 5% and 1% levels of significance.

The results in Table 5.5 indicate that only four independent variables out of the eleven added in the regression model had a positive correlation with the number of monthly visits by extension officers. However, only two (main sources of income and perceived quality of public extension and advisory services) were statistically significant at 1% significance level ($p<0.01$). The other seven independent variables (Age, gender, education level, farming category, farming experience, net farm income in the previous year and distance from extension office) fitted in the regression model had a negative influence on the number of monthly visits by extension officers. Nonetheless, only net farm income in the previous year had a significant influence ($p<0.01$) on the dependent variable (monthly extension visits). The main source of income positively ($\beta=0.140$) and significantly ($p=0.001$) influenced monthly visits by extension officers. This implied that farmers who relied on farming as their main source of income were more likely to receive 14% more visits from government extension officers, with all things being equal. This might be because farmers who relied on farming as their main source of income required more assistance from extension officers in order to sustain their livelihoods.

The perceived quality of public extension and advisory services had a positive ($\beta=0.335$) and significant relationship ($p<0.001$) with the number of monthly visits by extension officers. This meant that farmers who were satisfied with the quality of public extension and advisory services were more likely to receive 33.5% more visits on monthly basis from government extension officers when all other factors were held constant. This could have been because farmers showed appreciation to the extension officers and valued all the support they received. The other reason could have been that farmers who received frequent visits from extension officers were most productive, hence, they were more satisfied with the quality of extension and advisory services. The current findings agree with Ganpat *et al*. (2017) who found that farmers who were visited more frequently by extension agents were more satisfied with the quality of extension services. On the other hand, the coefficient value of net income in the previous year (annual net farm income) had a negative ($\beta=-0.276$) and significant relationship ($p<0.001$) with the number of monthly visits by extension officers. With all things being equal, it implied that an increase in annual net farm income decreased monthly extension visits by 27.6%. Thus, farmers who made more profit from farming had limited access to public extension and advisory services. This might be because farmers making more profit could afford to pay for support from different service providers; thus, they were less dependent on the government extension officers. Similarly, Umunna *et al*. (2012) reported a negative correlation between net income and access to extension services, although the relationship was not statistically significant (p>0.05). Also in contrast, Abdallah & Abdul-Rahaman (2016); Loki *et al*. (2021) found an insignificant but positive relationship between access to extension services and net income.

5.4.2.2 *Distance from extension office*

In Gauteng province, there are four regional offices located in Pretoria (City of Tshwane), Randfontein (Mogale City), Germiston (City of Ekurhuleni), and Vanderbijlpark (Emfuleni Local Municipality). Germiston and Vanderbijlpark are under the same administration. It is worth mentioning that all the extension regional offices are in the cities and towns, meaning that they are mostly located close to urban farmers than rural farmers. The distance between the extension offices and the farms (farming locations) is one of the determinants of job satisfaction among extension officers (Oladele & Mabe, 2010). Moreover, the distance between agricultural extension offices and the farms negatively influences the adoption of agricultural technologies in a significant manner (Asfaw *et al.*, 2016). That means, that farmers who are located closer to the extension offices are more likely to adopt agricultural technologies. Thus, the role played by the distance between extension offices and farmers is worth exploring in agricultural extension studies. Table 5.6 presents the results of farmers' distance from extension offices in the study area.

Table 5.6: Farmers' distance from extension offices (n=422)

Variable	Information
Mean (km)	42.4
Minimum (km)	4.0
Maximum (km)	91.0
Standard error of mean	0.95
Standard deviation	20.17
Coefficient of Variance (CV%)	47.8%

The results in Table 5.6 indicate that on average farmers receiving public extension and advisory services were located about 42.4 km away from extension offices, of which the closest distance was 4.0 km. A CV% percentage of 47.8% showed that the variation was high because it was between 40 and 100% (Mucha, 1994). It implied that there were farmers who were in close proximity to the extension offices, whereas others were at a greater distance. A minimum of 4.0 km and maximum of 91 km have been reported. In Kenya, Tanzania and Niger, an average distance of 8.6, 11.9 and 23.7 km between extension offices and farms was reported (Amare *et al.*, 2012; Kirui *et al*., 2013; Asfaw *et al*., 2016). Thus, the studies cited above were not comparable with the findings of the current study (mean=42.4 km). Moreover, the findings differ with what Oladele (2015) found in North-West province of South Africa, where the average distance between the extension office and farms was 264.3 km. The differences that exist between the two studies could have been influenced by geographical dispersion and the ratio of extension officers to farmers. The land size of North-West province (104 882 km^2) is bigger than Gauteng province (18 178 km^2) (Stats SA, 2011); therefore, farms in Gauteng province are more likely to be closer to extension offices. In the current study, it was found that farmers closer to extension offices were those who farmed on community gardens located in townships and informal settlements. In some instances, farmers who used community gardens were located far from extension personnel. For example, farmers in the City of Johannesburg Metropolitan Municipality received extension services from agricultural advisors located in Randfontein (Mogale City Metropolitan Municipality). On the other hand, most rural farmers were found in smallholder plots and large farms located far from the cities and towns, where regional extension offices are based. Additional analysis was performed to group the distance from farms/plot to extension offices. Figure 5.3 presents the results of the category of distance from extension offices.

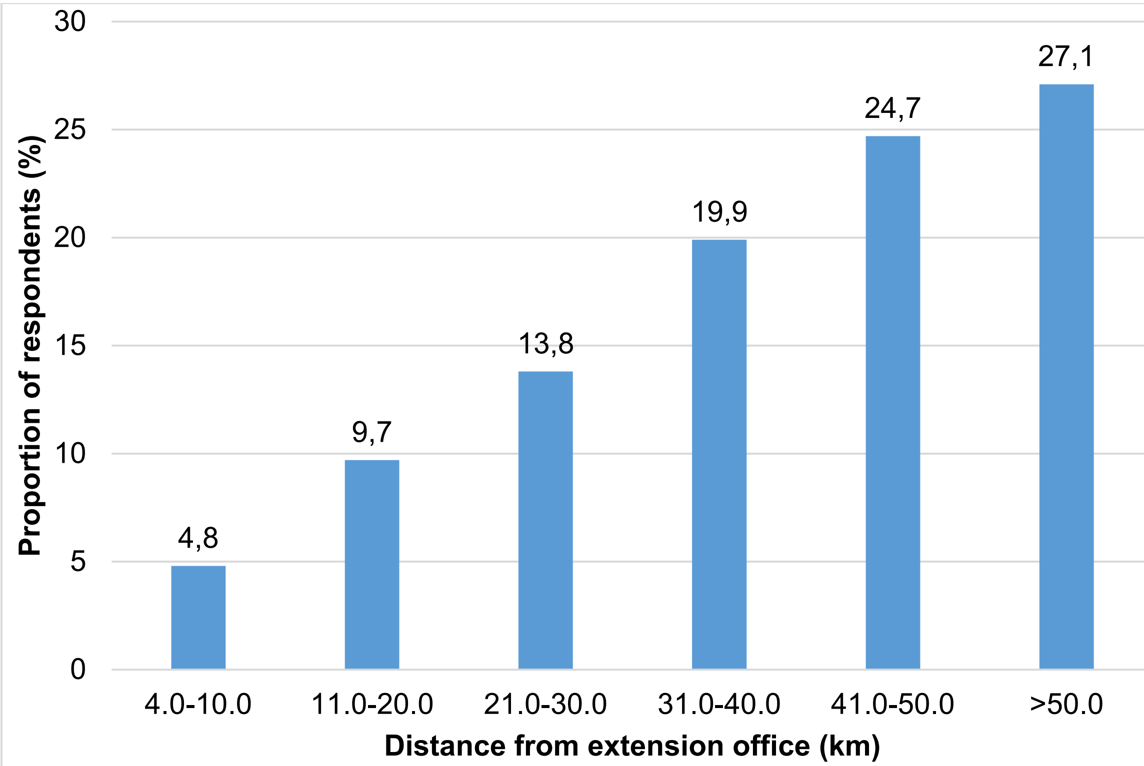

Figure 5.3: Category of distance from extension office (n=442)

The results in Figure 5.3 show that more than a quarter (27.1%) of the respondents were located more than 50 km away from government extension offices, followed by 24.7% who were between 41 and 50 km from extension regional offices. In general, large a proportion (72.9%) of the farmers receiving public extension services resided about 50 km away from the regional offices, where agricultural advisors (extension officers) were based compared with 27.1% who did not. Very few farmers (4.8%) resided about 10 km away from extension offices. In North-West province of South Africa, it was also found that most extension officers travelled more than 40 km to render extension services to the farmers (Oladele & Mabe, 2010); thus, their findings are similar. However, nearly half of the extension officers in the study cited above travelled more than 120 km to render extension services to the farmers. On the contrary, a maximum of 90 km between extension offices and farmers' locations was recorded in this study. Therefore, there were similarities and differences found between the two study areas (Gauteng and North-West provinces).

5.4.3 Perceived quality of public extension and advisory services and influencing factors

Farmers were required to rate the quality of public extension and advisory services using a five-point Likert scale explained in section 5.4. The results in Figure 5.4 show the perceptions of the respondents towards the quality of public extension and advisory services.

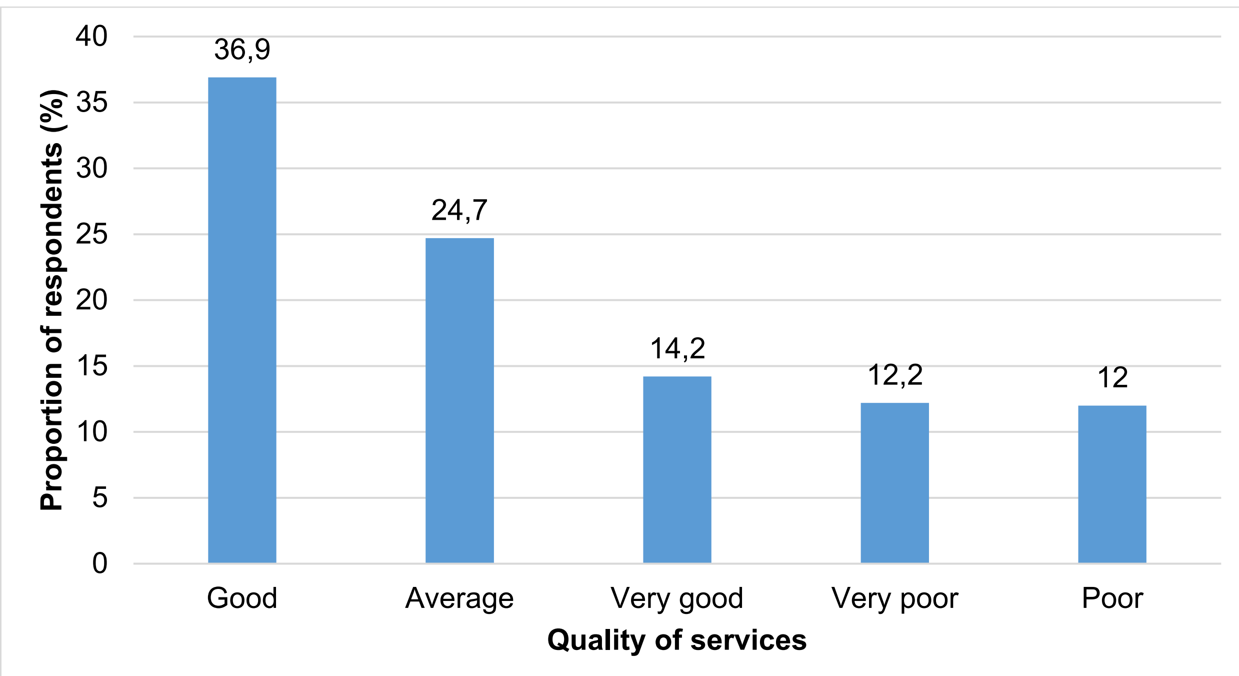

Figure 5.4: Perceptions of the respondents towards the quality of public extension and advisory services (n=422)

Figure 5.4 shows that more than one-third (36.9%) of the respondents perceived the quality of public extension and advisory services offered as good, followed by 24.7% who held the notion that the services were average. About 14.2% of the respondents perceived the quality of extension services as very good, whereas 24.2% disagreed with that notion because they perceived the services as poor or very poor. In general, the findings showed that more than half (51.1%) of the farmers were satisfied with the quality of public extension and advisory services as shown by the proportion of good and very good combined. The findings are in support of Agholor *et al.* (2013); Elias *et al*. (2015) who reported that most farmers were satisfied with the quality of public extension services. However, that differs from Mmbengwa *et al.* (2012); Kabir *et al*. (2020); Kassem *et al*. (2021) who reported that the quality of extension services rendered by the government did not satisfy most of the farmers. The fact that most of the farmers believed that government rendered extension services were of good quality could be an indication that extension officers met the demands of most of their clients.

A follow-up analysis was conducted using inferential statistics – Ordered Logistic Regression specifically – to ascertain factors influencing farmers' perceptions about the quality of public extension and advisory services. The results of the Ordered Logistic Regression are presented in Table 5.7. Firstly, the results from the model-fitting information showed that the model could significantly predict the threshold [$p<0.001$; $X^2(14) = 192.041$]. Therefore, the model that was used fitted the data. The outputs of goodness-of-fit showed that p-values from Pearson chi-square [$X^2(1950.095)$] and Deviance chi-square [$X^2(1135.704)$] statistics were 0.001 and 1.000, respectively. A non-significant result of Pearson and Deviance chi-square indicated that the type of data fitted the model well (Field, 2018). However, the significance value of Pearson and Deviance do not always have to be similar. The values of Pseudo R-Square were 0.352, 0.371 and 0.145 for Cox and Snell, Nagelkerke, and McFadden, respectively. Unlike in Multiple Regression Models, the Pseudo R-Squares measurements have limitations in evaluating the overall model fit (Hair Jr. *et al*., 2019). As a result, the values were accepted as they are without further interpretation. Table 5.7 presents the results of the parameter estimates of the Ordered Logistic Regression (OLR) model of the factors influencing farmers' perceptions of the quality of public agricultural extension and advisory services.

Table 5.7: Parameter estimates of the OLR results of the factors influencing perceptions towards the quality of public extension and advisory services (n=442)

Variable		Estimate (β)	Std. Error	P-value
Threshold	1 = Very poor	1.047	0.506	0.038
	2 = Poor	2.197	0.513	0.000
	3 = Good	3.732	0.533	0.000
	4=Very good	6.039	0.569	0.000
Location	Gender	-7.934E-5	0.180	1.000
	Age	0.120	0.076	0.116
	Education level	-0.167	0.068	0.013**
	Farming category	0.469	0.206	0.023*
	Farm size	-0.029	0.015	0.054*
	Farming experience	-0.025	0.019	0.192
	Net farm income	-3.994E-6	2.360E-6	0.091
	Number of monthly visits by extension officer	0.256	0.059	<0.001**
	Distance from farm to extension office	0.006	0.005	0.173
	Access to other sources of extension	0.335	0.204	0.100
	Compliance of extension services to Batho Pele principle when dealing with people and planning activities	0.513	0.152	0.001**
	Promote equity through subsistence small-scale farmers, women, disabled and commercial farmers	0.049	0.134	0.715
	Facilitate and provide access to technology	0.173	0.117	0.139
	Provide and facilitate advice on skills development in agriculture	0.174	0.116	0.133

Where * and ** shows significant at 5% and 1% levels of significance.

The findings in Table 5.7 indicate that out of 14 independent variables fitted in the OLR, nine of them (gender; age; farming category; monthly visits by extension officer; access to other sources of extension; compliance of extension services to Batho Pele when dealing with people and planning activities; facilitate and provide access to technology; provide and facilitate advice on skills development in agriculture; and promote equity through subsistence small-scale farmers, women, disabled and commercial farmers) were positive while the other four were negative. However, only three positive variables (farming category; number of monthly visits by extension officer; and compliance of extension services to Batho Pele) were statistically significant at 1% ($p<0.01$) and 5% levels ($p<0.05$) of significance (99% and 95% confidence interval). The farming category had a positive ($\beta=0.469$) and significant influence ($p=0.023$) on farmers' perceptions towards the quality of public agricultural extension and advisory services, with all other factors held constant. It implied that commercial farmers were more satisfied with the quality of public extension and advisory services. The postulation was that the advice received from extension officers enabled farmers to earn sufficient income to sustain their livelihoods. This was mainly because most commercial farmers depended on farm income to sustain their livelihoods. According to Elias *et al*. (2015), farmers who achieved high economic returns because of the support received from extension officers were more satisfied with agricultural extension services. In comparison with the current findings, it was not a surprise that commercial farmers were more satisfied with the quality of extension services offered by the government.

Furthermore, there was a positive ($\beta=0.256$) and significant relation ($p<0.001$) between the number of monthly visits by extension officers, and the perceptions of the quality of public extension and advisory services, with all other factors held constant. It meant that farmers who were visited more regularly by extension officers were more satisfied with the quality of extension and advisory services. That could have been because whenever extension officers visited farmers they rendered services that resolved farmers' problems. The results were consistent with the existing literature on the positive correlation that exists between access to extension and satisfaction with the services (Heidari-Sureban, 2012; Elias *et al*., 2015; Ganpat *et al*., 2017; Joshi & Narayan, 2019). It meant that government extension officers met the expectations of most of the farmers whom they visited regularly. Moreover, such farmers had adequate time to engage with extension officers and receive the required assistance timeously; hence, they rated the quality of public extension services highly.

The relationship between farmers' perceptions of the quality of public extension and advisory services, and the effectiveness of the compliance with Batho Pele (people first) when dealing with people and planning activities, was positive (β=0.513) and statistically significant at 1% interval level (p=0.001). It implied that farmers who received better services and goods (Batho Pele) were more satisfied with the quality of the services received from government extension officers. The Batho Pele principle is about delivering goods and services of good quality to the people; hence, compliance with that principle significantly influenced how farmers perceived the quality of extension services. Thus, for public extension services to be perceived as effective, farmers expected the government to provide goods (resources) and services that enhance agricultural productivity. For example, Ramesh *et al.* (2019) found that extension services that were innovative, providing training to the farmers and scientific orientation were perceived to be more effective. Regarding the provision of resources, various farmer support programmes in South Africa provide farmers with resources. Some of the resources provided to the farmers were production inputs, machinery, irrigation systems, livestock, finance, and other resources that are required to improve agricultural outputs. Therefore, it is highly probable that farmers anticipated extension officers to facilitate access to some of the aforementioned resources. Failure to provide production inputs or to facilitate access to such resources would be perceived as ineffective.

The results in Table 5.7 also indicate that from the five variables which had a negative influence (Gender, education level, farm size, farming experience and net farm income) on farmers' perceptions towards the quality of public agriculture extension and advisory services, only education level was statistically significant at 5% significance level (p<0.05). Furthermore, there was a negative (β=-0.167) and statistically significant (p=0.013) relationship between education level and farmers' perception on the quality of public extension and advisory services, with other factors held constant. Thus, farmers who had a higher education level were less satisfied with the quality of public extension and advisory services. In agreement, Al-Zahrani *et al.* (2019) reported that education had a negative relationship with the quality of agricultural extension services, with specific reference to farmers' needs. However, the current findings contrast with what Joshi and Narayan (2019) who found that the level of education positively and significantly influenced farmers' satisfaction with the quality of public agricultural extension services.

It showed that educated farmers in Gauteng province had higher expectations from government extension services; hence, they were less satisfied with the quality of the services rendered. This might be because highly educated people are well informed about the role of extension officers, and the type of support services that should be rendered to them.

Moreover, farm size had a negative (β=-0.029), but significant correlation (p=0.054) with perceived quality of public extension services by farmers. The findings implied that farmers who occupied large farms/plots were not satisfied with the quality of public extension and advisory services in the study area. This differed from Moradi and Poorsaeid (2014); Kassem *et al*. (2021) who found that farm size positively and significantly influenced farmers' satisfaction with extension services. It was evident in the current study that large-scale farmers were less satisfied with the quality of extension and advisory services rendered by the government. The motivation could be that large-scale farmers were not allocated sufficient resources and time that was proportional to their scale of operations.

5.5 SUMMARY AND CONCLUSIONS

This chapter presented the status of access to additional sources of extension services amongst the groups of farmers who received public extension and advisory services in Gauteng province. The frequency of access to public extension and the perceived quality of extension and advisory services were investigated. The results indicated that 48.6% of the respondents had access to additional sources of extension and advisory services compared with 51% which was anticipated. As a result, the null hypothesis (**H_0:** The proportion of farmers with access to other sources of extension and advisory services is 51%). Thus, significant majority of farmers in the Gauteng province had no access to additional sources of extension and advisory services. Nonetheless, cooperatives were the main source of extension amongst the minority group which had access to additional sources of extension and advisory services.

The results of access to public extension and advisory services showed that on average, the respondents were visited twice a month, of which 83.9% were visited at least once a month, whereas extension officers did not visit 16.1% of them on monthly basis. Again, 62.9% were visited twice or more per month by public extension officers. That was an indication of adequate access to public extension and advisory services amongst the beneficiaries. The results of Multiple Linear Regression revealed that the number of monthly visits by extension officers were positively and significantly associated with the main source of income (β=0.140; p=0.001) and perceived quality of public extension and advisory services (β=0.335; p<0.001). However, income had a negative (β=-0.276) but significant (p<0.001) influence on the number of monthly visits by extension officers. The results implied that farmers who relied on farming as their main source of income and those who were satisfied with the quality of public extension and advisory services received 14% and 33.5% more visits from government extension officers, respectively. However, farmers who made more profit per annum (annual net farm income) received 27.6% less visits per month from public extension officers.

The findings of the distance between farming location (farm/plot/community garden) and extension offices indicated that the average distance between the two locations was 42.4 km. The farming location of most (72.9%) farmers was ≤50 km away from extension offices. The general picture shown by the findings was positive because most of the farmers were located within a radius of 50 km from government extension offices in different regions. The findings of the perceived quality of public extension and advisory services illustrated that 51.1% of the respondents were satisfied with the quality of public extension and advisory services. Thus, the quality of government extension services was satisfactory to most recipients in the study area. The results from Ordered Logistic Regress (OLR) model, which predicted the influencing factors showed that farming category, number of monthly visits by extension officer, and compliance of extension services to Batho Pele principle (rendering good quality services and goods) when dealing with people and planning activities, significantly influenced farmers' perceptions of the quality of public extension and advisory services. Therefore, farmers who were frequently visited by extension officers and those farming on commercial scale had positive perceptions of the quality of public extension and advisory services. Moreover, farmers who held the opinion that public extension services were effective in complying with the principle of Batho Pele when dealing with people and planning activities, perceived the quality of public extension services positively.

CHAPTER 6: PERCEIVED EFFECTIVESS OF PUBLIC AGRICULTURAL EXTENSION AND ADVISORY SERVICES AMONG THE FARMERS

6.1 INTRODUCTION

Agricultural extension is a source of information for most farmers with low literacy levels and poor access to Information and Communication Technology (ICT) in developing countries. Agricultural extension agents, who render extension and advisory services to farmers, can provide diverse information about cultivation practices; fertilisation; plant protection (pests, weeds and disease control); marketing; livestock and crop management; climate change; and so forth. Agricultural extension has the potential to improve agricultural production and the quality of farmers' produce (Hosseini *et al*., 2008). Access to extension and advisory services can improve the livelihoods and the well-being of people in rural areas and sustain agricultural activities (Meinzen-Dick *et al*., 2011). Moreover, access to extension services improves the adoption of agricultural technologies (Wossen *et al.*, 2015). Hence, the agricultural productivity of farmers improves when they adopt agricultural innovations and technologies that enhance production. Agricultural extension services can assist farmers in many ways; the benefits of access to extension and advisory services are endless. And because of the important role and benefits of agricultural extension services, access to extension and advisory services is imperative for most farmers, especially those who cannot afford private extension services. The government is the main provider of extension services in most developing countries (Kidd *et al*., 2000; Anderson & Feder, 2004; Berhane *et al*., 2018). One of the reasons that the government is highly involved in rendering extension services, is to ensure that farmers receive the support which would enable them to produce adequate and quality produce, and thus enabling the country to be food secure. Therefore, public extension services rendered to the farmers should be effective and responsive to their needs. Poor public extension services are likely to reduce productivity amongst smallholder farmers in remote areas, where the cost of extension services is high (Conradie, 2016). Effective extension services would benefit farmers and the agricultural sector in general because the role of agricultural extension is very broad.

The goal of extension services is to improve farm productivity and income; however, the organisation and delivery of extension services is carried out in different ways (Kassem, 2014). As a result, the methods used to measure the effectiveness of extension services varies from one country to the other. The effectiveness of government extension services can be measured by assessing the training offered to the farmers and evaluating demonstrations; study groups; farmers' days; farm visits; on-site trials and research; workshops; printed materials; and office and telephone calls (Maoba, 2016). The study cited above found that public services were not effective in sharing printed information, communication and facilitating workshops, but were effective in utilizing other methods (Maoba, 2016). In another study, public extension services were most effective in demonstrations; meetings; and the distributions of pamphlets (Kassem, 2014). Public extension services were also found to be moderately effective in the dissemination of information through demonstrations and farm/home visits in a study that utilised a T-test to compare private and public extension services (Talib *et al*., 2018). However, in that study, it was found that public extension services were less effective in agricultural campaigns; farmers' days; and signboards aimed at building farmers' capacity. Again, public agricultural extension was ineffective in uplifting farmers from poverty and in providing the necessary resources (Makapela, 2015). This background indicates that the effectiveness of extension services is determined by farmers' expectations of extension agents.

The determinant of the effectiveness of extension services have been investigated by using various data analysis methods, such as, principal component analysis (PCA); Regression models (Ordered Logistic, Binary Logit; Probit; ordinary Least Squares; and Multiple logistic); descriptive statistics; and qualitative analysis. The factors which influence the effectiveness of extension services were identified using PCA methods, these are policy-making factors, which account for 17.2% of the variance; followed by socio-cultural factors (16.4%); and structural and economic factors which account for

14.1% and 13.3%, respectively (Rasouliazar *et al.*, 2011). In the regression model, it has been reported that the effectiveness of extension services is determined by factors such as age; marital status; work experience of extension personnel; acquisition of extension education; field of expertise; and the number of villages served by extension personnel (Sezgin *et al.*, 2010). Gender and farm size were found to significantly influence farmers' perception of the effectiveness of agricultural extension information and service delivery (Komba *et al.*, 2018). In another study which used logistic regression, it was reported that age, farming experience and knowledgeable extension personnel positively influenced farmers' perceptions of the effectiveness of extension methods; however, knowledgeable extension personnel was the only significant factor (Khan & Akram, 2012). Other significant determinants of the perceived effectiveness of extension services were measured using regression models. These determinants were educational status and farming experience (Oluwasusi & Akanni, 2014; Ramesh *et al.*, 2019). In addition, training received; contact with extension agents; scientific orientation; information source utilisation; and innovativeness, had a positive and significant relationship with the perceived effectiveness of extension services (Ramesh *et al.*, 2019). Gender; age; farmers' attitudes towards extension services, and extension services received, significantly influenced farmers' perceptions of the effectiveness of extension services (Oluwasusi & Akanni, 2014). In a study that utilised the Delphi Technique, it was found that quality of training and lack of resources influenced the performance of extension agents (Zwane *et al*., 2014). Based on these studies which were conducted on agricultural extension services, it was evident, that globally, scholars use different methods to measure the effectiveness of extension services. Furthermore, there are different factors that influence the effectiveness of agricultural extension services. Hence, there is no single method for determining the effectiveness of extension services rendered to farmers.

In South Africa, the provision of extension services is guided by the principles, norms and standards for extension advisory services in agriculture, which were developed by the Ministry of Agriculture. The guiding principles are demand-driven services; promotion of equity; flexibility to changing needs; monitoring and evaluation; participatory approaches;

prioritization of farmers' needs; social and human capital development; strengthening structural partnerships; facilitating skills development and access to technology; improved planning and decision-making; sustainable income generation; and the conservation of natural resources (Department of Agriculture, 2005). Therefore, it is important to measure the effectiveness of extension and advisory services against these guiding principles because they are the key drivers of extension services in South Africa. This background prompted the researchers to measure the effectiveness of extension and advisory services, by using the South African guiding principles as developed by the government. The aim of this chapter is to measure the perceived effectiveness of public agricultural extension and advisory services and to ascertain the explanatory factors. The structure of this chapter includes research objective, hypotheses, type of data and analytical methods, results and discussions, and summary and conclusions.

6.2 RESEARCH OBJECTIVES

The purpose of this chapter was to achieve the following objective of the study:

- To determine farmers' perceptions of effectiveness of the existing public agricultural extension and advisory services in Gauteng province with specific reference to:
    - the perceived effectiveness and influencing factors; and
    - exploratory factors associated with the perceived effectiveness.

6.3 TYPE OF DATA AND ANALYTICAL METHODS

6.3.1 Type of data

Data used to measure the perceived effectiveness of public extension and advisory services in the study were categorical data collected using the five-point Likert scale. The five-point Likert scale was structured as follows: 1=Very ineffective; 2=Ineffective; 3=Average; 4=Effective; and 5=Very effective. The variables used to measure the perceived effectiveness of public extension services in the study were adopted from the guiding principles for advisory services in agriculture in South Africa. The variables were as follows:

- high quality extension and advisory services;
- relevant extension approaches;
- demand driven extension services;
- compliant with the principles of Batho Pele when dealing with people and planning activities;
- promoting equity through subsistence small-scale farmers, women farmers, disabled farmers and commercial farmers;
- flexible in responding to farmers' ever-changing needs;
- effective monitoring and evaluation tools;
- prioritising the needs of the beneficiaries;
- focusing on human and social capital development;
- utilising participatory approaches in planning, implementation and evaluation of their project/programmes;
- facilitating access to extension and advisory services that lead to sustainable income generation by clients;
- providing and facilitating access to agricultural information for improved planning and decision-making;
- facilitating access to technology and where possible, provides such technologies;
- providing and facilitating access to advice on sustainable agricultural production (including conservation of natural resources);
- providing and facilitating advice on skills development in agriculture; and
- strengthening institutional arrangements (partnerships, restructuring, corporatisation, funding, establishment of new entity/ties) for the effective delivery of services.

6.3.2 Data analytical methods

Before statistical data analysis was performed, reliability and internal consistency of the Likert scale used to collect data about the perceived effectives of public extension and advisory services was determined using Cronbach alpha's coefficient. All the 16 variables that measured the perceived effectiveness of extension and advisory services in the survey questionnaire were loaded for analysis in the reliability test. The Cronbach's alpha coefficient value obtained in the analysis was 0.97 and because the internal consistency was satisfactory, the questionnaire was reliable. Cronbach's alpha coefficient values between 0.58 and 0.97 are considered satisfactory (Taber, 2018). Furthermore, the mean scores for all the variables ranged between 3.12 and 3.45. As a result, all the questions in the survey instrument were retained for principal Exploratory Factor Analysis (EFA) and descriptive statistical analysis. After it was found that the survey instrument was reliable, the descriptive and inferential statistical analyses were performed. The descriptive statistical analysis included median, frequencies, percentages and interquartile range (IQR). The proportions of very ineffective and ineffective were grouped together and categorised as ineffective, whereas the average was considered as moderately effective. Furthermore, the proportions of effective and very effective were grouped together and defined as effective.

In addition, Ordered Logistic Regression (OLR), Exploratory Factor Analysis (EFA) and correlation analysis were performed. OLR was used to analyse data of the socio-demographic factors influencing farmers' perceptions of the effectiveness of public agricultural extension and advisory services. EFA was performed to reduce the number of variables and assess multicollinearity that exists between the correlated factors (Thompson & Daniel, 1996). The type of EFA employed in the study was Principal Axis Factoring (PAF). PAF is used to determine the underlying factors related to a set of items (Burton and Mazerolle, 2011). The purpose of the PAF analysis in the study was to determine the underlying dimensions of the perceived effectiveness of public extension services. The first step was to determine the adequacy of the sample size for PAF analysis using the Kaiser-Meyer-Olkin (KMO) measure. Bartlett's test of sphericity was also performed as part of the analytical variance. Bartlett's test of sphericity is used to test whether the data is suitable for factor analysis (Williams *et al.*, 2010). Again, Bartlett's test measures the correlation matrix. The value of the KMO measurement obtained was 0.97, which indicated that the sample size was adequate for PAF analysis. A value of ≥0.90 is considered excellent for factor analysis (Kaiser, 1970). The results of the Bartlett's test were as follows: the Chi-Square value obtained was 7262.68 with 120 degrees of freedom (df), and the significance value was 0.00. This meant that the Bartlett's test of sphericity was statistically significant at 120 degrees of freedom. Because Bartlett's test of sphericity was statistically significant at 1% ($p<0.01$), the data was suitable for factor analysis. Thereafter, all the 16 variables that measured the perceived effectiveness of extension and advisory services in the survey questionnaire were loaded for PAF analysis. Principal Axis Factoring with oblique promax rotation was employed. Oblique rotations (direct oblimin, quartimin and promax) gives more accurate results in social science research compared with orthogonal rotations (Varimax, quartimax and equamax) that may lose valuable information (Costello & Osborne, 2005). Moreover, oblique promax rotation was selected because it gives better results than oblimin (Dien, 2010). Different criteria were used to retain the factors for further analysis. A scree plot was used to select the total percentage variance accounted for (PVAF) in the transformed variables. In the scree plots, factors located where the size of the eigenvalues started to make an elbow or break were retained (Cattell, 1978; Costello & Osborne, 2005). Factor loadings above 0.50 were also retained (Cattell, 1978; Hair *et al.*, 2006). After retaining the factors that met the above-mentioned criteria, a correlation analysis of the factors was performed.

Furthermore, the Ordered Logistic Regression (OLR) model was used to analyse data for factors influencing farmers' perceptions of the effectiveness of public agricultural extension and advisory services. The perceived effectiveness of public extension and advisory services was categorised as 1=Very ineffective; 2=Ineffective; 3=Average; 4=Effective; and 5=Very effective. In the study, a five-point Likert scale that was used to collect information for a dependant variable was ordinal; hence, OLR model was employed to analyse data. According to Gray and Kinnear (2012), OLR predicts a polychotomous-ranked dependant variable as a function of explanatory factors describing individual or unit characteristics (Gray & Kinnear, 2012). The basic principle of estimating Ordered Logistic Regression described by Gujarati (2012) is as follows:

$$Pr(Y_i \leq j) = Pr(\beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki} + u_i \leq \alpha_j)$$

In the equation, the probability is that Y_i (dependant variable) is within category j and below. Therefore Y_i is in category 1, 2, ..., or j), whereas u_i is the error term. In the current study, the empirical model that was estimated using Ordered Logistic Regression was as follows:

$$Pr(\text{PEPEAS} \leq 5) = Pr(\beta_1\text{ED} + \beta_2\text{G} + \beta_3\text{A} + \beta_4\text{FS} + \beta_5\text{FE} + \beta_6\text{MSI} + \beta_7\text{ANFI} + \beta_8\text{NMVEO} + \beta_9\text{DFFEO} + \beta_{10}\text{PQPEAS} + u_i \leq \alpha_5)$$

Whereby,

PEPEAS = perceived effectiveness of public extension and advisory services

ED = education level

G = gender

A = age

FS = farm size

FE = farming experience

MSI = Main source of income

ANFI = Annual net farm income

NMVEO = number of monthly visits by extension officer

DFFEO = Distance from farm to extension office

PQPEAS = Perceived quality of public extension and advisory services

U = error term

The average mean score of the overall perceived effectiveness of extension services was used as a dependent variable in the OLR model. The perceived effectiveness of public extension and advisory services was categorised as 1=Very ineffective; 2=Ineffective; 3=Average; 4=Effective and 5=Very effective. The description of the independent variables fitted in OLR model that was used to analyse factors influencing perceived effectiveness of public extension and advisory services is presented in **Table 6.1**.

Table 6.1: The description of the independent variables used in OLR model determining factors influencing perceived effectiveness of public extension and advisory services

Variable description	Valuation	Expected sign/influence	Interpretation of signs
X_1=Education Level	1=No formal education; 2=Primary education; 3=Secondary education; 4=Abet education; 4=Diploma; 5=Bachelor's degree; 6=Honours degree/BTech; 7=Masters; 8=Doctorate	Negative	Highly educated farmers would perceive extension services negatively due to high expectations
X_2=Gender	0=Female; 1=Male	Negative	Male farmers would perceive extension services negatively due to high expectations
X_3=Age	1=<35 years; 2=35–45 years; 3=46–55 years; 4=56–65 years; 5=>65 years	Positive	Older farmers would perceive extension services positively due to low expectations
X_4=Farm/plot size	Ha	Negative	Large-scale farmers would perceive extension services negatively due to high expectations
X_5=Farming experience	(Years)	Negative	Highly experienced farmers would perceive extension services negatively due to high expectations
X_6=Main source of income	0=Non-farming; 1=Farming	Negative	Farmers who rely on farming as their main income source would perceive extension services negatively due to high expectations
X_7=Annual net farm income	Amount in rand (ZAR)	Positive	Farmers making more profit would perceive extension services positively
X_8=Number of visits by extension officer	Number	Positive	Farmers visited frequently would perceive extension services positively
X_9=Distance from farm to extension office	Kilometers (km)	Negative	Farmers located further from extension office would perceive extension services negatively

X_{10}=Perceived quality of public extension and advisory services	1=Very poor; 2=Poor; 3=Average; 4=Good; 5=Very good	Positive	Farmer satisfied with the quality of extension service will have positive perceptions

6.4 RESULTS AND DISCUSSIONS

The results and discussions emanating from the statistical analysis performed to answer the research objective measured in this chapter are outlined between sub-sections 6.4.1 and 6.4.3. The first section focuses on the perceived effectiveness of public extension and advisory services, followed by explanatory factor analysis. In the last section, the results of the factors influencing perceived effectiveness of public extension and advisory services are presented together with the discussions.

6.4.1 Perceived effectiveness of public extension and advisory services

The variables used to measure the effectiveness of extension and advisory services were adopted from the guiding principles of extension and advisory services which were developed by the South African Ministry of Agriculture and adjusted accordingly. The results of the farmers' perceived effectiveness of public extension and advisory services in the study area are presented in Table 6.2.

Table 6.2: Perceived effectiveness of public extension and advisory services in Gauteng province (n=442)

Variable (Item)	Proportion of the participants (%)					Median (IQR)
	Very ineffective	Ineffective	Average	Effective	Very effective	
Renders high quality extension and advisory services	8.8	9.3	31.4	38.9	11.5	4(3.3-3.5)
Uses extension approaches that are relevant to the beneficiaries	9.0	8.8	31.2	38.5	12.4	4(3.3-3.5)
Is demand driven	8.6	13.1	29.6	36.9	11.8	3(3.2-3.4)
Is compliant with the principles of Batho Pele when dealing with people and planning activities	8.8	7.0	29.2	39.8	15.2	4(3.3-3.6)
Promotes equity through subsistence small-scale farmers, women farmers, disabled farmers and commercial farmers	10.0	10.9	25.6	37.3	16.3	4(3.3-3.5)
Is flexible in responding to farmers' ever-changing needs	11.1	13.6	28.7	35.7	10.9	3(3.1-3.3)
Has effective monitoring and evaluation tools	10.6	11.1	31.7	36.0	10.6	3(3.1-3.4)
Prioritises the needs of the beneficiaries	10.4	13.6	30.1	36.9	9.0	3(3.1-3.3)
Focuses on human and social capital development	10.0	12.9	29.4	35.1	12.7	3(3.2-3.4)
Uses participatory approaches in planning, implementation and evaluation of their project/programmes	12.2	8.4	29.4	36.0	14.0	3.5(3.2-3.4)
Facilitates access to extension and advisory services that lead to sustainable income generation by clients	10.2	13.1	30.8	34.8	11.1	3(3.1-3.3)
Provides and facilitates access to agricultural information for improved planning and decision-making	8.8	10.2	29.4	41.2	10.4	4(3.2-3.4)
Facilitates access to technology and where possible, provides such technologies	11.8	14.7	32.1	32.1	9.3	3(3.0-3.2)

Provides and facilitates access to advice on sustainable agricultural production (including conservation of natural resources)	10.2	9.0	30.8	36.2	13.8	3.5(3.2-3.5)
Provides and facilitates advice on skills development in agriculture	11.1	7.2	28.3	37.8	15.6	4(3.3-3.5)
Strengthens institutional arrangements (partnerships, restructuring, corporatisation, funding, establishment of new entity/ties) for the effective delivery of services	12.9	13.1	25.1	35.5	13.3	3(3.1-3.4)
Average	**10.3**	**11.0**	**29.6**	**36.8**	**12.4**	**3.3**

IQR: Interquartile Range

The results in Table 6.2 show that, of the 16 variables measured in the study, public extension and advisory services were perceived as effective in five variables. This was shown by more than half (>50%) of the respondents who agreed that public extension services were effective or very effective. A median of four (4) also support the notion that public extension services were perceived to be effective in all six variables. Moreover, the five variables had IQR between 3.2 and 3.6 for 95% CI lower bound and upper bound, respectively. Of great importance is that public extension and advisory services were perceived as effective by 55.0% for complying with the principles of Batho Pele (rendering good quality services and goods), when dealing with people and planning activities. Good quality services include the provision of resources (goods) that are required by farmers to improve their productivity. In disagreeing with the current findings, Makapela (2015) found that public extension was perceived to be ineffective in providing necessary resources to the farmers. Therefore, the findings of the current study provided a different perspective of the ability of public extension to provide farmers with resources. Secondly, public extension services were perceived to be effective in promoting equity through subsistence small-scale farmers, women farmers, disabled farmers and commercial farmers by most (54%) of the respondents. That contrasted with Ragasa *et al*. (2013) who reported that female farmers were less likely to receive extension services of good quality. Thus, the respondents in the current study held the opinion that public extension services did not exclude farmers because of scale of operation, gender or physical abilities. It showed that the respondents had full confidence with the approaches used by government extension officers to promote equality through extension and advisory services.

Thirdly, 53% of the respondents perceived public extension services to be effective in providing and facilitating advice on skills development in agriculture. The findings agreed with Maoba (2016); Somanje *et al.* (2021) who reported that most farmers perceived public extension services as effective in providing training. That was comparable with the current findings because training is about facilitating skills development. However, the findings by Khan and Akram (2012) contrasted with the current study because they found the ineffectiveness of public extension in the provision of training. Furthermore, 52% of the respondents held the opinion that public extension services were effective in providing and facilitating access to agricultural information for improved planning and decision-making. Similarly, Agholor *et al*. (2013); Somanje *et al*. (2021) reported that most farmers perceived public extension services as effective in the dissemination of information. However, in another study by Al-Zahrani *et al*. (2019) agricultural extension services provided insufficient information to most farmers, thus, they were ineffective in that regard. According to Davis and Heemskerk (2012), access to information enables farmers to make decisions that improve their farming and solves problems. Information is essential in improving agricultural outputs, marketing and distribution strategies (Oladele, 2006). Thus, through public extension and advisory services, most farmers in the study area made informed decisions when planning their agricultural activities because of the information received from extension officers.

Furthermore, about 51% of the respondents agreed that government extension officers used applicable extension approaches that were relevant to the beneficiaries. Khan and Akram (2012) disagreed with the study findings because public extension services were perceived as ineffective in the methods used to render services to the farmers. It implied that extension and advisory services rendered by the government considered the socio-demographic characteristics and farmers' needs because they determine the acceptability of extension approaches used Lastly, 50.4% of respondents believed the government was effective in rendering high quality extension and advisory services. However, the findings by Mcharo (2013); Al-Zahrani *et al.* (2021) disagreed with the findings of the study. In general, public extension and advisory services in Gauteng province were perceived as ineffective because 49.1% of the respondents indicated that the services rendered were average. The median score of 3.3 was also in support of the above explanation. Moreover, extension services were perceived to be ineffective in most of the variables measured, with a median of ≤3.5, while <50% of the respondents perceived the services as effective. The findings were consistent with the documented literature that has reported ineffective public extension services (Khan & Akram, 2012; Mcharo, 2013; Al-Zahrani *et al.,* 2021). On contrary, Maoba (2016); Onwuka *et al*. (2017) reported that public extension services were perceived as effective.

6.4.2 Exploratory factor analysis of the perceived effectiveness of public extension and advisory services

This section presents the results of the explanatory factor analysis which was performed using PAF. The purpose was to identify underlying factors regarding the perceived effectiveness of public extension and advisory services in the study area (Gauteng province). The results of the adequacy of the sample size for PAF analysis and the test of sphericity are presented first, followed by the scree plot; the cumulative column explaining total variance; the explanatory factor analysis; and the factor correlation matrix. After the first analysis, three factors were extracted from the explanatory factor analysis. Twelve variables were retained for further analysis after dropping those with loadings less than 0.50. The KMO score was 0.96, which implied that the sample size was still adequate for factor analysis. Bartlett's test of sphericity was statistically significant ($p<0.01$), meaning that the data was also appropriate for factor analysis. The Chi-Square value was 5113.89 with 66 degrees of freedom (df). **Figure 6.1** presents the scree plot that indicated how eigenvalues were plotted against the factors.

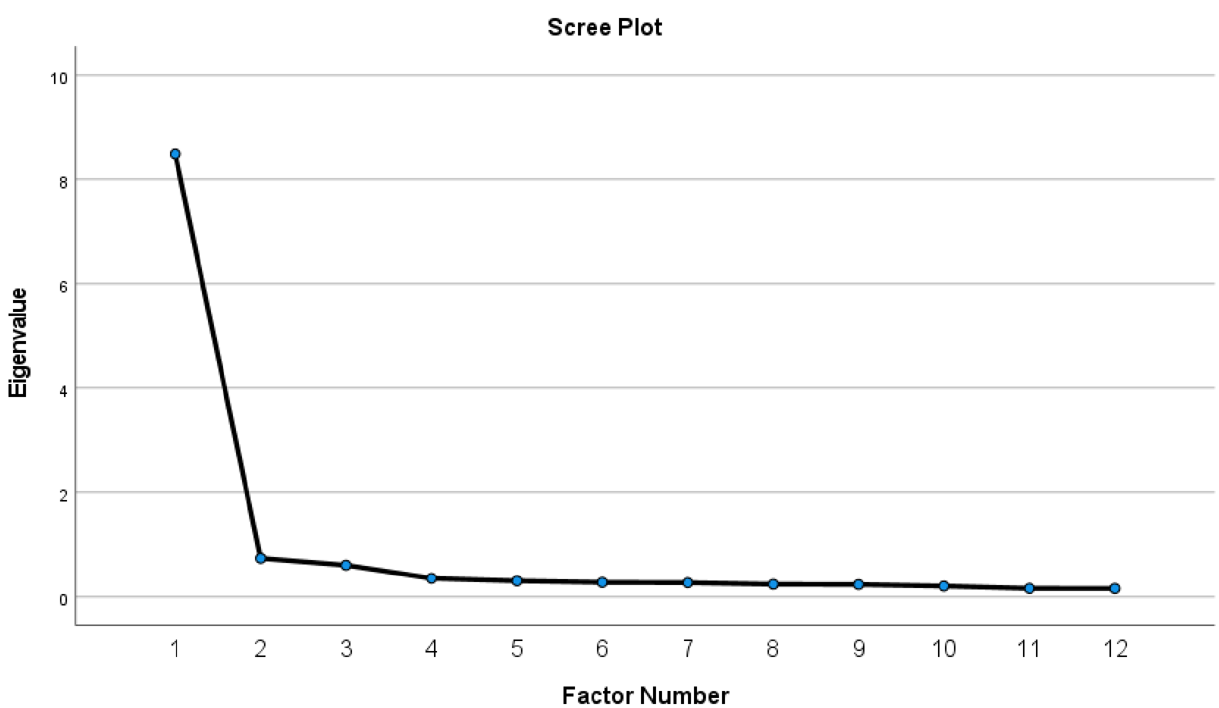

Figure 6.1: Scree plot for factor analysis 1 (n=442)

The results in the scree plot in **Figure 6.1** show that the elbow started to decrease at Factor 4 with an eigenvalue of 0.35. According to Cattell (1978); Costello and Osborne (2005), factors located where the size of the eigenvalues made an elbow or break should be retained. Therefore, the first three factors on the slope, before the graph started decreasing to form an elbow, were retained. The results of the cumulative column explaining total variance are presented in Table 6.3.

Table 6.3: Cumulative column explaining total variance

Total Variance Explained							
Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	8.49	70.72	70.72	8.24	68.69	68.69	7.35
2	0.73	6.10	76.81	0.48	4.03	72.72	6.57
3	0.60	5.00	81.81	0.31	2.61	75.33	6.47
4	0.35	2.91	84.72				
5	0.30	2.52	87.24				
6	0.27	2.28	89.52				
7	0.27	2.23	91.75				
8	0.24	1.98	93.73				
9	0.23	1.94	95.67				
10	0.20	1.69	97.36				
11	0.16	1.32	98.69				
12	0.16	1.31	100.00				

The results depict that the three extracted factors contributed 81.81% of the variance. Individually, Factors 1, 2 and 3 contributed 70.72%, 6.10% and 5.00% to the total variance, respectively. Factor 1 demonstrated the highest eigenvalue with 8.49, followed by Factor 2 with 0.73 and 0.60 for Factor 3. The findings echo Rasouliazar *et al.* (2012) who found that explanatory factors underlying the effectiveness of extension services account for >60% of the variance. The names of the extracted factors were as follows: Factor 1 is relevant and good quality extension and advisory services; Factor 2 is the provision of information which improves agricultural production, and Factor 3 is providing technologies required by farmers. Descriptions of all the factors, loading values and their communalities are presented in Table 6.4.

Table 6.4: Results of the explanatory factor analysis of the effectiveness of public extension and advisory services (n=442)

Variables	**Factor**			**Communalities**
	Factor 1	**Factor 2**	**Factor 3**	
Promotes equity through subsistence small-scale farmers, women farmers, disabled farmers and commercial farmers	0.80			0.77
Is compliant with the principles of Batho Pele when dealing with people and planning activities	0.80			0.79
Offers high quality extension and advisory services	0.67			0.79
Uses extension approaches that are relevant to the beneficiaries	0.65			0.77
Has effective monitoring and evaluation tools	0.65			0.78
Is flexible in responding to farmers' ever-changing needs	0.52			0.74
Provides and facilitates advice on skills development in agriculture		0.74		0.74

Provides and facilitates access to agricultural information for improved planning and decision-making		0.68		0.75
Provides and facilitates access to advice on sustainable agricultural production (including conservation of natural resources)		0.68		0.76
Strengthens institutional arrangements (partnerships, restructuring, corporatisation, funding, establishment of new entity/ties) for the effective delivery of services		0.60		0.63
Facilitates access to technology and where possible, provides such technologies			0.69	0.74
Prioritises the needs of the beneficiaries			0.65	0.78
Eigenvalue	**8.49**	**0.73**	**0.60**	**9.82**
Cumulative variance explained (%)	**70.72**	**6.10**	**5.00**	**81.81**

The results in Table 6.4 show that the analysis extracted three factors associated with perceived effectiveness of public extension and advisory services in the study area. Factor 1 consisted of six variables, followed by Factor 2 and Factor 3 with four and two variables, respectively. The three extracted factors were labelled as follows: Factor 1 is relevant and good quality extension and advisory services (Promoting equity when rendering relevant and good quality extension services; and using appropriate approaches that are flexible and effective in monitoring and evaluation). Factor 2 is the provision of information which improves agricultural production (Facilitating and providing access to information which improves agricultural skills; planning and decision-making; and which sustains agricultural production and strengthens institutional relationships). Factor 3 is providing technologies required by farmers (Facilitating and providing access to technology that prioritises farmers' needs). Factor 3 with two items was accepted because the variables were highly correlated (p<0.01; r_s=0.75). According to Yong and Pearce (2013), a rotated factor with two variables should be considered reliable if the variables are highly correlated with each other. Factor loading for a large proportion of the participants was more than 0.60; therefore, the correlation between the extracted factors and the items associated with them was high. In addition, most variation was extracted because the communalities of all the items were between 0.63 and 0.79. The results of the communalities showed that 63-79% of the variability in the perceived effectiveness of public extension and advisory services, was explained by the three factors (1-3). Therefore, the factor analysis explains the variation in eleven of the twelve variables very well.

In contrast with the current findings, Rasouliazar *et al.* (2011) found that the important factors influencing the effectiveness of extension services were structural, socio-cultural and economic factors, as well as factors relating to policymaking. In the current study, the most important predictor (Factor 1) included providing appropriate, good quality and flexible extension and advisory services to all farmers using relevant extension approaches and effective monitoring and evaluation tools. It implied that extension services using flexible approaches that have clearly defined and effective monitoring and evaluation systems, were perceived to be the most effective. Therefore, farmers in the study area perceived a participatory extension approach as effective compared to a top-down approach that is not flexible. That was not a surprise because globally, agricultural extension has been shifting from top-down towards participatory approaches. Participatory approaches enable farmers to play a critical role in the generation of knowledge and change of practice (Scoones & Thompson, 2009). The approach involves farmers in the planning of activities and ensures that their needs are catered for, as opposed to the needs perceived by the government (Loureiro, 2005). Moreover, monitoring and evaluation of the extension services was an important variable that determined the perceived effectiveness of public extension services in Factor 1. The reason could be that monitoring, and evaluation enables farmers and extension agents to identify the shortfalls of the services, to revise the extension methods, and to improve the services rendered.

Factor 2 shows that extension and advisory services which enabled farmers to acquire farming information and skills that improve and sustain their agricultural production and relationships with stakeholders and were perceived as effective. This could be motivated by the fact that access to agricultural information has a positive correlation with agricultural production (Onwuka *et al.*, 2017). Again, the respondents perceived their relationship with various stakeholders as an important variable that determines the effectiveness of extension services in Factor 2. It implied that farmers expected extension officers to link them with various stakeholders that play an integral role in farming. Therefore, extension officers who linked farmers with corporate, financial institutions and other relevant stakeholders were perceived as effective. Measuring the effectiveness of extension services by evaluating the relationship with various stakeholders, is an indication that farmers are in favour of a pluralistic extension delivery system. Globally, a pluralistic delivery system has gained popularity because extension approaches have evolved from linear approaches to agricultural innovation systems that requires participation of various stakeholders. Agricultural innovation systems bring all potential public and private sectors in creation, diffusion, adoption and use of all types of agricultural knowledge relevant to production and marketing of produce (Scoones & Thompson, 2009).

Factor 3 is providing technologies required by farmers. Thus, farmers perceived extension services that facilitate and provide access to technology that prioritises farmers' needs as effective. Transfer of technology through extension agents to the farmers; include critical information from research and development (Miller & Cox, 2006). Hence, farmers in the study area valued the role that extension agents could play in the transfer of technology. Adoption of technology has the potential to improve agricultural production of the farmers (Tiamiyu, 2009). However, not all technologies brought to the farmers improve agricultural production because some of them are irrelevant. As a result, farmers noted the importance of providing technologies that prioritize their needs as an important measure that determines the effectiveness of extension services.

The factor correlation matrix was generated after extracting all the factors and their individual variables. The results indicated that relevant and good quality extension and advisory services (Factor 1) was positively correlated with the provision of information that improves agricultural production (Factor 2), with r=0.74. This implied that participants, who believed public extension and advisory services were effective in rendering relevant and good quality extension services, perceived the provision of relevant information that improves agricultural production as an important measure of effective extension services. It was not a surprise because several studies have indicated that access to information improves agricultural productivity (Lio & Liu, 2006; Quandt *et al.*, 2020) and net income (Okwu & Umoru, 2009). Moreover, perceived effectiveness of agricultural extension could be significantly influenced by the impact of the services on agricultural productivity (Somanje *et al*., 2021). Thus, farmers who achieved higher agricultural outputs because of the information received from extension officers would perceive extension services as effective. Factors 1 (rendering relevant and good quality extension and advisory services) and Factor 3 (Providing technologies required by farmers) were correlated (r=0.74). The results meant that farmers who perceived relevant and good quality extension and advisory services as a measure of effectiveness, held the opinion that extension services should provide technologies that are required by farmers to be considered effective. Other scholars have reported that adoption of innovations has a positive and significant correlation with perceived effectiveness of extension services (Somanje *et al*., 2021); and quality of extension services (Kaliba *et al.*, 2020). It was not astonishing that farmers expected extension officers to facilitate and provide access to innovations for their services to be considered effective, because the adoption of innovations improves farming outputs (Okunlola *et al.*, 2011; Gebeyehu, 2016; Fowowe, 2020; Djoumessi, 2021) and net income (Boz & Akbay, 2005; Okunlola *et al.*, 2011; Kanyua *et al*., 2015). Therefore, the adoption and access to technologies play a critical role in the sustainability of farms; hence, the effectiveness of extension services is associated with provision of technologies to the farmers.

Lastly, Factors 2 (providing information that improves agricultural production) and Factor 3 (Providing technologies required by farmers) were positively correlated (r=0.71). Therefore, farmers who perceived public extension and advisory services as effective in providing information that improves agricultural production, held the opinion that extension services that provide technologies to the farmers were effective. It was logical for farmers to expect extension officers to provide information that could improve agricultural productivity and facilitate access to technologies, because extension officers were sources of information for most farmers, especially in areas where access to information was limited and farmers' illiteracy level was high. Again, extension officers have improved adoption of innovations amongst different groups of farmers (Nwankwo *et al.*, 2009; Freeman & Qin, 2020). Adoption of innovations occurs when farmers are well informed about the benefits of adopting innovations; hence, the two variables (access to information and provision of technologies) were associated with the perceived effectiveness of extension services in the study. According to Rodgers (1992), diffusion of innovations happens when there is information sharing.

6.4.3 Factors influencing perceived effectiveness of public extension and advisory services

As explained in section 3.7 in the methodology chapter (chapter 3), OLR model was used to analyse data of the factors influencing perceptions towards the effectiveness of public extension and advisory services. The results from the model-fitting information showed that the model could significantly predict the threshold [$p<0.001$; $X^2(10)=146.797$]; therefore, the model used fitted the data. The outputs of goodness-of-fit showed that Pearson chi-square (X^2) value was 4687.691, while Deviance chi-square [$X^2(1007.622)$] was achieved with 1718 degrees of freedom (df). The p-values for Pearson chi-square and Deviance chi-square were <0.001 (significant) and 1.000 (non-significant), respectively. According to Field (2018), non-significant results of Pearson and Deviance chi-square implied that the data fitted the model well. However, they do not always have to be similar. Therefore, the model fitted the data because Pearson chi-square was not statistically significant. The values of Pseudo R-Square were 0.283 for Cox and Snell, 0.305 for Nagelkerke, and 0.127 for and McFadden, respectively. In OLR, the Pseudo R-Square measurements have limitations in evaluating the overall model fit unlike in Multiple Regression Models (Hair Jr., Black, Babin & Anderson 2019). As a result, the Pseudo R-Square values were accepted without further interpretation. Table 6.5 presents the results of the parameter estimates of the Ordered Logistic Regression Model (OLRM) of the factors influencing perceptions towards the effectiveness of public extension and advisory services.

Table 6.5: Parameter estimates of the OLR results of the factors influencing perceptions towards the effectiveness of public extension and advisory services (n=442)

Variable		**Estimate (β)**	**Std. Error**	**P-value**
Threshold	1 = Very ineffective	1.113	0.515	0.031
	2 = Ineffective	2.432	0.515	<0.001
	3 = Average	4.511	0.546	<0.001
	4 = Effective	7.770	0.624	<0.001
Location	Education Level	0.431	0.066	<0.001**
	Gender	-0.295	0.185	0.110
	Age	0.162	0.078	0.038*
	Farm/plot size	-0.016	0.015	0.291
	Farming experience	0.010	0.020	0.624
	Main source of income	0.332	0.201	0.098
	Annual net farm income	4.670E-7	2.480E-6	0.851
	Number of visits by extension officer	0.261	0.062	<0.001**
	Distance from farm to extension office	-0.007	0.005	0.151
	Perceived quality of public extension and advisory services	0.660	0.091	<0.001**

Where * and ** shows significant at 5% and 1% levels of significance.

The results presented in Table 6.5 indicate that most (seven) independent variables fitted in OLR model had a positive influence on farmers' perceptions of the effectiveness of public extension and advisory services. However, only four variables (Education level, age, number of visits by extension officers and the perceived quality of public extension and advisory services) were statistically significant at 1% (p<0.01) and 5% (p<0.05) significance level (99% and 95% confidence interval). The other three independent variables (Gender, farm/plot size and the distance from the farm to extension office) had a negative and insignificant correlation with the dependent variable (perceived effectiveness of public extension and advisory services). Education level had a positive (β=0.431) and significant relationship (p<0.001) with the perceived effectiveness of public extension and advisory services. That was applicable when all other factors were held constant. The results implied that when farmers' education level increased, they perceived extension services as effective, probably because highly educated people are well informed about the role of extension services; hence, they do not have high expectations from government extension officers. As a result, they were satisfied with the extension and advisory services rendered and considered public extension services effective. On the contrary, education had a negative and significant correlation with the perceived effectiveness of extension services in promoting modern technologies (Al-Zahrani *et al.*, 2019).

There was a positive ($\beta=0.162$) and significant correlation ($p=0.038$) between age and the perceived effectiveness of public extension services, with all things being equal. Therefore, when farmers' age increased, they held the notion that extension services were more effective, most likely because older farmers were well experienced in farming thus, they had less expectations from extension officers. Moreover, they could be unaware of the kind of services that should be rendered to them in accordance with the norms and standards for extension and advisory services as prescribed by the Ministry of Agriculture. In support of these findings, Oluwasusi and Akanni (2014) also reported a positive and significant relationship between age and perceived effectiveness of extension services. However, in another study, age had a positive and insignificant influence on farmers' perceptions towards the effectiveness of extension services (Sezgin *et al.*, 2010).

The number of visits by extension officers positively ($\beta=0.261$) and significantly ($p<0.001$) influenced farmers' perceptions of the effectiveness of public extension and advisory services, with all other factors being constant. It implied that farmers who were visited frequently perceived public extension and advisory services as effective. Frequent visits by extension officers meant that farmers had regular contact with extension officers to discuss their challenges and possible solutions. This echoed what Somanje *et al.* (2021) found in their study, where farmers who had regular meetings with extension officers perceived participatory extension approach training as effective. Moreover, that group of farmers perceived extension services as effective because it increased their probabilities of adopting innovations. Frequently visited farmers were more likely to receive regular advice, had better access to resources provided through extension officers and adopted agricultural innovations. As a result, the probabilities of perceiving extension services as effective were higher among the group of farmers who had regular contact with extension officers.

Furthermore, farmers' perceptions of the quality of public extension and advisory services was positively ($\beta=0.162$) and significantly ($p<0.001$) associated with the perceived effectiveness of public extension and advisory services, holding other variables constant. Therefore, farmers who were satisfied with the quality of extension and advisory services that were rendered by the government held the view that public extension services were effective. It was logical that good quality services that satisfy farmers would be regarded as effective. For example, Turyahikayo and Kamagara (2016) found that farmers who perceived extension services positively held the opinion that extension programmes were effective; thus, the findings were similar. Positive perceptions could be influenced by the integrity and commitment of the extension officers (Turyahikayo & Kamagara, 2016); productivity and income (Onwuka *et al*., 2017); economic return (Elias *et al*., 2015); contact with extension agents, scientific orientation, innovativeness and training received (Ramesh *et al.*, 2019); appropriateness of delivery methods, availability of services, service relevancy and timelines (Sylla *et al.*, 2019) and other factors. Therefore, extension services perceived positively in some of the aforementioned variables were more likely to be considered effective by the farmers (recipients of extension services).

6.5 SUMMARY AND CONCLUSIONS

This chapter investigated farmers' perceptions of the effectiveness of public extension and advisory services. Sixteen variables were used to measure the perceived effectiveness of public extension services in the study area. The findings indicated that public extension and advisory services were perceived to be effective in six out of sixteen variables measured as shown by the proportion of more than 50% who agreed and a median score of four. Public extension and advisory services were perceived effective in the following variables compliant with the principles of Batho Pele (rendering good quality services and goods) when dealing with people and planning activities, promoting equity through subsistence of small-scale farmers, women farmers, disabled farmers and commercial farmers, and providing and facilitating advice on skills development in agriculture. Moreover, the services were perceived as effective in providing and facilitating access to agricultural information for improved planning and decision-making; utilising relevant extension approaches that were relevant to the beneficiaries and rendering high quality extension and advisory services. The overall findings showed that 49.1% of the respondents perceived public extension and advisory services as effective. The median score of 3.3 and a low proportion (49.1%) of farmers who agreed implied that in general, public extension and advisory extension services were perceived as ineffective by most farmers. Farmers' perceptions of the effectiveness of public extension and advisory services were significantly associated with education level, age, number of monthly visits by extension officers and the perceived quality of public extension and advisory services. It implied that highly educated and older farmers; frequently visited farmers and those farmers who were more satisfied with the quality of public extension and advisory services perceived extension services rendered by the government as more effective.

The results of exploratory factor analysis extracted three underlying factors which contributed 81.81% of the variance that were associated with the perceived effectiveness of public extension and advisory services; thus, the hull hypothesis was rejected. Factor 1 is relevant and good quality extension and advisory services; Factor 2 is the provision of information that improves agricultural production and Factor 3 is providing technologies that are required by farmers. Factor 1, 2 and 3 consisted of six, four and two variables, respectively. All the three underlying factors associated with the perceived effectiveness of public extension and advisory services were correlated. The results meant that farmers perceived public extension and advisory services that provided relevant and good quality services, provided information that improved agricultural production and access to technologies required by farmers as effective.

CHAPTER 7: FARMERS' ACCEPTABILITY OF UNIVERSITY AGRICULTURAL EXTENSION SERVICES

7.1 INTRODUCTION

Universities can provide a viable option for pluralistic extension system because they are mostly public-funded institutions. Moreover, universities are involved in agricultural development activities such as teaching, research, knowledge generation, curriculum and module development, and others academic activities that can improve agriculture. Therefore, it is imperative for universities to provide extension and advisory services where there is a demand. Internationally, University agricultural extension (cooperative extension) has been successful in many countries including the USA, India, Nigeria and others (Rodgers, 1992; McLean, 2007; Okolo, 2010). For example, in the USA, University extension seated in Land Grant universities has been the agent of innovation through research that improved the livelihoods of the beneficiaries (Franz & Townson, 2008). In India, state agricultural universities and colleges have been successful in rendering extension and advisory services in their surrounding communities (Van den Ban, 2003). In South Africa, there is evidence that university agricultural extension services played a critical role in the success of white-commercial farmers during the apartheid era before 1994 (Ngomane, 2010). During that era, farmers had easy access to agricultural research and information from universities through the Department of Agriculture. However, the cordial relationship that existed between universities and the Department of Agriculture has weakened in recent years (Koch & Terblanché, 2013). As a result, university agricultural extension services have slowly diminished in both small-scale and commercial farming settings.

The necessity for pluralism extension in the new millennium has opened the debate about the role played by universities in agricultural extension and advisory services. This is not surprising because in countries where university extension is formalised, it has been reported that agricultural research and teaching at the universities is relevant to the farmers because it is responsive to their needs (Rodgers, 1992; Anderson & Feder, 2004). In addition, farmers' productivity has increased enormously through university agricultural extension because it integrates farmers' needs and agricultural research (McDowell, 2003). Universities play an important role in the stimulation of innovations that create institutional linkages and accelerate the flow of ideas (Johanson & Saint, 2007). Documented literature has also shown that university agricultural extension has advanced development and dissemination of new innovations that improve agricultural productivity (Okolo, 2010; Liu & Tao, 2021). Therefore, it is evident that university extension can contribute significantly to agricultural development, research and food security. In South Africa, the national extension policy is in favour of pluralistic extension system involving institutions of higher learning, government, NPOs, private sector and other organisations (DAFF, 2016). However, there is no formal framework developed by either government or institutions of higher learning (universities). To develop a formal pluralistic extension delivery system, it is important to establish whether farmers are in favour of university extension as a complement to public extension and advisory services. Thus, farmers' acceptability of university agricultural extension is very crucial because farmers are the main beneficiaries of extension services. In order to fill this knowledge gap, this chapter is aimed at determining farmers' acceptability of university agricultural extension as a complement to public extension; and to identify important factors (predictors) that influence their decisions. This chapter presents research objectives, null hypotheses, methodology, results and discussions, and summary and conclusions at the end.

7.2 RESEARCH OBJECTIVES

The purpose of this chapter was to achieve the following objective:

- To ascertain farmers' acceptability of university agricultural extension as a complement to public extension and advisory services with specific reference to:
    - willingness to accept and the perceived benefits of university agricultural extension; and
    - factors influencing the acceptability of university agricultural extension.

7.3 METHODOLOGY

Data of farmers' acceptability of university agricultural extension was gathered using a dichotomous scale with yes and no as possible responses. In the scale, one (1) and zero (0) represented yes and no, respectively. A five-point Likert scale collected information about the perceived benefits of university agricultural extension services. In the Likert scale, 1, 2, 3, 4 and 5 denoted Strongly Disagree (SD), Disagree (D), Uncertain (U), Agree (A) and Strongly Agree (SA), respectively. Through a dichotomous scale, it was determined whether participants knew about universities offering agricultural programmes (qualifications) in the study area. Moreover, open-ended questions enabled the gathering of information about the perceived challenges of pluralistic extension system that included universities. Thus, to achieve the research objective in this chapter, ordinal and nominal data were used. Nominal and ordinal data were analysed using frequencies and percentages. Binomial Test was utilised to analyse nominal data. Additional descriptive statistical analyses such as median and interquartile range (IQR) were also used to analyse ordinal data. The first analysis involved the determination of Cronbach alpha's coefficient, which aimed at measuring whether the five-point Likert scale used to collect data was reliable and consistent. The analysis included all 12 Likert-scale type questions in the study. The coefficient value of Cronbach alpha's coefficient obtained was 0.95. Thus, the scale was reliable; and had good reliable consistency (Hair *et al*., 2006). All twelve (12) Likert-scale type questions were selected for explanatory factor analysis, descriptive and inferential statistical analysis. Binary Logistic Regression (BLR) and Principal Axis Factoring (PAF) were the types of inferential statistical analysis and Exploratory Factor Analysis (EFA) methods applied, respectively.

After performing PAF, all factors' loadings above 0.50 were retained. Subsequently, three factors with ten individual variables (items) were extracted. All the 10 variables that constituted three retained factors were subjected to inferential statistics using Binary Logistic Regression (BLR) model. BLR model was used to determine factors influencing farmers' acceptability of university agricultural extension. The dependant variable was binary using zero (0) and one (1) as possible response. On the other hand, independent variables were made of categorical data from five-point Likert scale. The specification of BLR model used was as follows:

$$\log\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki} + U_i$$

Where, P_i is the probability of farmers accepting university agricultural extension (Y=1), ($1 - P_i$) is the probability of not accepting university agricultural extension (Y=0), β_0 is the intercept, $X_1 \ldots X_{12}$ are the covariates (predictors), $\beta_1 \ldots \beta_{12}$ are the regression coefficients of predictors, and U is the constant value. Farmers' willingness to accept university agricultural extension was categorized as 1=Yes and 0=No. The description of the independent variables used in BLR model one and two is presented in Table 7.1.

Table 7.1: The description of the independent variables used in BLR1 and BLR2 model that determine factors influencing farmers' acceptability of university agricultural extension

Type of model	Variable description	Valuation	Expected sign/influence	Interpretation of signs
BLR1	X_1=Farmers will have better access to agricultural extension and advisory services	1=Strongly Disagree; 2=Disagree; 3=Uncertain; 4=Agree; 5=Strongly Agree	Positive	Farmers who agree that universities will provide better access to agricultural extension and advisory services will accept university agricultural extension
	X_2=Farmers will receive advise from subject matter experts		Positive	Farmers who agree that they will receive advice from subject matter experts from universities will accept university agricultural extension
	X_3=Farmers will have access to formal education and training		Positive	Farmers who agree that universities will provide access to formal education and training will accept university agricultural extension
	X_4=Farmers will have access to research journals		Positive	Farmers who agree that universities will provide access to research journals will accept university agricultural extension.
	X_5=Farmers will have access to research innovations		Positive	Farmers who agree that universities will provide access to research innovations will accept university agricultural extension
	X_6=Farmers will have access to research funding		Positive	Farmers who agree that universities will provide access to research funding will accept university agricultural extension.
	X_7=Farmers will have access to research infrastructure		Positive	Farmers who agree that universities will provide access to research infrastructure will accept university agricultural extension

	X_8=Universities will be linked with practical extension work		Positive	Farmers who agree that universities will be linked with practical extension work will accept university agricultural extension
	X_9=Universities will communicate their research findings to the farmers		Positive	Farmers who agree that universities will communicate their research findings to them will accept university agricultural extension
	X_{10}=Universities will conduct research that is responsive to the farmers' needs		Positive	Farmers who agree that universities will conduct research that is response to their needs will accept university agricultural extension
BLR2	X_1=Gender	0=Female; 1=Male	Negative	Male farmers will not accept university agricultural extension
	X_2=Age	1=<35 yrs; 2=35–45 yrs; 3=46–55 yrs; 4=56–65 yrs; 5=>65 yrs	Positive	Older farmers will accept university agricultural extension
	X_3=Education level	1=No formal education; 2=Primary education; 3=Secondary education; 4=Abet education; 4=Diploma; 5=Bachelor's degree; 6=Honours degree/BTech; 7=Masters; 8=Doctorate	Positive	Highly educated farmers will accept university agricultural extension
	X_4=Farm/plot size	Ha	Positive	Large-scale farmers will accept university agricultural extension.
	X_5=Farming experience	(Years)	Negative	Vastly experienced farmers will not accept university agricultural extension
	X_6=Annual net farm income	Amount in rand (ZAR)	Positive	Farmers earning more profit will accept university agricultural extension

7.4 RESULTS AND DISCUSSION

This section presents the results and discussion of the acceptability of university agricultural extension and perceived benefits, exploratory factor analysis of acceptability of university extension and factors influencing acceptability of university agricultural extension.

7.4.1 Acceptability of university agricultural extension and perceived benefits

The results of farmers' acceptability of university agricultural extension showed that 91.2% of the respondents were in favour of including universities as part of pluralistic extension system in the study area, and 8.8% were against the idea. The null hypothesis was that most farmers (≥51%) would not accept the inclusion of university agricultural extension in a pluralistic extension system. A significant value ($p<0.01$) was obtained from the results of Binomial test; thus, the null hypothesis was rejected. The results implied that farmers in the study area were in favour of pluralistic extension system that is offered by the government and institutions of higher learning. Therefore, pluralistic extension system that included universities in the study area was demand-driven. The participation of institutions of higher learning in the provision of agricultural extension services is parallel to what is practised in other countries including South Africa. For example, in Canada (Rodgers, 1992; McLean, 2007), China (Liu & Tao, 2021); India (Glendenning *et al.*, 2010); Malawi (Chowa *et al.*, 2013; Masangano *et al*., 2017); Nigeria (Okolo, 2010); South Africa (Zwane, 2009); and the USA (McLean, 2007; Rennekamp & Engle, 2008; Collins & Mueller, 2016). Moreover, the current findings show that the need for pluralistic extension system in Gauteng province is demand-driven because it is widely accepted by the farmers. Pye-Smith (2012) reported that pluralistic extension delivery system should be demand-led and participatory. A demand-led and participatory system would enable universities to render services that are responsive to farmers' needs. Chowa *et al.* (2013) found that pluralistic agricultural extension was accepted by farmers in Malawi because it provided more access to extension services and diversity of information from various sources. Globally, pluralistic extension system has been supported because it provides extension services from multiple organisations (Rivera & Alex, 2004; Klerkx & Proctor, 2013; Phillipson *et al*., 2016). Nonetheless, it is necessary to determine whether universities in the study area have the capacity and resources to participate in pluralistic extension system. According to Birner *et al*. (2009), capacity (staff numbers, training level, skills, infrastructure and financial resources) is one of the most important elements that determine the success of a pluralistic extension system. Moreover, the authors cited above indicated that management, advisory methods and governance structure are also some of the determinant factors of pluralism extension.

Additional statistical outputs showed that only 35.5% of the respondents knew about universities that offer agricultural qualifications (programmes) in Gauteng province, while 64.5% did not. This was not expected because the assumption was that most of the farmers were familiar with universities that teach agriculture in the study area. However, the outputs from Binomial test yielded a significant p-value of <0.001. Thus, the null hypothesis was accepted because the universities that teach agriculture were only known to a few farmers (<50%). The study findings, implied that the universities that offer agricultural qualifications in the study area engage with very few farmers. Thus, marketing of agricultural qualifications is not widely extended to the farming communities in Gauteng province. The disadvantage is that the universities could be conducting impactful research that is not known and accessible to farmers within their vicinity. According to McDowell (2003), academic personnel use research projects for post-graduate students to solve farmers' problems, which often arise during engagements between academics and farmers. The fact that universities that teach agriculture were only known to the minority of farmers in the study area suggested that academics in universities did not engage with most of the farmers who could influence their research and teaching. The results of perceived benefits of university agricultural extension are presented in Table 7.2.

Table 7.2: Perceived benefits of the acceptability of university agricultural extension (n=442)

Variable (Item)	Proportion of the respondents (%)					Median (IQR)
	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree	
Farmers will have better access to agricultural extension and advisory services	5.0	2.3	6.1	63.6	23.1	4.0(3.9-4.1)
Farmers will receive advise from subject matter experts	1.6	6.1	8.1	55.4	28.7	4.0(4.0-4.1)
Farmers will have access to formal education and training	4.5	2.0	8.4	56.6	28.5	4.0(3.9-4.1)
Farmers will have access to research journals	3.6	8.8	14.3	55.4	17.9	4.0(3.7-3.8)
Farmers will have access to research innovations	7.0	3.6	14.0	52.7	22.6	4.0(3.7-3.9)
Farmers will have access to research funding	6.6	5.7	14.3	54.8	18.8	4.0(3.6-3.8)
Farmers will have access to research infrastructure	7.7	7.5	9.5	55.0	20.4	4.0(3.6-3.8)
Universities will be linked with practical extension work	3.4	7.9	13.6	55.2	19.9	4.0(3.7-3.9)
Universities will communicate their research findings to the farmers	5.2	4.3	9.5	60.2	20.8	4.0(3.8-4.0)
Universities will conduct research that is responsive to the farmers needs	3.2	4.8	8.8	61.8	21.5	4.0(3.9-4.0)
Universities will develop curriculum that is relevant to the society	4.3	4.3	10.6	58.8	21.9	4.0(3.8-3.9)
Universities will use their community engagement and outreach activities to benefit the farmers	3.4	6.1	12.2	59.3	19.0	4.0(3.8-3.9)
Average	**4.6**	**5.3**	**10.8**	**57.4**	**21.9**	**4.0(3.8-3.9)**

The descriptive statistical outputs in Table 7.2 indicate that on average, 79.3% of the respondents accepted university agricultural extension and advisory services as part of the pluralistic extension system. This was shown by the combined proportions of Agree and Strongly Agree. An average median score of 4.0 also supported this. All the variables that measured perceived benefits of university agricultural extension achieved a median score of 4.0. Furthermore, the findings in Table 7.2 depict that more than four-fifth (>80%) of the respondents perceived five benefits of university agricultural extension and advisory services as the most important. In chronological order, the three most important benefits were having better access to agricultural extension and advisory services (86.7%), having access to formal education and training (85.1%), and receiving advice from subject matter specialists (84.1%). The others important benefits perceived by the respondents were creating an environment for universities to conduct research that is responsive to the farmers' needs (83.3%), allowing universities to communicate their research findings to the farmers (81%), and enabling universities to develop a curriculum that is relevant to the society to benefit the farmers (80.7%). Moreover, about three quarters of the respondents held the notion that university agricultural extension and advisory services would enable universities to use their community engagement and outreach activities to benefit the farmers (78.3%), and to provide farmers with access to research infrastructure (75.4%). Again, the same proportional representation (about three quarters) of the respondents perceived university agricultural extension and advisory services as a system that could enable farmers to access research innovations (75.3%), and to link universities with practical extension work (75.1%). On the other hand, less than three quarters of the respondents perceived university extension as a system that could provide farmers with access to research funding (73.6%) and research journals (73.3%).

In general, the results showed that nearly four-fifth (79.3%) of the respondents were optimistic about the perceived benefits of university agricultural extension and advisory services presented in Table 7.2. It showed that most farmers in the study area were aware of the potential benefits of allowing universities to render agricultural extension and advisory services in collaboration with the government. Moreover, the respondents were well informed about some of the happenings in the universities that offer agricultural programmes (qualifications). Hence, a large proportion of the farmers agreed with the statements that measured the perceived benefits of university agricultural extension and advisory services. The overall findings implied that most of the benefits of pluralistic extension system that include institutions of higher learning (universities) were known to the farmers in the study area. Additionally, farmers' anticipation that the inclusion of universities in pluralistic extension system would provide better access to agricultural extension and advisory services agreed with documented literature. According to Adhiguru *et al*. (2009); Chowa *et al.* (2013); Masangano *et al*. (2017), pluralistic extension system provides access to more and diverse sources of extension and advisory services; meaning that access to extension services would improve. In Gauteng province universities offer agricultural programmes such as agricultural management, agribusiness management, agricultural economics, crop/plant production, animal science, animal health and other related programmes. University agricultural extension services could be rendered by diverse subject specialists from universities; thus, access to agricultural extension services would be improved. As a result, most farmers agreed that university agricultural extension would create a suitable environment to engage subject specialists of their choice from different disciplines and universities. However, there would be a redundancy of work if specialists from different universities did not come together to form a partnership that could improve access to extension services. Mukherjee *et al*. (2012) found that a pluralistic extension system without a convergence would result in duplication of efforts and low efficiency extension system.

Regarding the outcome of farmers' access to formal education and training, which was expected because the role of universities is to provide formal education and training to the society, hence, most farmers were optimistic that their association would provide access to education. However, Kahan (2013) reported that universities in developing countries provide limited, purposeful and unstructured training to farmers. The challenges were very likely to occur in the study area because an admission requirement for formal education programmes at universities is Grade 12 (Matric), which most farmers might not have. Moreover, the university fees might be unaffordable to some e farmers unless the provision of university agricultural extension services was linked to formal education and training. From research perspective, indeed the relationship between universities and farmers through the provision of extension services could enable universities to conduct research that is responsive to the farmers' needs and communicate their research findings to the farmers. According to Reddy and Ankaiah (2005), most knowledge from research institutions remained in those institutions due to poor linkage between farmers and extension systems. So, if farmers received extension services from universities, knowledge generated from research could be easily communicated to the farmers. During communication of research findings from universities, farmers would have an opportunity to share their ideas and challenges with university scholars. As a result, universities are more likely to conduct research aimed at solving farmers' problems; thus, it would be responsive to farmers' needs. Additionally, universities would develop research-informed curricula that are responsive to the societal needs.

7.4.2 Exploratory factor analysis of acceptability of university extension

As explained in the methodology section, the Principal Axis Factoring (PAF) with promax rotation was conducted using data presented in Table 7.2. The purpose of explanatory factor analysis was to categorize the underlying factors (dimensions) of the acceptability of university agricultural extension in the study area. The results of Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity were 0.921 and 3392.377 (Chi-square value), respectively. Moreover, KMO results were statistically significant at 1% ($p<0.001$). According to Kaiser (1970), a KMO value of ≥ 0.90 implies that the data is suitable for factor analysis. Therefore, the sample size and data was appropriate for factor analysis because there was internal coherence of the data. To select Total Percentage of Variance-Accounted-For (PVAF) in the variables, a scree plot in Figure 7.1 was used.

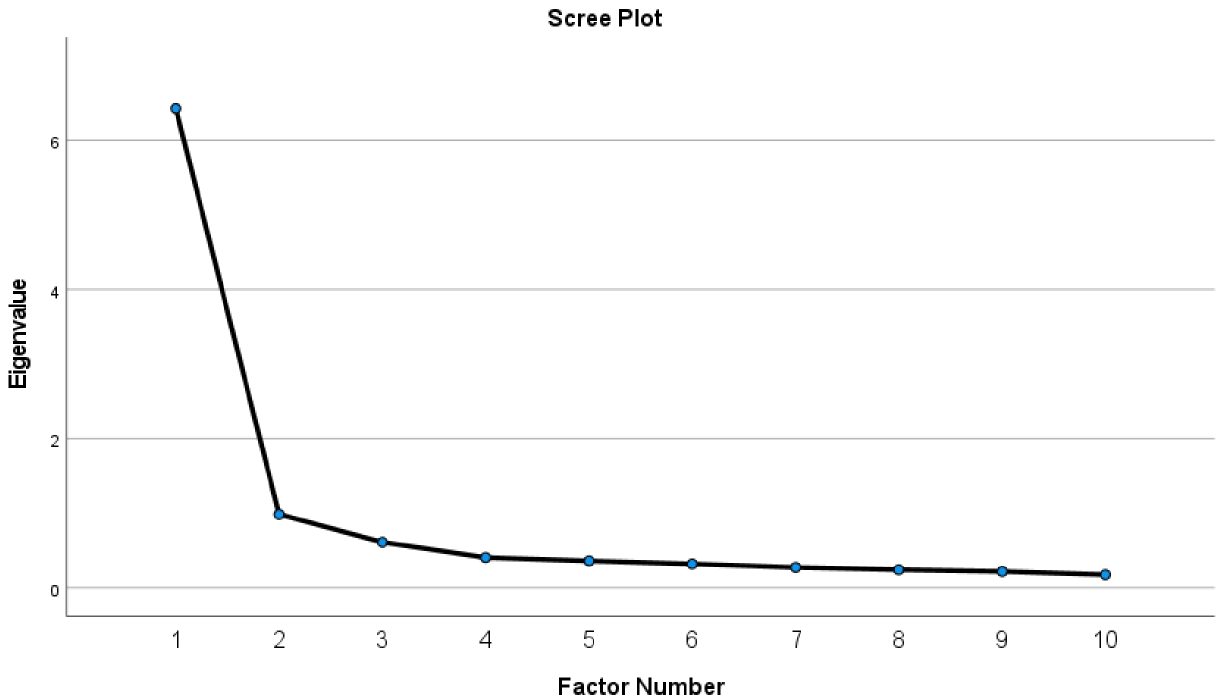

Figure 7.1: Scree plot for factor analysis 2 (n=442)

The scree plot in Figure 7.1 indicates that the decrease of the elbow starts at factor 4 with an eigenvalue of 0.40. As a result, the first three factors before the graph started forming an elbow (decreasing) were retained. According to Cattell (1978); Costello & Osborne (2005), factors located where the size of the eigenvalues started to make an elbow or break should be retained. Hence, the first three factors on the slope, before the graph started decreasing to form an elbow were retained. The results of the cumulative column explaining total variance are presented in Table 7.3.

Table 7.3: Cumulative column explaining total variance

Total Variance Explained							
Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	6.43	64.32	64.32	6.15	61.54	61.54	5.34
2	0.98	9.84	74.16	0.71	7.11	68.65	4.70
3	0.61	6.09	80.24	0.35	3.45	72.09	4.83
4	0.40	4.03	84.27				
5	0.36	3.58	87.85				
6	0.32	3.17	91.02				
7	0.27	2.71	93.73				
8	0.24	2.39	96.12				
9	0.22	2.15	98.27				
10	0.17	1.73	100.00				

The results in Table 7.3 depict that three factors contributed 80.24% of the variance. The three extracted factors have been named 1) Access to research resources, 2) Improved extension services and training, and 3) Diffusion of university research. Factor 1 consisted of five items (variables) that account for 64.32% of the total variance. Factor 2 and Factor 3 contributed to 9.84% and 6.09% of the total variance, respectively. Table 7.4 presents the results of the explanatory factor analysis of the acceptability of university agricultural extension.

Table 7.4: Results of the explanatory factor analysis of acceptability of university agricultural extension (n=442)

Variables	**Factor Loading for Components**			**Communalities**
	Factor 1 (F1)	**Factor 2 (F2)**	**Factor 3 (F3)**	
Farmers will have access to research infrastructure	0.86			0.74
Farmers will have access to research funding	0.84			0.70
Farmers will have access to research journals	0.72			0.66
Farmers will have access to research innovations	0.70			0.71
Universities will be linked with practical extension work	0.59			0.71
Farmers will have better access to agricultural extension and advisory services		0.88		0.83
Farmers will have access to formal education and training		0.74		0.76
Universities will communicate their research findings to the farmers			0.71	0.75
Universities will conduct research that is responsive to the farmers needs			0.71	0.69
Farmers will receive advise from subject matter experts			0.53	0.68
Eigenvalue	**6.43**	**0.98**	**0.61**	**8.03**
% of Variance	**64.32**	**9.84**	**6.09**	**80.24**
Number of items	**5**	**2**	**3**	**10**

The results in Table 7.4 show that the analysis extracted three factors associated with acceptability of university agricultural extension. Factors 1, 2 and 3 had five, two and three items, respectively. Factor 2 with two items was accepted because the variables were highly correlated ($p<0.001$; $r_s=0.70$). According to Yong and Pearce (2013), a rotated factor with two variables should be considered reliable if the variables are highly correlated with each other. The variables (items) for Factor 1 (Access to research resources) were farmers' access to the following: research infrastructure, funding, journals and innovations; and linking universities with practical extension work. It showed that most farmers were aware that research is one of the core functions of universities in the society. Furthermore, some universities have adequate funding for research projects aimed at enhancing human development (Cummings, 2014). Regarding research infrastructure, universities that teach agricultural programmes have infrastructure such as laboratories, farms and test stations that are used for research and student practical activities. University test stations are used to transform innovative agricultural technologies into applications that benefit local communities (Liu & Tao, 2021). According to Johanson and Saint (2007), universities play an important role in the stimulation of innovations that create institutional linkages and accelerate the flow of ideas. Additionally, universities are affiliated with databases that provide access to different research journals. Therefore, the introduction of university agricultural extension services in the study area had the potential to provide access to research resources required by farmers.

Better access to agricultural extension and advisory services; and access to formal education and training were the items that constituted Factor 2 (Improved extension services and training). Kenney and Mowery (2014), reported about the role of universities in the training of the recipients of extension services. Through training, university extension has a significant role in lifelong learning for non-traditional students such as farmers (Mutimba *et al*., 2010). Therefore, farmers' expectations for university agricultural extension to provide training match what has been documented in literature. However, farmers could also benefit from informal university training programmes without admission requirements like formal educational programmes (qualifications) offered by universities. Thus, training programmes offered through university agricultural extension services should be informed by farmers' needs. In cases where farmers intend to enrol for formal qualifications, suitable delivery methods such as online, distance learning and part-time education should be explored.

On the other hand, Factor 3 (Diffusion of university research) consisted of the following items: the capabilities of universities to communicate their research findings to the farmers; universities conducting research that is responsive to the farmers' needs; and farmers receiving advice from subject matter specialists. Similarly, Lyons *et al*. (2018) found that in land grant universities that render extension services in the USA, new research knowledge supporting agricultural activities is disseminated through extension services. Thus, the expectations for universities to disseminate (diffuse) research knowledge were equivalent to what is commonly practiced in areas where university agricultural extension services are rendered. Moreover, literature has shown that university agricultural extension has advanced development and dissemination of new innovations that improve agricultural productivity (Okolo, 2010; Liu & Tao, 2021). The development of new innovations that improve agricultural productivity implied that universities can conduct research that is responsive to farmers' needs. Additionally, research activities at universities are mostly driven by subject matter specialists. Hence, the respondents held the opinion that their association with universities would enable subject matter specialists in the institutions of higher learning (universities) to conduct research that is responsive to their needs and communicate research findings to them.

The factor loading for most items in Table 7.4 was greater than 0.50; therefore, there was a correlation between the extracted factors and their items. Furthermore, the communalities of the items ranged between 0.66 and 0.83; therefore, most variations were extracted. It implied that 66%-83% of the variability in the perceived benefit of university agricultural extension was explained by Factors 1 to 3. After extracting and naming three important factors underlying acceptability of university agricultural extension, factor correlation was performed. The results of the factor correlation matrix showed that Factor 1 was positively correlated with Factor 2 ($r=0.658$). The results implied that the respondents who held the opinion that university agricultural extension would provide access to research resources believed that they would have improved access to extension services and training. Furthermore, the same farmers perceived improved access to research resources as a way of diffusing university research to the farmers (r=0.702). Again, Factors 2 and 3 were positively correlated (r=0.704). It implied that the respondents who perceived university agricultural extension as a way of improving access to extension services and training held the notion that universities would improve diffusion of research from institutions of higher learning.

7.4.3 Factors influencing acceptability of university agricultural extension

Binary Logic Regression was used to determine factors (perceived benefits) that influenced farmers' acceptability of university agricultural extension. The results of Hosmer and Lemeshow Test that measures model fit was as follows; a Chi-square value of 7.702 was achieved with six (6) degrees of freedom (df), and significance value of 0.261. The model was therefore fit for the data analysed because the p-value was not statistically significant ($p>0.05$). Furthermore, the values of Pseudo R-Square were 0.331 and 0.737 for Cox and Snell, and Nagelkerke, respectively. In Binary Logistic Regression (BLR), the values of Pseudo R-Squares measurements have limitations in evaluating the overall model fit unlike in Multiple Regression Models (Hair Jr., Black, Babin & Anderson, 2019). As a result, the limitation of Pseudo R-Squares explained above, the values of Cox and Snell, and Nagelkerke were accepted without further interpretation. The Binary Logistic Regression results of the factors influencing acceptability of university agricultural extension are presented in Table 7.5.

Table 7.5: Binary Logistic Regression results of the factors influencing acceptability of university agricultural extension (n=442)

Variable	B	S.E.	Wald	df	P-value	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Farmers will have better access to agricultural extension and advisory services	0.791	0.526	2.264	1	0.132	2.205	0.787	6.178
Farmers will receive advice from subject matter experts	0.577	0.470	1.509	1	0.219	1.781	0.709	4.472
Farmers will have access to formal education and training	0.933	0.508	3.377	1	0.066	2.542	0.940	6.877
Farmers will have access to research journals	-1.133	0.554	4.186	1	0.041	0.322	0.109	.953
Farmers will have access to research innovations	-0.162	0.449	.131	1	0.718	0.850	0.353	2.048
Farmers will have access to research funding	1.117	0.494	5.111	1	0.024	3.055	1.160	8.046
Farmers will have access to research infrastructure	0.409	0.435	.885	1	0.347	1.505	0.642	3.529
Universities will be linked with practical extension work	-0.558	0.600	.865	1	0.352	0.572	0.177	1.855
Universities will communicate their research findings to the farmers	0.608	0.591	1.058	1	0.304	1.837	0.577	5.852
Universities will conduct research that is responsive to the farmers needs	0.488	0.482	1.026	1	0.311	1.629	0.634	4.187
Constant	-7.834	1.494	27.502	1	<0.001	0.000		

The results showed that seven (7) out of ten (10) independent variables fitted in the BLR model had a positive relationship with the dependent variable, while three of them were negative. However, only the coefficient value of one variable (Farmers will have access to research funding) was positive and statistically significant at 5% level of significance (95% confidence interval). Access to research journals by farmers had a negative and was significant correlation with acceptability of university extension by farmers.

The results in Table 7.5 depict that there was a positive (β=1.117) and significant relationship (p=0.024) between farmers' acceptability of university agricultural extension and access to research funding. It meant that farmers who were willing to accept university agricultural extension believed that they would access research funding by virtue of receiving extension and advisory services from universities. This might be because farmers were aware that universities and other stakeholders received funding from government to conduct agricultural related research. The expectations for universities to provide access to research funding were not far-fetched because most universities are involved in research projects funded by various stakeholders. In South Africa, the government provides core funding for research to universities through the Ministry of Higher Education and Training (Luruli & Mouton, 2016). Considering that most universities in South Africa are public institutions, it is not surprising that farmers perceived their association with universities as a way of accessing research funds. According to Cloete and Maassen (2015), the role of universities is to conduct research and provide services to the public. In this context, universities could utilize their research funds to conduct on-farm research of some of the recipients of university agricultural extension services. By so doing, universities would conduct research that is responsive to farmers' needs and link universities with practical extension work.

On the other hand, the relationship between farmers' acceptability of university agricultural extension and access to research journals was negative (β=-1.133) and statistically significant (p=0.041). It implied that farmers who perceived university agricultural extension as a mechanism to access research journals were less likely to accept extension and advisory services from universities. The reason could be that farmers in the study area had no better understanding of the benefits of reading research journals, even though university personnel could easily access research articles from academic journals and share them with the farmers. It implied that farmers who accepted university agricultural extension did not perceive access to research journals as a benefit associated with access to extension services from universities; although, institutions of higher learning are affiliated to databases that provide access to academic journals. Moreover, the scholars have the capacity to explain academic and scientific information in the language that farmers could understand. However, access to research journals did not influence farmers' perception positively. The reason could be that most academic research documents were limited to peer review rather than transferring knowledge to the main beneficiaries (Atchoarena & Holmes, 2005). As a result, some of the scientific jargons used in academic journals might be difficult for farmers to understand without the help of subject specialists. Consequently, farmers in the study area might be unfamiliar with how access to information from academic journals could improve their farm productivity.

Additional Binary Logistic Regression analysis was performed whereby socio-demographic characteristics were fitted in the model as independent variables. The results of Hosmer and Lemeshow Test showed a non-significant (p=0.299) chi-square (X^2) value of 9.540 with eight (8) degrees of freedom (df). A non-significant ($p>0.05$) chi-square value implied that the model was fit for the type of data analysed. The values of Pseudo R-Square were 0.041 and 0.092 for Cox and Snell, and Nagelkerke, respectively. The values of Cox and Snell, and Nagelkerke were accepted without further interpretation. According to Hair Jr. *et al.* (2019), the values of Pseudo R-Squares measurements have limitations in evaluating the overall model fit for Binary Logistic Regression compared with Multiple Regression models. The results of farmers' socio-demographic characteristic that influence the acceptability of university agricultural extension are presented in Table 7.6.

Table 7.6: Binary Logistic Regression results of farmers' socio-demographic characteristic that influence the acceptability of university agricultural extension (n=422)

Variable	B	S.E.	Wald	df	P-value	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Gender	-0.100	0.351	0.081	1	0.776	0.905	0.455	1.801
Age	0.066	0.154	0.182	1	0.670	1.068	0.789	1.445
Education level	0.017	0.109	0.024	1	0.877	1.017	0.821	1.259
Farm/land size	-0.013	0.019	0.486	1	0.486	0.987	0.951	1.024
Farming experience	-0.057	0.031	3.305	1	0.069	0.945	0.889	1.004
Net farm income	0.000	0.000	5.114	1	0.024	1.000	1.000	1.000
Constant	2.831	0.664	18.189	1	0.000	16.968		

The results in Table 7.6 indicate that three independent variables had a positive correlation (Age, education level and net farm income) with farmers' acceptability of university agricultural extension, while the other three variables had a negative correlation (Gender, farm/land size and farming experience). However, only one positive predictor (net farm income) was statistically significant at 5% level of significance (95% confidence interval). None of the negative variables had significant correlation with farmers' acceptability of university agricultural extension. Net farm income had a positive (β=0.000) and significant influence (p=0.024) on farmers' acceptability of university agricultural extension, with all other factors held constant. It implied that those farmers who made more profit from farming accepted the inclusion of universities as a complement to public agricultural extension and advisory services. The postulation was that farmers with high net income have been exposed to various sources of information that have improved profitability of their farming enterprises. As a result, the aforementioned group of farmers was optimistic about pluralistic extension system that included the collaboration of universities and the government. Farmers' perceptions were not far-fetched because in areas where pluralistic extension delivery model was practiced, farmers' income and production (output) had increased significantly (Suvedi *et al*., 2017; Muzenda *et al.*, 2018). Moreover, literature has shown that there is a positive correlation between net income and access to extension services (Abdallah & Abdul-Rahaman, 2016; Loki *et al*., 2021). Thus, pluralistic extension systems have the potential to improve access to extension services, and ultimately improved net farm income.

7.5 SUMMARY AND CONCLUSIONS

This chapter presented the acceptability of university agricultural extension by the respondents in Gauteng province. The findings revealed that the largest proportion (91.2%) of the respondents accepted the inclusion of universities in a pluralistic extension delivery system. The null hypothesis that most farmers would not accept university agricultural extension was rejected. It implied that the pluralistic extension system that included universities in the study area was demand driven. However, the majority (64.5%) of the respondents did not know about universities that teach agricultural qualifications in the province. The null hypothesis was rejected because most farmers were not familiar with universities that teach agriculture in the study area. Thus, universities in the study area did not engage with most of the farmers within their vicinity. The results of the perceived benefits of university agricultural extension showed that generally most of the farmers (79.3%) were optimistic about the benefits of receiving extension services from universities through pluralistic extension system. The benefits that were perceived by the largest proportion (>80%) were better access to agricultural extension and advisory services; access to formal education and training; receiving advice from subject matter specialists; creating an environment for universities to conduct research that is responsive to the farmers' needs; allowing universities to communicate their research findings to the farmers; and enabling universities to develop curricula that are relevant to the society. The findings implied that the potential benefits of university agricultural extension services were well known to most farmers in the study area.

The results of exploratory factor analysis extracted three underlying factors which contributed 80.24% of the variance that were associated with the perceived benefits of university agricultural extension; thus, the null hypothesis was rejected. The underlying factors were access to research resources; improved extension services and training; and diffusion of university research. All the three underlying factors associated with perceived benefits of university agricultural extension were correlated. The results meant that farmers who held the opinion that university agricultural extension has the potential to provide access to resources perceived the inclusion of universities in a pluralistic extension system as a way of improving access to extension services. Access to research resources from universities was perceived as a mechanism to diffuse university research. Additionally, farmers perceived diffusion of university research as a mechanism to improve access to extension services and training.

There were two perceived benefits that significantly influenced farmers' acceptability of university agricultural extension as part of a pluralistic extension system. Access to research funding had a positive and significant correlation with acceptability of university agricultural extension. The findings implied that farmers who accepted university agricultural extension perceived their association with universities as an opportunity to access research funding from institutions of higher learning. On the other hand, access to research journals was a significant but negative predictor. It meant that farmers who perceived university agricultural extension as a mechanism to provide access to research journals were less likely to accept extension and advisory services from universities. Thus, farmers were not familiar with the benefits of utilising information from research journals to improve their farm production (outputs). The only socio-demographic variable that significantly predicted farmers' acceptability of university agricultural extension was net farm income. Therefore, it was concluded that farmers who made more profit from their farming enterprises accepted the inclusion of universities in a pluralistic extension system.

CHAPTER 8: DELIVERY SYSTEMS FOR UNIVERSITY AGRICULTURAL EXTENSION SERVICES

8.1 BACKGROUND AND INTRODUCTION

The origin of agricultural extension was premised on extending research knowledge to the farmers through extension agents (officers) as the mediators. Thus, extension agents are the most important stakeholders in the delivery of extension services to the farmers. In most countries, the government is the main provider of agricultural extension services (Kidd *et al.*, 2000; Rutatora & Mattee, 2001; Anderson & Feder 2004; Maoba, 2016, Nkosi, 2017; Rohit *et al*., 2017). As a result, most extension agents rendering extension services are affiliated to the government through ministries that are responsible for agriculture in their respective countries. The paradigm shift of extension approaches from linear (top-down) to participatory and farmers' first approaches has altered the delivery of extension services to the farmers. For example, in top-down approaches, the role of extension agents is to convey research outputs to the farmers and promote the adoption of scientific technologies (Knickel *et al.*, 2009). However, in participatory extension approaches, extension agents facilitate the development of technologies. The reason is that participatory approaches are based on the partnership between farmers and researchers in the development of appropriate and adaptable technologies through a learning process (Sadighi & Mohammadzadeh, 2002; Akinnagbe & Ajayi, 2010). In addition, the participatory approaches enhance farmers' learning by allowing them to make decisions and influence research activities that will benefit them.

The paradigm shift has also resulted in the participation of different stakeholders in the delivery of extension services. Globally, the reform of agricultural extension has shifted towards pluralistic extension delivery systems (Nahdy *et al*., 2002; Rivera & Alex, 2004; Gemo *et al.*, 2013; Knierim *et al*., 2017; Masangano *et al.*, 2017; Alimirzaei *et al.*, 2019). In pluralistic extension systems, different organisations such as the government, the private sector and non-profit organisations are involved in the provision of extension services (Zwane, 2009; Klerkx & Proctor, 2013; Koch & Terblanché, 2013; Phillipson *et al*., 2016; Rohit *et al.*, 2017). In a pluralistic system, multiple stakeholders share the functions and tasks of extension (Rivera & Alex, 2001). As a result, the system enables farmers to receive information, innovations, resources, and support from different stakeholders. Therefore, the role of the government in a pluralistic extension system has changed because it is a multi-institutional activity driven by different interests and support structures. For example, Rivera and Alex (2001) reported that the role of government in a pluralistic extension system is to implement public policy, collect information, deal with emerging concerns, respond to emergencies, provide information, regulate, quality control and enhancement, coordinate systems and promote reform. Additionally, there are extension roles that overlap between stakeholders. The changing role of government in a pluralistic extension system has created a new delivery system for agricultural extension services. Nonetheless, different extension approaches (top-down and participatory) approaches are applied in each extension delivery system, depending on farmers' needs and the scope of extension. In the current study, the main aim was to assess the acceptability of university agricultural extension as a complement to public extension and advisory services. The results in chapter seven indicated that a significant majority of the respondents accepted the university agricultural extension; thus, the basis of establishing a pluralistic extension system in the study area was demand-driven. According to Kabir *et al*. (2020), pluralism extension without proper coordination does not respond better to farmers' needs and demands. Hence, it was to explore a pluralistic extension delivery system that is suitable for university and public extension from farmers' perspective.

In this chapter, research objectives and the methodology used are presented in the first and second section, respectively. Thereafter, the results and discussions are presented in the same section, followed by chapter summary and conclusions at the end.

8.2 RESEARCH OBJECTIVES

This chapter aimed at attaining the following study objectives:

- To determine university agricultural extension delivery system (s) preferred by farmers and factors influencing their choice.
- To identify the reasons why farmers preferred different university extension delivery systems.

8.3 METHODOLOGY

Information about the type of extension delivery model preferred by farmers in a pluralistic extension system that include University agricultural extension was collected using structured (closed) questions. In the questionnaire, farmers were required to choose their preferences for university agricultural extension with specific reference interaction (contact), place and language (s) during the delivery of extension services. The possible interactions provided were as follows:

- Farmer ⟷ University
- Farmer ⟷ Public extension ⟷ University
- Farmer ⟷ Cooperative (farmers' organisations) ⟷ University
- Farmer ⟷ Cooperative (farmers' organisations) & Public extension ⟷ University

In addition, the respondents were required to choose whether they preferred university personnel who renders extension services to do the following: (a) visit farmers in their farms/plots/gardens (b) farmers will only visit universities, and (c) both a and b. On the other hand, the options for preferred language of interaction were (a) Vernacular, (b) English, and (c) Vernacular and English.

Data from open-ended questions that collected information about the reasons why the respondents chose each extension delivery system was classified as qualitative data. Qualitative data were analysed using codes, themes, and indicators. Thereafter, they were transformed into frequencies and converted to percentages. Quantitative data were analysed using descriptive statistics, precise frequencies, and percentages. In addition, Multinomial Logistic Regression (MNLR) model was used to analyse data. MLR model is suitable for situations where the dependent variable has more than two categories (El-Habil, 2012). There are two types of MNLR models, namely nominal or unordered and ordered (Gujarati, 2012). In this study, nominal or unordered MNLR model was used to predict the determinants of extension delivery system, place and language of delivery for university agricultural extension services preferred by the respondents. The MNLR model was performed three times (MNLR1, MNLR2 and MNLR3) using different dependent variables, and the same independent variables. The dependent variables fitted in each model were farmers' preferred extension delivery system (MNLR1), farmers' preferred place (MNLR2) and language (MNLR3) for receiving extension services. The test for MNLR1 consisted of four possibilities, $Y_{ij} = (1, 2, 3\ and\ 4)$, associated with the independent variables and preferred extension delivery system. The probability of the respondent choosing farmer-university extension delivery system was denoted by Y_1, the probability of the respondents choosing Farmer-public extension-university delivery system was represented by Y_2. In addition, the probability of the respondent choosing farmer-cooperative (farmer organisations)-University was denoted by Y_3 and farmer-cooperative (farmer organisations) & public extension-university delivery system was represented by Y_4. The following model specification by Gujarati (2012) was used for MNLR:

$$Y_{ij} = 1,\ if\ the\ participants\ i + select\ alternative\ j\ (j = 1,\ 2,\ 3\ and\ 4)$$

Furthermore,

$$\pi_{ij} = \Pr(Y_{ij} = 1)$$

Where; Pr stands for probability, and $\pi_{i1},\ \pi_{i2},\ \pi_{i3},\ \pi_{i4} = 1$ represent the probabilities that individual i chooses alternative 1, 2, 3 or 4, respectively. The alternatives were the following extension delivery systems: farmer-university, farmer-public extension-university, farmer-cooperative (farmer organsiations)-university and farmer-cooperative (farmer organisations) and public extension-university. If the aforementioned were the only alternatives available for an individual to choose from, then,

$$\pi_{i1} + \pi_{i2} + \pi_{i3} + \pi_{i4} = 1 \tag{1}$$

The main reason was that the sum of probabilities of mutually exclusive and exhaustive events must be 1. As a result, π was the response probability. If any three probabilities are determined, the fourth one will be determined automatically. Thus, four probabilities cannot be estimated independently. The factors or variables (Refer to Table 8.1 for detailed description) that determine the probability of choosing university agricultural extension delivery system were as follows:

X_2 = Age
X_3 = Education level
X_4 = Farm size
X_5 = Farming experience
X_6 =Annual net farm income

X_1 represents the intercept. Variables X_2 and X_3 were ordinal; while X_4, X_5 and X_6 were continuous. Random variables that affect the choice were denoted by the error term in estimating the model. The MNLR model used to analyse that was generalized as follows:

$$\pi_{ij} = \frac{e^{\alpha_j} + \beta_j X_i}{\sum_{j=1}^{4} e^{\alpha_j} + \beta_j X_i} \tag{2}$$

Where: j = intercept;
X = Vector of variables;
β = Vector of coefficient

Four probabilities estimated from Equation 2 above could have different coefficients for regressors. Thus, the model would estimate four regressions. As mentioned earlier, the model could not estimate all four probabilities independently. In MNLR, the common practice is to select one category as the base, reference or comparison category and then set its coefficient to zero. In this case, we chose Farmers-University extension delivery system which was the first category and set $\alpha_1 = 0$ and β_1 = 0, thus, the following estimates of the probabilities for the four choices were obtained:

$$\pi_{i1} = \frac{1}{1+e^{\alpha_2}+\beta_2 X_i+ e^{\alpha_3}+\beta_3 X_i+e^{\alpha_4}+\beta_4 X_i} \tag{3}$$

$$\pi_{i2} = \frac{1+e^{\alpha_2}+\beta_2 X_i}{1+e^{\alpha_2}+\beta_2 X_i+ e^{\alpha_3}+\beta_3 X_i+e^{\alpha_4}+\beta_4 X_i} \tag{4}$$

$$\pi_{i3} = \frac{1+e^{\alpha_3}+\beta_3 X_i}{1+e^{\alpha_2}+\beta_2 X_i+ e^{\alpha_3}+\beta_3 X_i+e^{\alpha_4}+\beta_4 X_i} \tag{5}$$

$$\pi_{i4} = \frac{1+e^{\alpha_4}+\beta_4 X_i}{1+e^{\alpha_2}+\beta_2 X_i+ e^{\alpha_3}+\beta_3 X_i+e^{\alpha_4}+\beta_4 X_i} \tag{6}$$

Even though the regressors in each probability or response might be the same, their coefficients will not be the same. If there is more than one regressor, *X*=vector of variables, whereas β=vector of coefficient. When four probabilities given in equations (3), (4), (5), and (6) above were added, a value of one (1) was obtained; that should be the case because there were four mutually exclusive choices. The probability expression given in Equations (3), (4), (5), and (6) were not linear. However, the following expressions were considered:

$$\text{In}\left(\frac{\pi_{i2}}{\pi_{i1}}\right) = \alpha_2 + \beta_2 X_i \tag{7}$$

$$\text{In}\left(\frac{\pi_{i3}}{\pi_{i1}}\right) = \alpha_3 + \beta_3 X_i \tag{8}$$

$$\ln\left(\frac{\pi_{i4}}{\pi_{i1}}\right) = \alpha_4 + \beta_4 X_i \quad (9)$$

$$\pi_{i1} = 1 - \pi_{i2} - \pi_{i3} - \pi_{i4} \quad (10)^6$$

Models (7), (8) and (10) were estimated simultaneously through Maximum Likelihood (ML) method.

On the other hand, MNLR2 consisted of three possibilities, $Y_{ij} = (1, 2\ and\ 3)$, associated with the independent variables and preferred place for receiving extension services. The probability of the respondents choosing farming place (farm/plot/garden) as their preferred place for receiving extension place was denoted by Y_1, and the probability of the respondents choosing university as their preferred place was represented by Y_2. Again, the likelihood of the respondents choosing farming place and university as their preferred place for receiving extension services was denoted as Y_3. Likewise, MNLR3 consisted of three possibilities, $Y_{ij} = (1, 2\ and\ 3)$, associated with the independent variables and preferred language for receiving extension services. The probability of the respondents choosing Vernacular or English, or both Vernacular and English as their preferred language for receiving extension services were denoted by Y_1, Y_2, and Y_3, respectively.

Table 8.1: Definition and explanation of variables used in the Multinomial Logistic Regression model (MNLR1-MNLR3)

Type of model	Variable	Type	Description and value
MLR1	**Dependent variable** (Y_i): Preferred extension delivery system (model)	Nominal	Farmer-University=1; Farmers-Public extension-University=2; Farmer-Cooperative (Farmer Organisation)-University=3; Farmer-Cooperative (Farmer Organisation) & Public extension- University=4
MLR2	**Dependent variable** (Y_i): Preferred place for rendering extension services	Nominal	Farming place=1; University=2; University and farming place=3
MLR3	**Dependent variable** (Y_i): Preferred language for receiving extension services	Nominal	Vernacular=1; English=2; Vernacular and English=3
MLR1, MLR2 and MLR3	**Independent variables**		
	Age (X_2)	Ordinal	<35 yrs=1; 35–45 yrs=2; 46–55 yrs=3; 56–65 yrs=4; >65 yrs=5
	Education level (X_3)	Ordinal	No formal education=1; Primary education=2; Secondary education=3 Abet education=4; Diploma=5; Bachelor's degree=6; Honours degree/BTech=7; Masters=8; Doctorate=9
	Farm size (X_4)	Continuous	Ha
	Farming experience (X_5)	Continuous	(Years)
	Net farm income in the previous year (X_6)	Continuous	Amount in Rands (ZAR)

8.4 RESULTS AND DISCUSSION

8.4.1 Farmers' preferred extension delivery system and influencing factors

Farmers in the study area were required to choose the type of extension delivery system they preferred from universities that could render agricultural extension services through a pluralistic extension system. The results of the university agricultural extension system preferred by the respondents are presented in Table 8.2.

Table 8.2: University agricultural extension delivery systems (model) preferred by the respondents (n=442)

Type of extension delivery system	Frequencies	Percentages
Farmer-Public extension-University	251	56.8
Farmer-University	82	18.6
Farmer-Cooperative (Farmer organisations) & Public extension-University	78	17.6
Farmer-Cooperative (Farmer organisations)-University	31	7.0
Total	**442**	**100.0**

The results in Table 8.2 indicate that the majority (56.8%) of the respondents preferred Farmer-Public extension-University extension delivery system. Again, less than 20% were in favour of engaging universities directly or utilising public extension and farmer organisations as facilitators. The results implied that; most farmers were in favour of a pluralistic extension system that could allow them to engage universities through public extension officers as the facilitators. The reason could be that farmers wanted government extension officers to be informed about supplementary support services they received from universities. Moreover, the respondents still believed in the traditional method of extension which utilized top-down approach, where the role of public extension officers is to transfer technology and information from universities and other research institutions. In support of these study findings, World Bank (1997) reported that international organisations were in favour of a pluralistic extension system that included the government because it has the capacity to play roles that cannot be fostered by private institutions. Similarly, it was found that the government serves as a coordinator for university extension services through a pluralistic extension system, even though sometimes universities can reach out to farmers directly (Rajesh *et al*., 2018). Informing the government about support provided to farmers by universities will create a relationship between the two extension stakeholders. According to Kabir *et al*. (2020), a pluralistic extension system that creates a conducive environment for two institutions to work together enables extension organisations to respond to farmers' diversified needs, provides alternative livelihoods options, training, credit support and others. Therefore, the extension delivery system preferred by most of the respondents enabled farmers to receive advice and resources from both the government and universities. In addition, this type of pluralistic extension delivery system is more likely to save resources and avoid duplication of efforts due to overlapping roles between the government and universities. For example, Chowa *et al*. (2013), found that poorly coordinated pluralistic agricultural extension created parallel structures that duplicated activities and created conflicts.

Furthermore, inferential statistics was performed to determine factors influencing farmers' preferred extension delivery system. The results of model fitting information are presented in Table 8.3.

Table 8.3: Model fitting information for MNLR1

Model	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC	BIC	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	985.389	997.663	979.389			
Final	898.397	972.040	862.397	116.992	15	<0.001

The results in Table 8.3 illustrate that the full model is statistically significant [$X^2(15)=116.992$; $p<0.01$]. It implied that the full model could significantly predict better than the null model. On the other hand, the results of Goodness of Fit showed mixed outcomes. According to the results of Deviance chi-square test, the model fitted the data well [$X^2(1227)=847.827$, $p=1.000$]. However, the results of Pearson's chi-square test showed that the model did not fit the data well [$X^2(1227)=1635.372$, $p<0.001$]. The results of Deviance chi-square can be relied on even though Pearson's chi-square test findings were in contrast because the results of both tests do not always have to be similar. Regarding Pseudo R-square outputs, the values achieved were 0.233 for Cox and Snell, 0.260 for Nagelkerke and 0.117 for McFadden. Pseudo R-Square measurements have limitations in MLR model; thus, the values were accepted without further interpretation.

The Likelihood Ratio Tests formed part of the analysis for MLR. The purpose of Likelihood Ration Tests was to determine the overall contribution of each independent variable to the model. The results of Likelihood Ratio Tests presented in Table 8.4 indicate that age and annual net farm income were statistically significant at 1% and 5% significance level ($p<0.01$; $p<0.05$), while education level was not as significant ($p=0.052$). Therefore, age and annual net farm income were significant predictors in the model.

Table 8.4: The result of Likelihood Ratio Tests for MLR1

Effect	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC of Reduced Model	**BIC of Reduced Model**	**-2 Log Likelihood of Reduced Model**	**Chi-Square**	**df**	**Sig.**
Intercept	905.448	966.818	875.448	13.052	3	0.005
Age	907.829	969.199	877.829	15.433	3	0.001
Education level	900.143	961.513	870.143	7.747	3	0.052
Farm size	895.712	957.082	865.712	3.315	3	0.346
Farming experience	896.818	958.188	866.818	4.421	3	0.219
Annual net farm income	934.941	996.311	904.941	42.544	3	0.000

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are zero (0). The results of the parameter estimate of the MNLR analysis are presented in Table 8.5. The results provide information that compares each extension delivery system against the reference group (Farmer-University extension delivery system).

Table 8.5: Multinomial Logistic Regression results of the factors influencing university agricultural extension delivery system preferred by the respondents (n=442)

Extension delivery system[a]		**B**	**Std. Error**	**Wald**	**Sig.**	**Exp(B)**	**95% Confidence Interval for Exp(B)**	
							Lower Bound	**Upper Bound**
Farmer-Public Extension-University	Intercept	1.140	0.491	5.395	0.020			
	Age	0.148	0.115	1.655	0.198	1.159	0.926	1.452
	Education level	-0.008	0.097	0.007	0.933	0.992	0.820	1.200
	Farm size	-0.021	0.028	0.607	0.436	0.979	0.927	1.033
	Farming experience	0.010	0.031	0.114	0.735	1.010	0.951	1.073
	Annual net farm income	0.000	0.000	21.345	<0.001	1.000	1.000	1.000
Farmer-Cooperative (Farmer Organisation)-University	Intercept	-0.218	0.749	0.085	0.771			
	Age	-0.349	0.198	3.113	0.078	0.705	0.478	1.039
	Education level	-0.032	0.145	0.048	0.826	0.969	0.729	1.287
	Farm size	-0.014	0.034	0.173	0.677	0.986	0.923	1.053
	Farming experience	0.074	0.043	2.973	0.085	1.076	0.990	1.170
	Annual net farm income	0.000	0.000	0.462	0.497	1.000	1.000	1.000
Farmer-Cooperative (Farmer organisation) & Public Extension-University	Intercept	-0.420	0.570	0.542	0.462			
	Age	-0.249	0.152	2.695	0.101	0.780	0.579	1.049
	Education level	0.213	0.096	4.910	0.027	1.237	1.025	1.493
	Farm size	-0.037	0.022	2.918	0.088	0.963	0.923	1.006
	Farming experience	0.049	0.036	1.853	0.173	1.050	0.979	1.127
	Annual net farm income	0.000	0.000	1.988	0.158	1.000	1.000	1.000

a. Reference category is farmer-university extension delivery system

The results in Table 8.5 show that the comparison between reference category (Farmer-University extension delivery system) and Farmer-Public Extension-University extension delivery system yielded three positive predictors: age, farming experience and annual net farm income. However, only annual net farm income was positive (β=0.000) and statistically significant at 1% significance level ($p<0.01$). It implied that farmers who had high annual net farm income preferred Farmer-Public Extension-University extension delivery system to Farmer-University extension delivery system (category reference). The reason could be that farmers who had higher annual net farm income received adequate support from public extension officers. These farmers were in favour of engaging universities through government extension officers; thus, they preferred to source information from two institutions to solve similar and/or different challenges they encountered. This is not surprising because Ong'ayo *et al.* (2016); Muzenda *et al*. (2018) found that demand-driven pluralistic extension increases farmers' income significantly. Therefore, the respondents were hopeful that by involving government extension officers in all activities that form part of university agricultural extension would increase their net farm income.

In the second group that compared Farmer-Cooperative (Farmer Organisation)-University extension delivery system with the reference category (Farmer-University extension delivery system), only two variables: farming experience and annual net farm income were positive predictors; however, none of the predictors were statistically significant ($p>0.05$). In the third comparison group, the results in Table 8.5 shows that there were three positive predictors: education level, farming experience and annual net farm income in the model that compared Farmer-University extension delivery system (reference category) and Farmer-Cooperative (Farmer organisation) and Public Extension-University extension delivery system. However, only education level was statistically significant at 5% significance level ($p<0.05$). The findings implied that farmers who attained high education levels preferred Farmer-Cooperative (Farmer organisation) and Public Extension-University extension delivery system than Farmer-University extension delivery system. The postulation was that highly educated farmers valued the coordination of farmer organisations and public extension officers in the provision of university agricultural extension services. Apart from coordination process, farmer-farmer organisations and public extension-university extension delivery system provide farmers with a diversity of information from different stakeholders. Similarly, a positive and significant correlation between farmers' education and access to sources of information has been discovered (Sarker & Itohara, 2007). It can be argued that literate farmers favoured a pluralistic extension delivery system that could extend the function of information provision to various stakeholders and create a platform for mediation from the government and farmer organisations.

8.4.2 Perceived advantages and disadvantages of university extension delivery models

After the respondents chose their preferred university extension delivery model, they were required to provide the reasons for their choices (perceived benefits). The results and discussions of the perceived benefits for each university extension delivery model are presented from section 8.4.2.1 to 8.4.2.4.

8.4.2.1 *Farmer-University extension system*

Farmer-University extension delivery model implied that farmers received agricultural extension services from universities directly without the facilitator (s). Therefore, university personnel involved in the delivery of extension services communicated directly with farmers whenever necessary without informing public extension officers, organisations and other stakeholders. As mentioned in section 8.4.2, each extension delivery model has advantages (benefits). Table 8.6 shows the reasons why the respondents chose farmer-University extension delivery system.

Table 8.6: Reasons why the respondents preferred farmer-University extension delivery model (n=442)

Reason	Frequency	Percentage
Acquire more knowledge and skills	50	11.3
Universities will identify farmers challenges without interference	16	3.6
Direct access to training programmes	14	3.2
Better access to new technologies	13	2.9
Direct interaction with subject experts	12	2.7
Save time	11	2.5
Improve access to extension services	8	1.8
Exclude government extension officers	6	1.4
Accurately convey the message to universities	4	0.9
Better access to funds	3	0.7
Enable universities to teach indigenous knowledge	3	0.7
Easily access laboratories	2	0.5
Farmer will easily understand information	2	0.5
Public extension officer may not be always available	1	0.2
Universities are dedicated to their work	1	0.2
Lost confidence in public extension officers	1	0.2

The results in Table 8.6 show that the main reason farmers preferred to receive extension services from universities without the mediator (facilitator) was to acquire more knowledge and skills (11.3%). The respondents held the notion that by interacting with university extension personnel directly, they would acquire more knowledge about production practices and ultimately improve their production. The respondents were of the view that university extension personnel could easily identify their challenges (3.6%) and provide access to training programmes (3.2%) if they engaged them without the facilitator (intermediator). About 2% of the respondents preferred to engage universities directly with anticipation that they would increase their chances of accessing new technologies, interact with subject matter experts and save time. The other reasons that prompted farmers in the study area to prefer engaging universities directly were expressed by less than 2% of the respondents as shown in Table 8.6. Farmers' perceptions were not farfetched because universities involved in a pluralistic extension system have met most of the expectations listed in Table 8.6. For example, agricultural universities conduct research that generate new information and develop new technologies (Johanson & Saint, 2007; Okolo, 2010; Liu & Tao, 2021). Thus, it was understandable that farmers in the study perceived their direct interaction with universities as a way to improve access to information and technologies. Also, most subject-matter specialists are located in the institutions of higher learning (Universities, Colleges, Polytechnic Institutes, Universities of Technology and so forth) and research. In some instances where universities render agricultural extension services to the farmers, subject-matter specialists have joint research and extension appointments (Ghimire *et al*. 2014). Therefore, farmers' desire to interaction with subject-matter specialists could easily be achieved through Farmer-University extension delivery system. Regarding direct access to training programmes, one of the major roles played by institutions of higher learning in society is to train; thus, the expectations for universities to provide formal and informal training to the farmers could be there amongst the recipients of extension services. Similarly, Kenney and Mowery (2014) reported that universities play an important role in training the recipients of extension services. In addition, training from universities can play a significant role in lifelong learning for non-traditional students such as farmers (Mutimba *et al*., 2010).

Furthermore, the respondents who lost confidence in public extension services were in favour of reaching out to the universities directly to ensure that their needs were communicated accurately to the universities to save time, thereof. Direct interaction enables universities to identify farmers' challenges and provides solutions that could easily be understood by farmers. According to Atchoarena and Holmes (2005), universities were more likely to generate knowledge that was acceptable to their academic peers, but irrelevant to the people responsible for knowledge application if there was no interaction between the two stakeholders. As a result, information generated through university research programmes would not provide solutions for societal challenges. Therefore, the intentions of the respondents in the study was to safeguard the aforementioned manifestations.

8.4.2.2 *Farmer-public extension-university extension model*

Farmers-public extension-university extension delivery model means that public (government) extension officers facilitate the delivery of extension services from universities to the farmers and/ are informed about extension services rendered to the farmers. Therefore, government extension officers function as intermediaries between farmers and universities in rendering extension services or they are informed by universities/farmers about extension services rendered to the farmers. Table 8.7 presents the reasons why the respondents preferred engaging universities through public extension officers.

Table 8.7: Reasons why the respondents preferred farmer-public extension-university extension delivery model (n=442)

Reason	Frequency	Percentage
Acquire more information from government and University	100	22.6
Maintain (Strengthen) relationship with government	40	9.0
Public extension can easily obtain contact details for university personnel	20	4.5
Public extension officers can easily convey message to universities	20	4.5
Public extension has better understanding of farmer's problems	17	3.8
Government introduced Universities to farmers	15	3.4
Public extension officers are perceived as project managers	25	5.7
Avoid duplication of efforts	13	2.9
Access to Extension Services from different service providers	13	2.9
Create relationship between university and government	11	2.5
Enable public extension to monitor farmer's progress	10	2.3
Highly costly to contact Universities directly	5	1.1
Public extension can determine when Universities would be required	3	0.7
Universities provide knowledge while government will fund extension services	3	0.7
Public extension officers can easily convey message to universities	3	0.7
Visit Universities with public extension officers	2	0.5

Table 8.7 depicts that the most important reason farmers were in favour of engaging universities through public (government) extension officers was to obtain information from both institutions (government and universities), as shown by more than one-fifth (22.6%) of the respondents. Secondly, 9% of the respondents wanted to maintain the relationship that exists between them and the government by engaging universities through public

extension officers. By so doing, it would avoid duplication of efforts, enable public extension officers to monitor extension services rendered by universities and create a relationship between two institutions involved in the provision of extension services. The other reasons expressed by more than 4% of the respondents were the perceived ability of public extension officers to obtain contact details of university personnel; and to easily convey farmers' messages to the universities. Less than four percent of the respondents expressed other reasons that influenced farmers' preference to use public extension officers as the facilitators.

Some of the reasons why the respondents preferred farmer-public extension-university extension model were aligned with the benefits of a pluralistic extension system that have been documented in literature. Acquisition of more information from various sources of extension is in support of what Rajesh *et al*. (2018) found in situations where a pluralistic extension system involved universities and the government. All the respondents have a relationship with the government through public extension officers; as a result, they intend to maintain that relationship than to create a new one between the government and universities. In Malawi, Chowa *et al*. (2013) revealed a poor relationship between some stakeholders providing extension services to farmers; as a result, conflicts erupted because there was an overlap of activities. According to Kabir *et al*. (2020), pluralism extension without proper coordination cannot adequately respond to farmers' needs and demands. Proper coordination can only be achieved if there was a cordial relationship between all three-stakeholder involved (farmers, universities and government). Therefore, a reciprocal relationship between government and universities is important to ensure effective provision of extension services through a pluralistic extension system in the study area.

Furthermore, some of the respondents were of the view that public extension should play the mediation role (coordination) because they knew universities through public extension officers. In support of the above findings, other scholars have divulged that public extension agents coordinated certain university extension services rendered to farmers because of the cordial relationship that existed between the two institutions (Singh *et al*., 2016; Rajesh *et al.*, 2018). Again, government is the main provider of extension services in many countries (Cary, 1993; Kidd et al, 2000; Anderson & Feder, 2004; Ajayi, 2006; Magoro & Hlungwani, 2014; Maoba, 2016). Therefore, public extension agents could liaise with university extension personnel and easily convey messages because they were familiar with farmers' challenges as indicated by the respondents. Farmer-Public Extension-University extension delivery system was preferred because public extension agents were perceived as project managers who should monitor farmers' progress. Several studies attested that the project management is one of roles of extension services (Lopokoiyit *et al*., 2013; Shah *et al*., 2013; Zwane & Kekana, 2014). Farmers' expectations about the role of extension services in Farmer-Public Extension-University extension delivery model are not bizarre; thus, they justify the inclusion of public extension in university agricultural extension. From funding perspective, the government is the main funder of extension services in many countries (Mullen *et al*., 2000; Rutatora & Mattee, 2001; van den Ben, 2003; Babu *et al*., 2013; Issa, 2020), and because of that, the respondents were in favour of including public extension as the mediator (coordinator) between them and universities to continue receiving funding and access to free extension services.

8.4.2.3 *Farmer-farmer organisations-university extension model*

Farmer-farmer organisations-university extension delivery model implied that cooperatives (farmer organisations) are informed about university extension services rendered to the farmers, and/ they function as the intermediaries between farmers and universities. The reason why the respondents were in favour of farmer-farmer organisations-university extension delivery system is presented in **Table 8.8**.

Table 8.8: Reasons why the respondents preferred farmer-farmer organisations-University extension delivery model (n=442)

Reason	Frequency	Percentage
Farmer organisations will improve access to extension services	9	2.0
Farmer organisations have been helpful	7	1.6
Farmer organisations are informed about farmer's activities	6	1.4
Farmer organisations are reliable	5	1.1
Strengthen relationship between farmers and cooperatives	3	0.7
Farmer organisations know farmer's needs	2	0.5
Cooperatives will communicate farmers' needs collectively	1	0.2
Lost faith in government extension services	1	0.2
Provide positive results	1	0.2

The results presented in Table 8.8 show that the respondents were mainly motivated by improved access to extension services if they engaged universities through farmer organisations. Secondly, the respondents preferred farmer organisations as the facilitators of university agricultural extension because they have been helpful to them. Again, between one and two percent of the respondents were in favour of farmer-farmer organisations-university extension delivery model because farmer organisations were reliable and informed about farmers' activities. Less than one percent of the respondents were prompted by other reasons depicted in Table 8.8.

The study findings were in support of Mukherjee *et al*. (2012); Tolno *et al*. (2015) who found that farmer organisations (cooperatives) improved access to extension services. The respondents expected farmer organisations involved in the coordination of university agricultural extension to also provide extension services. This is not surprising because there are several farmer cooperatives that render extension services in South Africa (Zwane, 2009; Koch & Terblanché, 2013). As a result, the respondents affiliated to farmer organisations perceived the inclusion of cooperatives in university agricultural extension delivery system as an advantage. This was mainly because farmers had benefitted from their association with farmer organisations; thus, it was important to strengthen their relationships with those organisations. Although the respondents did not specify the benefits they received from farmer organisations, there was evidence from the literature that farmer organisations have contributed meaningfully to farmers' development. For example, farmer organisations have improved farmers' profits (Moustier *et al*., 2010; Tolno *et al*., 2015; Aku *et al.*, 2018); access to markets (Moustier *et al*., 2010; Aku *et al.*, 2018); access to credit and reduced production costs (Tolno *et al*., 2015); and provided information (Adhiguru *et al*. 2009; Mukherjee *et al*., 2012; Chowa *et al*., 2013). Because of the benefits associated with affiliation to farmer organisations, it was understandable why farmers valued their relationships with such organisations. The relationships influenced farmers to prefer the inclusion of farmer organisations as coordinators for university agricultural extension because they were informed about farmers' activities and needs. As a result, farmers were convinced that farmer organisations would communicate their needs collectively to the universities that render extension services. Likewise, Ortmann and King (2001); Moustier *et al*., (2010); Tolno *et al*. (2015) have reported that farmer organisations provided a collective voice for farmers affiliated to them. Therefore, the inclusion of farmer organisations in university agricultural extension contributed meaningfully to the delivery of extension services because the organisations were acquainted with farmers' challenges.

8.4.2.4 *Farmer-farmer organisations and public extension-university extension model*

In farmer-cooperative (farmer organisations) and public extension-university extension delivery model, both public (government) extension officers and cooperatives (farmer organisations) are informed about university extension services rendered to the farmers and/ they functioned as intermediaries between farmers and universities that render agricultural extension services. The reasons why the respondents favoured farmer-cooperatives (farmer organisations) and public extension university extension system are presented in **Table 8.9**.

Table 8.9: Farmers' perceived advantages of farmer-cooperative (farmer organisations) and public extension-University extension delivery model (n=442)

Reason	Frequency	Percentage
Acquire more information and skills from different stakeholder	40	9.0
Access extension services from different sources	30	6.8
Strengthen relationship between farmer's stakeholders	12	2.7
Promote collaboration between extension stakeholders	8	1.4
Access funds from different stakeholder	4	0.9
Allow sharing of activities	3	0.7
Improve decision-making	3	0.7

The findings in Table 8.9 show that the main reason the respondents preferred to engage universities through cooperatives and public extension was that they acquired more information and skills from different stakeholders. Moreover, 6.8% and 2.7%, respectively, perceived farmer-cooperative (farmer organisations) and public extension-university extension delivery model as a mechanism to improve access to extension services from various sources and strengthening relationship between farmers' stakeholders. Nonetheless, the other reasons that prompted the respondents to favour farmer-cooperatives (organisations) and public extension-university extension delivery model were expressed by less than two percent of the respondents.

In support of the study findings, Adhiguru *et al*. (2009); Mukherjee *et al*. (2012); Rohit *et al*. (2017) reported that the involvement of different stakeholders in the provision of extension services through pluralistic extension improved farmers' access to information. This is mainly because stakeholders have access to various sources of information; thus, farmers were exposed to diversify of information. Therefore, the role of government and farmer organisations in university agricultural extension should be coordination and provision of extension services as defined by the farmers. In addition, strengthening the relationship between extension stakeholders (government, farmer organisations and universities) promoted the collaboration and allowed sharing of activities. However, that could be achieved if the role played by each stakeholder was clearly defined and agreed upon. According to Chowa *et al*. (2013), if stakeholders providing extension services to farmers had no proper coordination of activities, parallel structures that duplicate activities could be created and lead to conflicts.

8.4.3 Farmers' preferred place of extension delivery and influencing factors

In Gauteng province, universities that offer agricultural qualifications are mostly located in urban areas whereas farming activities are dominant in rural settings. Moreover, there are urban community gardens located in urban settings such as townships, informal settlements, and suburbs. The aforementioned factors have influence on access to extension services; therefore, it was important to determine the respondents' preferred place of receiving university agricultural extension services. **Table 8.10** presents the results of the respondents' preferred place of receiving university agricultural extension services:

Table 8.10: University agricultural extension delivery model preferred by the respondents (n=442)

Preferred place	Frequencies	Percentages
Farming place	222	50.2
University	111	25.1
Farming place and University	109	24.7
Total	**442**	**100.0**

The findings presented in Table 8.10 show that about half (50.2%) of the respondents were in favour of receiving university agricultural extension services in their farming places (farm, plots, household, and community gardens). About a quarter of the respondents were in favour of only visiting universities and both places of delivery (farming place and university). By looking at the proportions of farming place alone (50.2%); and farming place and Universities combined (24.7%), it can be argued that majority of the respondents preferred university extension personnel to visit them at their farming places as part of extension delivery. The findings were aligned with the widespread practice in the delivery of extension services whereby the number of visits by extension agents were used to determine adequate access to extension services

(Umunna *et al*. (2012; Abdallah & Abdul-Rahaman, 2016; Atsbeha & Gebre, 2021). In addition, Ganpat *et al.* (2017) found that extension visits were significant predictors of farmers' satisfaction with extension service. Therefore, it is highly probable that farmers would use extension visits to determine the level of access to- and quality of services because they expected university extension personnel to visit them at their farming places. Again, the importance of farmers visiting universities could not be overlooked because it was mentioned independently by 25.1% of the respondents; and again by 24.7% of the respondents in the combination of farming place and university. Farmer would have access to training programmes and facilities, research infrastructure and research innovations by visiting universities that provide extension services. This was due to universities having test stations used to transform innovative agricultural technologies into extensive applications (Liu & Tao, 2021). Test stations available in universities include research farms, laboratories, skill development centres and others. In addition to the descriptive statistics, the results presented in the previous section, MLR was performed to determine factors influencing the respondents preferred place for receiving university agricultural extension services. Table 8.11 presents the results of MLR2 model fitting information.

Table 8.11: Model fitting information for MNLR2

Model	**Model Fitting Criteria**			**Likelihood Ratio Tests**		
	AIC	**BIC**	**-2 Log Likelihood**	**Chi-Square**	**df**	**Sig.**
Intercept Only	901.820	910.003	897.820			
Final	868.727	917.823	844.727	53.094	10	<0.001

The findings in Table 8.11 indicate that the full model was statistically significant [$X^2(11)=53.094$; $p<0.01$]. The results meant that the full model was a significant predictor better than the null model. In addition, the Goodness of Fit was part of MLR model. The results of Goodness of Fit were inconsistent because Deviance chi-square test indicated that the model fitted the data well [$X^2(818)=827.149$, $p=0.404$], whereas Pearson's chi-square test was in contrast [$X^2(818)=998.937$, $p<0.001$]. The results of Goodness of Fit were accepted because Deviance chi-square and Pearson's chi-square do not always have to be similar. The findings of Pseudo R-square obtained the following values 0.113, 0.129 and 0.058 for Cox and Snell, Nagelkerke and McFadden, respectively.

Regarding, Pseudo R-square outputs, the values achieved were 0.233 for Cox and Snell, 0.260 for Nagelkerke and 0.117 for McFadden. Pseudo R-Square measurements were accepted without further interpretation because they have limitations in MLR model. In addition, Likelihood Ratio Tests were also part of the analysis in the model. Likelihood Ratio Tests were included in MNLR model analysis because they can determine the overall contribution of each independent variable to the model. The results of Likelihood Ratio Tests are presented in Table 8.12. The results show that only annual net farm income was statistically significant at 1% significance level (p<0.01). Therefore, annual net farm income was a significant predictor in the model, whereas other independent factors: age, education level, farm size and farming experience were not.

Table 8.12: The result of Likelihood Ratio Tests for MLR2 (n=442)

Effect	**Model Fitting Criteria**			**Likelihood Ratio Tests**		
	AIC of Reduced Model	**BIC of Reduced Model**	**-2 Log Likelihood of Reduced Model**	**Chi-Square**	**df**	**Sig.**
Intercept	865.825	906.738	845.825	1.098	2	0.578
Age	865.176	906.089	845.176	0.449	2	0.799
Education level	864.798	905.712	844.798	0.072	2	0.965
Farm size	869.317	910.230	849.317	4.590	2	0.101
Farming experience	867.235	908.148	847.235	2.508	2	0.285
Annual net farm income	900.713	941.626	880.713	35.986	2	0.000

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are zero (0). The results of the parameter estimate of the MLR2 analysis are presented in Table 8.13. The results provided information that compared each preferred place with the reference group (farming place).

Table 8.13: Multinomial Logistic results of the factors influencing farmers' preferred place for receiving university agricultural extension delivery services (n=442)

Place[a]		B	Std. Error	Wald	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
							Lower Bound	Upper Bound
University	Intercept	-0.396	0.433	0.834	0.361			
	Age	0.050	0.099	0.252	0.616	1.051	0.865	1.276
	Education level	0.014	0.086	0.025	0.875	1.014	0.857	1.199
	Farm size	-0.006	0.031	0.038	0.845	0.994	0.936	1.056
	Farming experience	-0.032	0.027	1.472	0.225	0.968	0.919	1.020
	Annual net farm income	0.000	0.000	6.475	0.011	1.000	1.000	1.000
Farming place and University	Intercept	-0.364	0.452	0.648	0.421			
	Age	0.060	0.100	0.363	0.547	1.062	0.873	1.293
	Education level	-0.015	0.095	0.025	0.875	0.985	0.818	1.186
	Farm size	0.057	0.029	3.726	0.054	1.058	0.999	1.121
	Farming experience	-0.036	0.027	1.738	0.187	0.965	0.915	1.018
	Annual net farm income	0.000	0.000	17.378	<0.001	1.000	1.000	1.000

a. The reference category is farming place

The results presented in Table 8.13 indicate that three factors: age, education level and annual net farm income were positive predictors in the comparison between farming place (reference category) and university as the respondents' preferred place for receiving agricultural extension services from universities. Nonetheless, annual net farm income was the only positive ($\beta=0.000$) and significant predictor at 5% significance level ($p=0.011$). The results implied that farmers who had high annual net farm income were in favour of receiving university agricultural extension services at the universities compared to their farming place (category reference). Farmers' decision could be due to their willingness to explore different innovations and information that universities could offer them during their visits. On the contrary, the findings deviated from traditional norm where net farm income was significantly associated with extension visits to the farms (Teshome & Edriss, 2013; Agyeman *et al.*, 2014). This is not surprising because not much focus has been given to farmers' visits to extension offices, research institutions and institutions of higher learning as part of access to extension services.

The results of the comparison between the category reference (farming place), and farming place and university showed that age, farm size and annual net farm income were positive predictors in the model. However, annual net farm income ($\beta=0.000$) was the only significant predictor ($p<0.001$), whereas farm size was near significant ($p=0.054$). Thus, annual net farm income was a significant predictor at 1% significance level ($p<0.01$). It meant that farmers with high annual net farm income preferred receiving university agricultural extension services at both farming place and universities than farming place only. This could be because when university personnel visit farmers in their farming places, they would understand the farmers' challenges and develop practical solutions to address them. By visiting universities, farmers could receive formal training, or access research materials and textbooks. Therefore, farmers would have access to diversity of information by visiting universities and receiving the visits from university extension personnel in their farming place. In comparison to the study findings, various scholars have concurred that access to various information was a positive and significant predictor of net farm income (Okwu & Umoru, 2009; Birthal *et al.*, 2015). Therefore, the current findings are in agreement with what other scholars have found even though the approach was different.

8.4.4 Farmers' preferred language for receiving university agricultural extension services and influencing factors

The results of socio-demographics of the respondents presented in chapter 4 showed that more than four-fifth of the farmers in the study area spoke nine South African indigenous (vernacular) languages whereas only 2.5% and 1.7% were English and Afrikaans speaking farmers, respectively. Because of the description, it was therefore important to determine the language (s) preferred by the respondents when they received agricultural extension services from universities. The results of the language (s) preferred by the respondents are presented in Table 8.14.

Table 8.14: The respondents' preferred language (s) for the delivery of university agricultural extension services (n=442)

Type of extension delivery system	Frequencies	Percentages
Vernacular	185	41.9
Vernacular and English	177	40.0
English	80	18.1
Total	**442**	**100.0**

Table 8.14 depicts that the language (s) preferred by most (41.9%) respondents in the delivery of university agricultural extension were vernacular or indigenous South African languages, followed by vernacular and English (40.1%). English was the least preferred language of communication. In general, vernacular languages were the most preferred when considering the proportions of vernacular languages individually and the combination of vernacular and English. The results meant that university academic personnel who render agricultural extension services in the study area should be able to speak English and one of South African indigenous languages to reduce language barrier in communication of extension messages. In support of the current findings, Doamekpor (2006) found that in Volta region of Ghana, most (55.8%) farmers communicated with

extension agents using Ewe the local or indigenous language compared to English only at 1.9%; or English and Ewe at 23.1%. The other local languages were preferred by less than one-fifth of the farmers. Therefore, in both studies the most preferred languages were vernacular (local), followed by a combination of local languages and English as the least preferred language of communication. In the current study, the most preferred languages were Sotho (Southern Sotho, Sepedi and Setswana) and Nguni (IsiZulu, IsiXhosa, IsiNdebele and IsiSwati) as shown by the proportions in chapter four. Therefore, an academic personnel who can speak one of the Sotho and/or Nguni languages would be in a better position to render extension services to the farmers with minimal language barrier.

Furthermore, MNLR was performed to ascertain the determinants of farmers' preferred language (s) for receiving university agricultural extension services. The results of MLR model fitting information are presented in Table 8.15.

Table 8.15: Model fitting information for MLR2 (n=422)

Model	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC	BIC	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	901.053	909.236	897.053			
Final	858.682	907.778	834.682	62.371	10	<0.001

Table 8.15 indicates that the full model was statistically significant [$X^2(10)=62.371$, $p<0.01$]. It implied that the full model was a significant predictor better than the null hypothesis model. In addition, the results of Goodness of Fit performed to test whether the model fitted the data were not consistent. The results of Goodness of Fit were inconsistent. Deviance chi-square test results showed that the model fitted the data well [$X^2(818)=814.332$, $p=0.530$]. However, Pearson's chi-square test findings indicated that the model did not fit the data well [$X^2(818)=3071.946$, $p<0.001$]. But because Deviance chi-square and Pearson's chi-square do not always have to be similar, the results were accepted. On the other hand, the values of Pseudo R-square obtained were 0.132 for Cox and Snell, 0.150 for Nagelkerke and 0.068 for McFadden.

The additional analysis that determined the overall contribution of each independent variable to the model was also part of MLR analysis. The name of the analysis is Likelihood Ratio Tests. The results of Likelihood Ratio Tests in Table 8.16 indicate that farming experience and annual net farm income were statistically significant at 5 % (p<0.05) and 1% significance level (p<0.01), respectably, while education level was near significant (p=0.058). The results implied that farming experience and annual net farm income were significant predictors in the model.

Table 8.16: The result of Likelihood Ratio Tests for MLR3 (n=422)

Effect	**Model Fitting Criteria**			**Likelihood Ratio Tests**		
	AIC of Reduced Model	**BIC of Reduced Model**	**-2 Log Likelihood of Reduced Model**	**Chi-Square**	**df**	**Sig.**
Intercept	855.943	896.856	835.943	1.261	2	0.532
Age	857.520	898.433	837.520	2.838	2	0.242
Education level	860.377	901.290	840.377	5.695	2	0.058
Farm size	857.235	898.148	837.235	2.553	2	0.279
Farming experience	862.819	903.732	842.819	8.137	2	0.017
Annual net farm income	891.503	932.416	871.503	36.821	2	<0.001

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are zero (0). The results of the parameter estimate of the MNLR analysis are presented in Table 8.17. The findings provided information that compared each language (s) preferred by the respondents against the reference group (vernacular).

Table 8.17: Multinomial Logistic results of the factors influencing farmers' preferred language (s) for receiving university agricultural extension delivery services (n=442)

Language[a]		**B**	**Std. Error**	**Wald**	**Sig.**	**Exp(B)**	**95% Confidence Interval for Exp(B)**	
							Lower Bound	**Upper Bound**
English	Intercept	-0.399	0.567	0.497	0.481			
	Age	-0.072	0.113	0.406	0.524	0.930	0.745	1.162
	Education level	-0.046	0.128	0.131	0.717	0.955	0.743	1.226
	Farm size	0.036	0.036	1.024	0.312	1.037	0.967	1.112
	Farming experience	0.057	0.032	3.135	0.077	1.058	0.994	1.126
	Annual net farm income	0.000	0.000	13.937	<0.001	1.000	1.000	1.000
Vernacular and English	Intercept	-0.422	0.393	1.153	0.283			
	Age	-0.154	0.092	2.813	0.093	0.857	0.716	1.026
	Education level	0.151	0.073	4.289	0.038	1.163	1.008	1.342
	Farm size	0.027	0.019	2.107	0.147	1.027	0.991	1.066
	Farming experience	0.067	0.025	7.171	0.007	1.069	1.018	1.123
	Annual net farm income	0.000	0.000	6.090	0.014	1.000	1.000	1.000

a. The reference category is vernacular (Indigenous South African language)

The findings in Table 8.17 show that the comparison between vernacular languages (Category reference) and English had three positive predictors in the model. The positive predictors were farm size, farming experience and annual net farm income. However, annual net farm income was the only positive (β=0.000) and significant predictor at 1% significance level ($p<0.001$). Thus, farmers who made more profit from farming preferred to receive university agricultural extension services in English than their vernacular languages or mother tongue. The reason could be that farmers achieved higher annual net farm income by accessing information and materials written in English because in South Africa, most agricultural and scientific information is available in English. In support of the current findings, Casale and Posel (2011) found that highly educated Africans who were eloquent in English (speaking and reading) earned more income than their counterparts did. Therefore, it is not surprising that the respondents were in favour of extension services delivered in English compared to their mother tongue (vernacular language) because it had the higher probability of increasing their farm income.

Furthermore, education level, farm size, farming experience and annual net farm income were positive predictors in the model that compared farmers' preference for vernacular and English against vernacular languages (category reference). Nonetheless, only three factors were positive and significant predictors (Education level, annual net farm income and farming experience). Education level (β=0.151) and annual net farm income were positive (β=0.000) and significant predictors at 5% significance level ($P<0.05$). The results implied that farmers who attained higher educational level desired to receive agricultural extension services from universities in both English and vernacular language compared to vernacular language only. The findings meant that highly educated farmers were multilingual. This is because teaching and learning of most formal programmes (qualifications) and subjects is offered in English (Hazeltine, 2013; Mkhize & Balfour, 2017). Hence, highly educated African farmers in the study area were willing to receive extension services in two languages: English and vernacular; since they could speak, read, and write both languages.

Additionally, farmers with high annual net farm income were in favour of receiving university agricultural extension services in English and vernacular languages than vernacular languages only. The findings implied that farmers making more profit were multilingual because they preferred to receive extension services in two languages. According to Kroll and Dussias (2017), multilingualism improved opportunities for socio-economic advancement. Thus, farmers making more profit could afford to access information written in different languages and utilized it to make informed decisions that improved their net farm income. In addition, farming experience ($\beta=0.067$) was a significant predictor at 1% significance level ($p<0.01$). The results meant that, experienced farmers were in favour of receiving university agricultural extension services in their home languages (vernacular) and English than vernacular only. Again, it meant that experienced farmers were multilingual (bilingual). Farmers' preference could be influenced by their exposure to extension services rendered in English and indigenous languages during their farming duration (experience). According to Divita (2014), individuals become multilingual (bilingual) through life experiences in social and historical circumstances. Therefore, through farming experience and/or education, vastly experienced farmers in the study area developed the understanding of English and became multilingual. Hence, they were open to receiving extension services in two languages instead of one.

8.5 SUMMARY AND CONCLUSIONS

In this chapter, quantitative data was analysed using percentages, frequencies, and Multinomial Logistic Regression (MNLR). Qualitative data were transformed into frequencies and percentages after codes and themes were used to classify them. The findings of the study showed that majority of the respondents preferred farmer-public extension-university extension delivery system, followed by farmer-university extension delivery system. Farmer-farmer organisations and public extension-university extension delivery system, and farmer-farmer organisations-university extension delivery system were the third and fourth most preferred, respectively. Therefore, most farmers favoured university agricultural extension delivery system that included public extension agents.

The results of MNLR showed that farmers who had high annual net farm income preferred farmer-public extension-university extension delivery system than farmer-university extension delivery system. Highly educated farmers favoured farmer-farmer organisations and public extension-university extension delivery system than farmer-university extension delivery system. There were sixteen (16) reasons why the respondents chose farmer-public extension-university extension delivery system, with acquisition of more information from different institutions (government and universities) and maintaining relationships with the government being the most important reasons for their choices. The acquisition of more knowledge and skills and enabling universities to identify farmers' challenges without interference were the most important reasons that influenced the respondents' choices for farmer-university extension delivery system. Furthermore, seven factors influenced farmers' preference for farmer-farmer organisations public extension-university extension delivery system of which, improved access to extension services and assistance received from farmer organisations were the most important. Therefore, the respondents' opinions about extension delivery system that provided more information and skills differed.

Regarding the place for offering extension services, the study revealed that about half of the respondents preferred their farming places, followed by universities and both farming places and universities. It was concluded that most farmers expected university extension personnel to visit their farming places during the delivery of extension services. The respondents who had high annual net farm income preferred receiving university agricultural extension services at the universities compared to their farming places. Farmers with high annual net farm income favoured receiving university agricultural extension services at both farming places and universities more than farming places only. The findings for languages used in the delivery of extension services showed that vernacular was the most preferred; followed by vernacular and English, and English alone. Therefore, University personnel who provide extension services should speak at least one of the dominant South African languages (Nguni or Sotho languages). The respondents who made more profit from farming preferred receiving university agricultural extension services in English than their vernacular languages. Highly educated respondents desired to receive extension services from universities in both English and vernacular languages compared to their home languages. More experienced farmers favoured receiving university agricultural extension services in their vernacular and English than vernacular only. In conclusion, information and/or extension services provided to farmers making high profit from their farming enterprises should be provided in English. On the other hand, experienced and educated farmers should receive extension services in both English and vernacular languages.

CHAPTER 9: FUNDING FOR UNIVERSITY AGRICULTURAL EXTENSION SERVICES

9.1 INTRODUCTION

In most countries agricultural extension services are highly funded by the government through revenue collection (Birkhaeuser, Evenson & Feder, 1991; Cary, 1993; Van den Ban, 2000; Qamar, 2005; Nwalieji *et al*., 2013). The main reason is that the government is the main provider of extension services in many countries (Kidd *et al.*, 2000; Rutatora & Mattee, 2001; Sulaiman & van den Ban, 2003; Anderson & Feder 2004; Maoba, 2016; Nkosi, 2017; Rohit *et al*., 2017). In countries where university agricultural extension services are rendered, the government provides most funding for extension and research activities through colleges/faculties where extension services are housed in the universities (Brown *et al*., 2006; Singh *et al.*, 2013; Babu *et al*., 2015; Feldhues & Tanner, 2017; Perry, 2022). Universities also provide funding for extension programmes through community outreach funds (Ilvento, 1997; Anderson & Feder, 2004). In addition, universities receive funding for extension activities through grants, fees and gifts because government funding has declined (Feldhues & Tanner, 2017; Perry, 2022). The decline in government funding for extension services has occurred in many countries since the 20th century because of extension reforms. For example, Picciotto and Anderson (1997); Anderson and Feder (2004); Afful and Lategan (2014) reported that countries have reformed public extension services because they are struggling to meet the demand for services due to high costs, limited resources, change in extension philosophies or approaches, slow increase in public funding activities and globalization. As a result, the financial viability of government funded agricultural extension services (public extension) has been scrutinized (Cary, 1993; Kidd *et al*., 2000; Afful & Lategan, 2014). This has resulted in the decline of fiscal allocation for agricultural extension services in some countries (Sulaiman & van den Ban, 2003; Anderson & Feder, 2007; Afful & Lategan, 2014; Feldhues & Tanner, 2017; Perry, 2022). The reduction of government financial support for agricultural extension services is common in most developed countries compared to developing countries (Anderson & Feder, 2004; Davis, 2008). As a result, agricultural extension services are predominantly rendered by private sectors in most developed countries (Qamar, 2005). The reform of extension services has increased the number organisations involved in the provision of agricultural extension services; and changed the funding models for extension services in many countries. The number private institutions; Non-Governmental Organisations (NGOs); farmer organisations; institutions of higher learning; Non-Profit Organisations (NPOs) and other organisations involved in the provision of extension services has increased because of the extension reforms.

Funding for agricultural extension services in the private sector varies between countries. This includes full withdrawal of public funding, cost recovery approach (through collection of levies, fees charged for public extension services, or contracting extension services from government) and generating income by selling inputs, surplus land and sales of information materials (Kidd *et al*., 2000). Other types of agricultural extension privatisation systems include partial privatisation, outsourcing and contracting out (Qamar, 2005). There have been suggestions that agricultural extension services should be totally privatised because they are ineffective and irrelevant in the 21st century. The main argument is that government funded agricultural extension services have failed and are not satisfactory to the farmers' needs (Kidd *et al*., 2000; Qamar, 2005; Magoro & Hlungwani, 2014; Kabir *et al.*, 2020; Kassem *et al.*, 2021). However, other scholars have disputed this notion and argued that full privatisation of agricultural extension services can only be beneficial to large-scale commercial farmers and neglect poor farmers (Kidd *et al*., 2000; Anderson & Feder, 2007). For example, Davie (2008), reported that privatisation systems such as fee for services have failed in most developing countries. This is because most farmers in developing countries are not willing to pay for extension services (Anderson & Feder, 2004; Ozor, Garforth & Madukwe, 2013; Afful *et al*., 2014; Uddin *et al*., 2016; Loki *et al*., 2019). However, in some countries it was found that there were group of farmers who were willing to pay for extension services (Foti *et al*., 2007; Ali *et al*., 2008; Oladele, 2008). Thus, there is a degree of polarisation regarding farmers' willingness to pay for extension services across the globe.

In the current study, it was found that a pluralistic extension system involving universities was accepted by most farmers. Therefore, university agricultural extension was widely accepted in the study area. As a result, it was important to investigate farmers' perceptions about the funding model suitable for university agricultural extension services as part of pluralistic extension system.

9.2 RESEARCH OBJECTIVES

The objectives of chapter nine were as follows:

- To ascertain farmer perceptions about funding model suitable for university agricultural extension services.
- To determine farmer willingness to pay for university agricultural extension services and factors influencing their choice.

9.3 RESEARCH METHODOLOGY

The type of data used to measure farmers' perceptions about the funding model suitable for university agricultural extension services was categorical. Firstly, the respondents were required to share their opinions about stakeholders who should pay for university agricultural extension services. The possible stakeholders were farmers, the government, universities and farmers organisations. The questions used to collect data were a multiple response type of questions that allowed the respondents to choose more than one answer in the same question. A dichotomous scale with yes and no as possible responses was employed. In the scale, one (1) and zero (0) represented yes and no, respectively. The options for payment of university agricultural extension services: transport, gross income, medical aid, pension fund, Unemployment Insurance Fund (UIF), office space, office equipment and furniture, Information and Communication Technology (ICT), stationary, farmers' training and research. In addition, another dichotomous scale was used whereby the respondents' willingness to pay for university agricultural extension services was determined. In respective order, zero (0) and one (1) denoted no and yes in the dichotomous scale.

Data were analysed using descriptive statistics (frequencies, percentages and mean), Binomial Test, Binary Logistic Regression (BLR), Cochran Test, McNemar Test. Binomial Test was used to analyse data that measured whether significant proportions of the respondents were willing to pay for extension services. Binary Logistic Regression (BLR) analysed data about factors influencing farmers' willingness to pay for university agricultural extension services. On the other hand, Cochran's Q Test was used to determine whether farmers' opinions about the contribution of different stakeholders (farmers, university, government and farmer organisations) in the funding for university agricultural extension services differed significantly.

Model specification for Binary Logistic Regression (BLR)

The dependant variable was binary using zero (0) and one (1) as possible responses. On the other hand, independent variables consisted of both continuous and categorical data. The specification of BLR model used was as follows:

$$\log\left(\frac{\mathrm{P_i}}{1-\mathrm{P_i}}\right) = \beta_0 + \beta_1\mathrm{X}_{1i} + \beta_2\mathrm{X}_{2i} + \cdots + \beta_k\mathrm{X}_{ki} + \mathrm{U}_i$$

Where, P_i is the probability of the respondents' willingness to pay for university agricultural extension services (Y=1), $(1 - P_i)$ is the probability of not willing to pay for university agricultural extension services (Y=0), β_0 is the intercept, $\mathrm{X}_1 \ldots \mathrm{X}_{12}$ are the covariates (predictors), $\beta_1 \ldots \beta_{12}$ are the regression coefficients of predictors, and U is the constant value. Farmers' willingness to accept university agricultural extension services was categorized as 1=Yes and 0=No. The description of the independent variables used in BLR model one and two is presented in Table 9.1.

Table 9.1: The description of independent variables used in Binary Logistic Regression model of the factors influencing farmers' willingness to pay for university agricultural extension services

Variable description	Valuation	Expected sign	Interpretation of signs
X_1=Gender	0=Female; 1=Male	Positive	Male farmers would be willing to pay for university agricultural extension services
X_2=Age	1=<35 yrs; 2=35–45 yrs; 3=46–55 yrs; 4=56–65 yrs; 5=>65 yrs	Positive	Increase in farmers' age will make them accept university agricultural extension
X_3=Education Level	1=No formal education; 2=Primary education; 3=Secondary education; 4=Abet education; 4=Diploma; 5=Bachelor's degree; 6=Honours degree/BTech; 7=Masters; 8=Doctorate	Positive	Highly educated farmers would be willing to pay for university agricultural extension services
X_4=Farming category	0=Non-commercial; 1=Commercial	Positive	Commercial farmers would be willing to pay for university agricultural extension services
X_5=Farm/plot size	Ha	Positive	Large-scale farmers would be willing to pay for university agricultural extension services
X_6=Farming experience	(Years)	Negative	Vastly experienced farmers would be unwilling to pay for university agricultural extension services
X_7=Main source of income	0=Non farming; 1=farming	Positive	Farmers whose farming is their main source of income would be willing to pay for university agricultural extension services
X_8=Annual net farm income	Amount in rand (ZAR)	Positive	Farmers making more profit would be willing to pay for university agricultural extension services
X_9=Monthly visits from extension officer	Number	Negative	Farmers visited frequently by public extension officers would be unwilling to pay for university agricultural extension services
X_{10}=Distance from farm to extension office	Km	Positive	Farmers located further from public extension officers would be willing to pay for university agricultural extension services

Cochran's Q Test

In the study, binary responses were used to collect data that were analysed using Cochran's *Q* Test statistic. The binary responses were used whereby the participants had to choose the possible funders for university agricultural extension services. The binary responses were yes and no denoted by zero (0) and one (1), respectively. According to Sheskin (2011), Cochran's Q test statistic for binary response, $Y_{i,j}$, in k matched groups from N subject, is computed as follows:

$$Q = \frac{(k-1)[kC - T^2]}{kT - R}$$

Where,

$$C = \sum_{j=1}^{k} \left(\sum_{i=1}^{N} Y_{i,j} \right)^2$$

$$T = \sum_{i=1}^{N} \left(\sum_{j=1}^{k} Y_{i,j} \right)$$

$$R = \sum_{i=1}^{N} \left(\sum_{j=1}^{k} Y_{i,j} \right)^2$$

Because the sample size was large, Q test statistics were distributed as chi-square with $k-1$ degrees of freedom. As a result, subjects without the same response in all categories contributed to the overall Q statistic (Refer to McNemar equation below because the principles are the same). The p-value for the test was computed as follows:

P-value = $\Pr = \left(Q > X^2_{1-\alpha,k-1}\right)$

Where, $X^2_{1-\alpha,k-1}$ is the value of the $(1-\alpha)$ quintile of the chi-square distribution with $k-1$ degree of freedom.

The results of Cochran's Q test statistic for all the comparisons (funding for transport, gross income, medical aid, pension fund, UIF, ICT, office space, office equipment and furniture, stationary, farmers' training and research) were statistically significant. Therefore, the null hypothesis for Cochran's Q test was rejected. As a result, multiple comparisons were necessary to determine the groups that differed significantly. This was done by computing multiple pairwise comparisons. Group "a" and "b" were paired whereby the null hypothesis was tested. Firstly, the comparison performs Minimum Required Difference (MRD) to identify whether there was a statistical difference in the pair of experimental conditions. Thereafter, McNemar test that compares the significant difference in the pairwise between two groups (a and b) was performed. To control the overall experiment-wise tests error, Bonferroni alpha adjustment was used by both MRD and McNemar test. In the adjustment, overall alpha (*α*) was divided by the number of pairwise tests (*c*); where,

$$c = \frac{k(k-1)}{2}$$

For each individual test, alpha level, α_{adj} is

$$\alpha_{adj} = \frac{a}{c}$$

(i) MRD

The sample size (n=442) was considered larger as required by MRD. According to Sheskin (2011), in MRD, large samples, $n \geq 4$ and $nk \geq 24$, where n denotes the number of subjects with responses that are not all zeros (0's) and ones (1's). On the other hand, k represents different experimental groups in the minimum proportions of any pair, in the following manner:

$$MRD = z_{adj}\sqrt{2\left[\frac{kT-R}{N^2k(k-1)}\right]}$$

In the definition above, the definition of N, T and R is the same as in Cochran's Q statistic, in the following manner:

$$T = \sum_{i=1}^{N}\left(\sum_{j=1}^{k}Y_{i,j}\right)$$

$$R = \sum_{i=1}^{N}\left(\sum_{j=1}^{k}Y_{i,j}\right)^2$$

and,

z_{adj} is the value of the $\left(1-\alpha_{adj}/2\right)$ quintile from the standard normal distribution. If the absolute difference in the proportions of two groups is greater than MRD, they are considered to be statistically significant; that is if,

$$|\pi_a - \pi_b| > MRD$$

(ii) McNemar Test

According to Sheskin (2011), each pair of groups in McNemar test statistic is computed as follows:

$$M = \frac{(n_1\ -\ n_2)^2}{n_1\ +\ n_2}$$

Where,

$n_1 =$ the number of subjects where group “a” response = 0 and group “b” response = 1

$n_2 =$ the number of subjects where group “a” response = 1 and group “b” response = 2

For large samples,

n ≥ 4 and *nk* ≥ 24, where *n* is the number of subjects for which the responses are not all 0’s and 1’s. In large samples, *M* test statistic is asymptotically distributed as chi-square with one degree of freedom. Individual test’s p-value with protected overall alpha, *α*, is computed as follows:

P-value = $\mathrm{Pr} = \left(M > X^2_{1-\alpha_{adj,1}}\right)$

Where $X^2_{1-\alpha_{adj,1}}$ is the value of the $\left(1-\alpha_{adj}\right)$ quintile of the chi-square distribution with one degree of freedom.

9.4 RESULTS AND DISCUSSION

This section presents the results and discussion of farmers’ perceptions about the funding model appropriate for university agricultural extension, farmers’ willingness to pay for university agricultural extension services and factors influencing their decisions.

9.4.1 Funding for university agricultural extension services

Farmers’ perceptions about the funding model appropriate for university agricultural extension services were measured using the following variables: transport, gross income, medical aid, Unemployment Insurance Fund (UF) and pension fund, office space, office equipment and furniture, Information and Communication Technology (ICT), stationery, farmers training and research. The results and discussion are presented in sections 9.4.1.1 and 9.4.1.11.

9.4.1.1 *Transport*

The provision of agricultural extension services require adequate access to transport because farmers expect frequent visits from extension personnel. In Gauteng province, public extension officers have access to government and subsidized cars. Therefore, it is important to ensure that university extension personnel have adequate transport to travel to the farming locations and other areas during the provision of extension services to farmers. To have adequate and reliable transport, it is necessary to determine a transport-funding model that is appropriate for university agricultural extension. Because the current study was about farmers' perceptions, it was appropriate to collect information about their perception about a transport funding model that is suitable for university agricultural extension. The results of farmers' perceptions about transport funding model for university agricultural extension are presented in Figure 9.1.

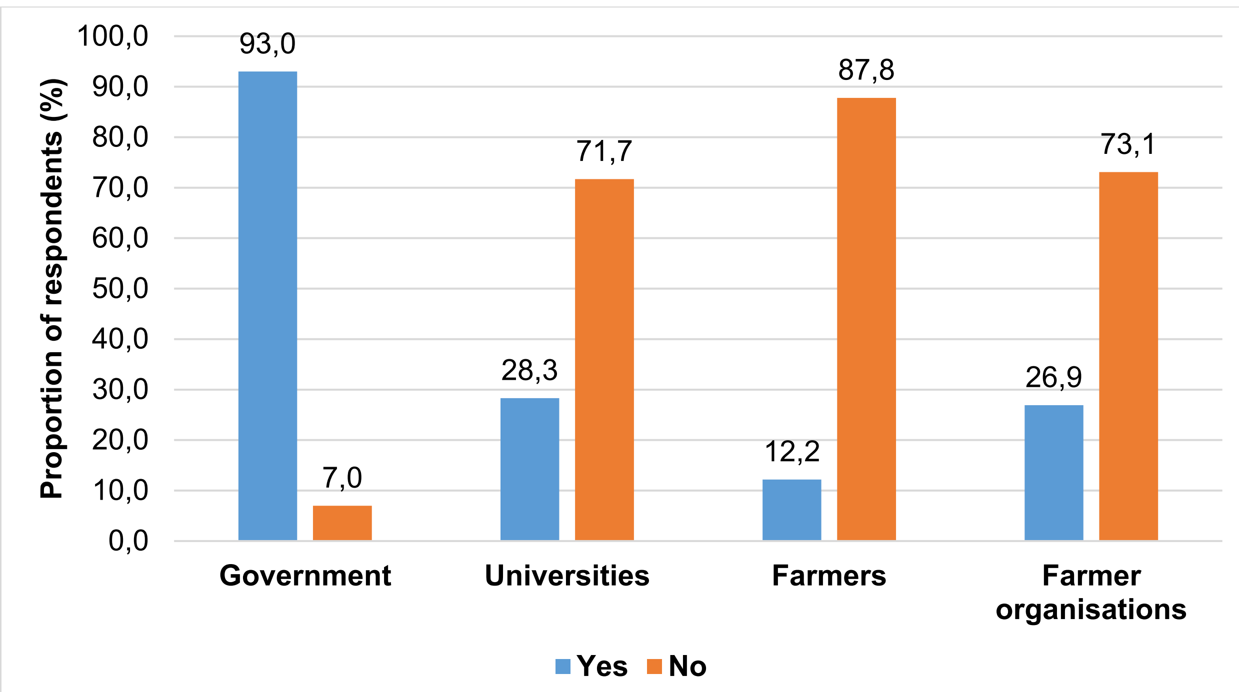

Figure 9.1: Farmers' perceptions about transport funding for university agricultural extension (n=442)

The results in Table 9.1 indicate that the majority (93.0%) of the respondents held the opinion that the government should provide funding for transport to the universities involved in the provision of agricultural extension services. In addition, more than a quarter (>25%) of the respondents perceived that universities (29.3%) and farmers (26.1%) as the second and third important organisations should contribute to transport funding for university extension services. The results implied that most farmers were not willing to fund transport required by university personnel to render extension services. On the other hand, the results of Cochran's Q Test achieved a statistically significant ($p<0.001$) Q value of 707.085 with a degrees of freedom (df) of three (3). The results implied that there was a statistically significant difference between farmers' perceptions on whether government, university, farmers and farmers' organisations should fund transport required by universities to render agricultural extension services. As a result, McNemar Test (Post Hoc Test) was performed to determine where the statistical difference existed between paired variables. Table 9.2 presents the results of McNemar Test of the pairwise of transport funders for university agricultural extension services.

Table 9.2: McNemar Test results of the pairwise of transport funders for university agricultural extension services (n=442)

Pairwise	Chi-square	P-value
Government & universities	244.654	<0.001
Government & farmers	332.640	<0.001
Government & farmers' Organisations	269.685	<0.001
Universities & farmers	50.515	<0.001
Universities & farmers' organisations	0.431	0.511
Farmers & farmers' organisations	38.280	<0.001

The results in Table 9.2 and Figure 9.1 show that significant ($p<0.001$) majority (93%) of the respondents were in favour of government funding transport for university agricultural extension services rather than universities (28.3%), farmers' organisations (26.9%) or farmers (12.2%) funding the transport for extension services. Again, significant ($p<0.001$) proportions (28.3%) of the respondents held the notion that universities should fund transport instead of farmers (12.2%), whereas there was no statistical difference between university and farmers' organisations. Lastly, significant proportions of the farmers perceived that farmers' organisations are the most the suitable funders for transport services required for the provision of university agricultural extension services rather than farmers. The results implied that farmers perceived that the government is a suitable organisation that should pay for transport required by universities to render agricultural extension services.

9.4.1.2 *University staff allowance*

Allowance is about paying salaries for university academics who renders agricultural extension services to farmers through university agricultural extension. In the current setup, university extension personnel receive their monthly gross income (salaries) from universities that employ them. Therefore, it is necessary to determine whether the additional work that emanate through the provision of agricultural extension services would not require additional remuneration for university academics. Figure 9.2 presents results of farmers' perceptions about funding for gross income for university agricultural extension.

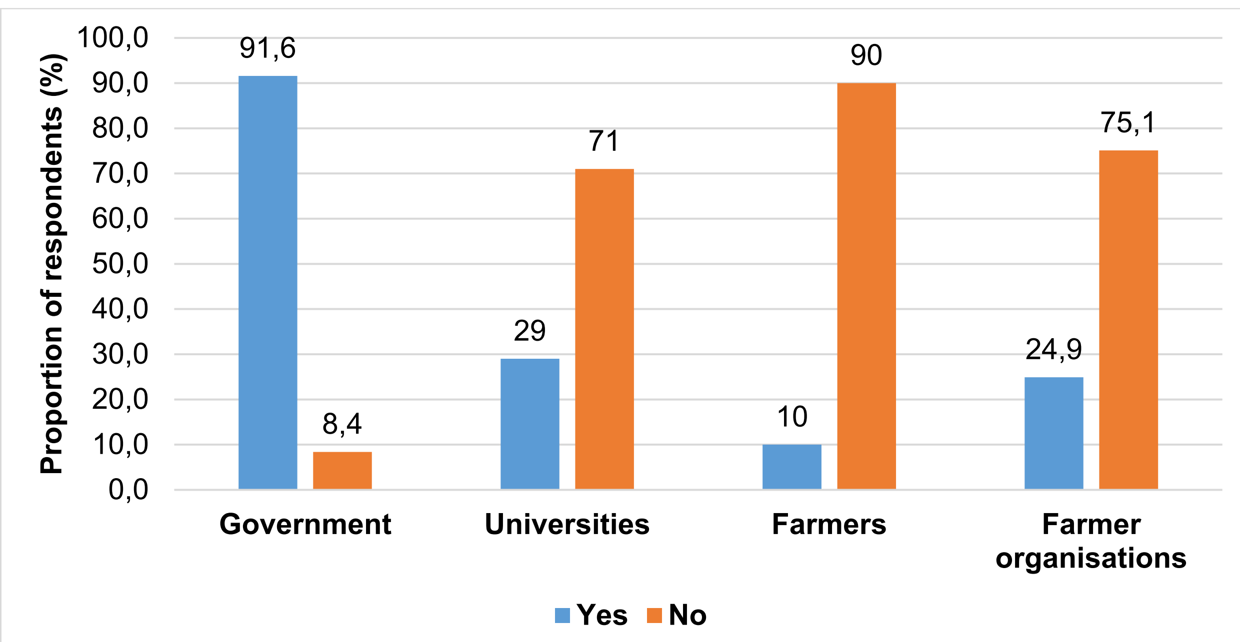

Figure 9.2: Farmers' perceptions about funding for university staff allowance for university agricultural extension (442)

Figure 9.2 depicts that the largest proportion (91.6%) of the respondents held the notion that the government should provide funding for university staff allowance, if required. On the other hand, 29% and 24.9% were in favour of university and farmers' organisations as the possible funders for university staff allowance, respectively. The results of Cochran's Q Test (Q=706.261) were statistically significant ($p<0.001$) Q value of =706.261 with a degrees of freedom (df) of three (3). As a result, McNemar Test (Post Hoc Test) was performed to identify where statistical difference existed between paired variables. Table 9.3 shows McNemar Test results of the pairwise of gross income funders for university agricultural extension.

Table 9.3: McNemar Test results of the pairwise of payment for staff allowance for university agricultural extension (n=442)

Pairwise	Chi-square	P-value
Government & universities	230.139	<0.001
Government & farmers	341.953	<0.001
Government & farmers' organisations	267.604	<0.001
Universities & farmers	66.240	<0.001
Universities & farmers' organisations	4.379	0.036
Farmers & farmers' organisations	44.010	<0.001

The results in Table 9.3 and Figure 9.2 shows that significant ($p<0.001$) majority (91.6%) of the respondents indicated that gross income for university extension personnel should be funded by the government instead of university, farmers' organisations or farmers. A significant proportions (29%) of the farmers were of the view that universities should fund gross income for university personnel instead of farmers ($p<0.001$) or farmers' organisations ($p=0.036$). In addition, there was a statistically significant difference ($p<0.001$) between the proportions of farmers and farmers organisations regarding funding for gross income of university academic personnel.

9.4.1.3 *Medical aid*

Medical aid includes funding for university extension personnel who are responsible for rendering agricultural extension services. Figure 9.3 shows farmers' perceptions about medical aid funding for university agricultural extension.

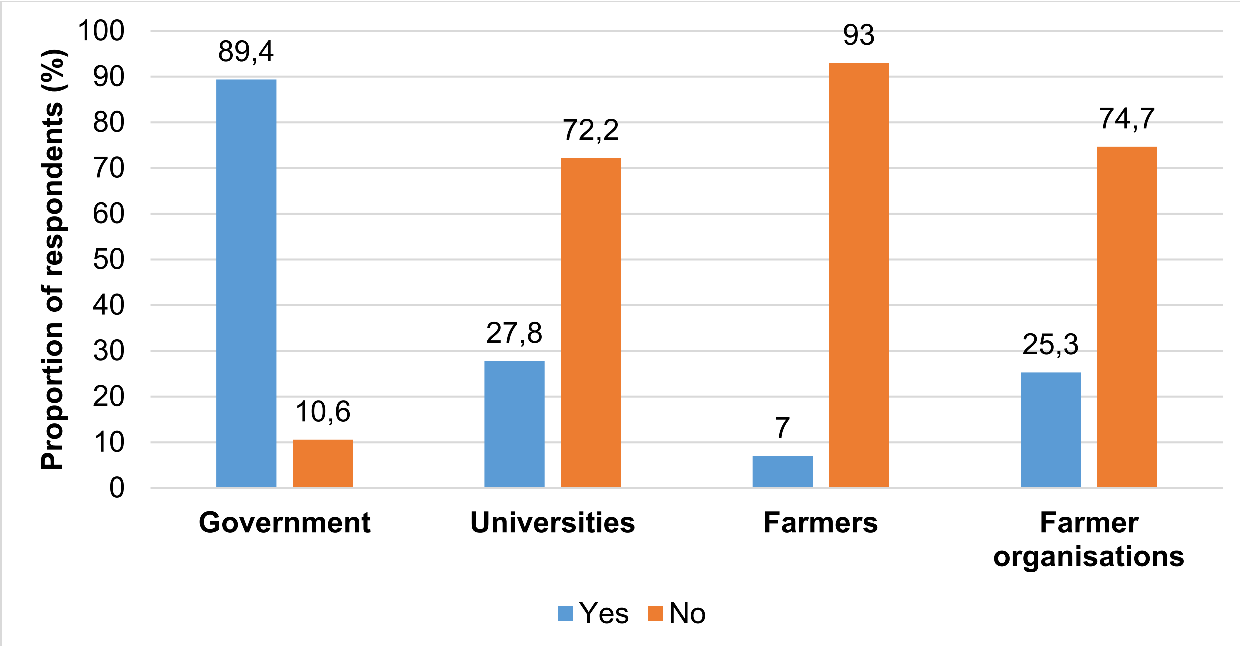

Figure 9.3: Farmers' perceptions about medical aid funding for university agricultural extension (442)

The results in Figure 9.3 show that most (89.4%) farmers perceived that the government is the organisation that should fund medical aid for university personnel who render agricultural extension compared to 27.8%, 25.3% and 7% who were in favour of university, farmers organisations and farmers, respectively. Again, the findings of Cochran's Q Test were statistically significant ($p<0.001$) with Q value of 675.986 and degrees of freedom (df) of three (3). It implied that farmers' perceptions about who should fund medical aid for university agricultural extension personnel services among the four possible funders (Government, university, farmers and farmers' organisations) was statistically significant. Because there was a statistically significant difference ($p<0.01$), it was imperative to perform McNemar Test as a Post Hoc Test to identify where the difference existed. Table 9.4 presents McNemar Test results of the pairwise of medical aid funders for university agricultural extension.

Table 9.4: McNemar Test results of the pairwise of medical aid funders for university agricultural extension (n=442)

Pairwise	Chi-square	P-value
Government & universities	208.639	<.001
Government & farmers	344.945	<0.001
Government & farmers' organisations	250.864	<0.001
Universities & farmers	79.625	<0.001
Universities & farmers' organisations	1.370	0.242
Farmers & farmers' organisations	57.658	<0.001

The results in Table 9.4 and Figure 9.3 illustrate that significant ($p<0.001$) proportions (89.4%) of the respondents were of the view that the government should fund medical aid for university extension personnel rather than university, farmers or farmers' organisations. The study also found that significant ($p<0.001$) proportions (27.8%) of the respondents perceived universities as suitable organisations for funding medical aid for university agricultural extension instead of farmers. Furthermore, significant proportions ($p<0.001$) of the farmers held the opinion that farmers organisations should fund medical aid instead of farmers.

9.4.1.4 *Unemployment Insurance Fund (UIF) and pension fund*

UIF is about the government, university, farmers and farmers organisations contributing to the payment of UIF and pension fund for university extension personnel. In the current setup, universities and their staff members contribute to UIF for potential university extension personnel. If necessary, it would be important to determine whether the current arrangements are suitable for university agricultural extension. Because of the above background, farmers' perceptions about funding for UIF and pension fund were measured. Figure 9.4 presents the results of farmers' perceptions about funding for UIF and pension fund for university agricultural extension.

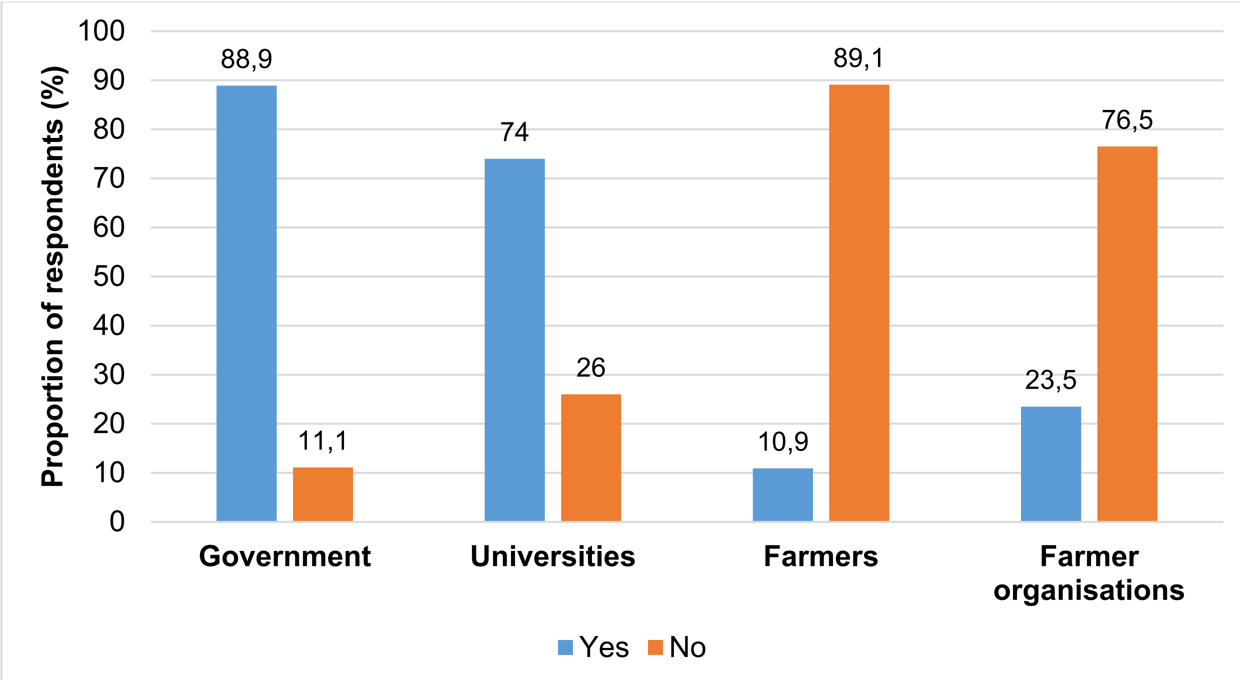

Figure 9.4: Farmers' perceptions about funding for UIF and pension fund for university agricultural extension (442)

Figure 9.4 illustrates that most (88.9%) of the respondents were in favour of the government as main source of fund for UIF and pension fund for university extension personnel, whereas about a quarter (74%) indicated that universities should also contribute. Very few farmers were willing to contribute to UIF and pension fund for university extension personnel. The findings of Cochran's Q Test were statistically significant ($p<0.001$) with a Q value of 669.820 and degrees of freedom of three ($df=3$). The results implied that there was a significant difference ($p<0.01$) between farmers' perceptions about who should pay for UIF and pension fund for university extension personnel among the government, University, farmers and farmers' organisations. It was therefore important to perform Post hoc Test using McNemar Test to determine where differences existed between the paired variables, Table 9.5 present the results of McNemar Test of the pairwise of UIF and pension funders for university agricultural extension.

Table 9.5: McNemar Test results of the pairwise of UIF and pension funders for university agricultural extension (n=442)

Pairwise	Chi-square	P-value
Government & universities	221.760	<0.001
Government & farmers	317.255	<0.001
Government & farmers' organisations	255.212	<0.001
Universities & farmers	45.853	<0.001
Universities & farmers' organisations	1.587	<0.001
Farmers & farmers' organisations	35.174	0.208

The results in Table 9.5 and Figure 9.4 depict that a significant ($p<0.001$) proportion of the respondents (88.9%) perceived the government as an organisation that should pay for UIF and pension fund for university extension personnel who render agricultural extension services instead of the university (74%), farmers' organisations (23.5%) and farmers (10.9%). Again, there was statistically significant difference between the university and farmers, and the university and farmers' organisations. It implied that a significant majority believed that universities should contribute to UIF and pension fund for university extension personnel instead of farmers or farmers organisations.

9.4.1.5 *Information and communication technology*

Information and Communication Technology (ICT) plays a significant role in the provision of extension and advisory services because most of the information is available online. Moreover, communication with farmers, research and other stakeholders can be done using various technologies. It was therefore important to determine farmers' perceptions about the contribution of various stakeholders in the funding of university agricultural extension services. Figure 9.5 presents the results of the respondents' perceptions about ICT funding for university agricultural extension.

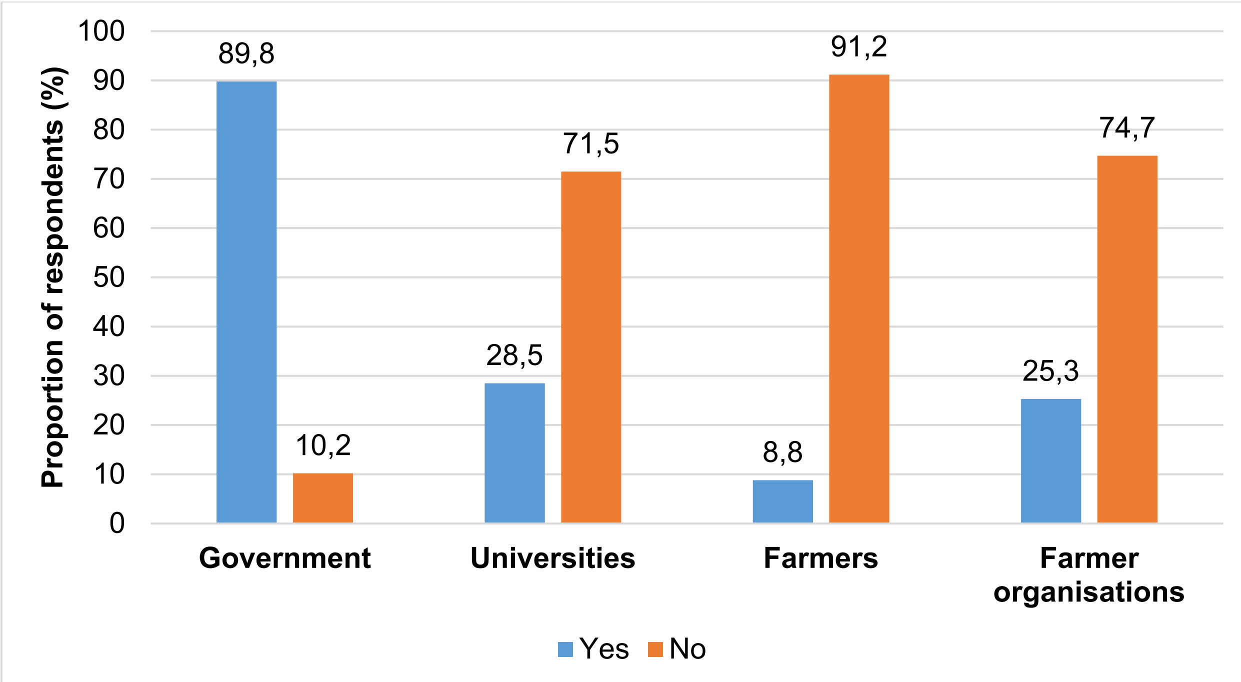

Figure 9.5: Respondents' perceptions about ICT funding for university agricultural extension (n=442)

The findings presented in Table 9.6 show that the largest proportion (89.8%) of the respondents were in favour of the government as the main contributor of ICT that is required by university personnel who are responsible for the provision of extension services. In addition, the perceived second, third and fourth contributors of ICT were universities, farmers' organisations and farmers. A significant ($p<0.001$) Q value of 673.575 with degrees of freedom of three (df=3) was achieved from the results of Cochran's Q Test that measured the difference among the four possible funders (government, university, farmers and farmers' organisations) of ICT for university extension personnel. It was therefore important to perform McNemar Test as part of Post Hoc analysis because the four variables (government, university, farmers and farmers' organisations) were statistically significant. McNemar Test results of the pairwise of ICT funders for university agricultural extension are presented in Table 9.6.

Table 9.6: McNemar Test results of the pairwise of ICT funders for university agricultural extension (n=442)

Pairwise	Chi-square	P-value
Government & universities	211.304	<0.001
Government & farmers	337.167	<0.001
Government & farmers' organisations	251.265	<0.001
Universities & farmers	71.806	<0.001
Universities & farmers' organisations	2.414	0.120
Farmers & farmers' organisations	51.327	<0.001

The statistical outputs presented Table 9.6 and Figure 9.5 indicate that a significant ($p<0.001$) majority of the respondents (89.8%) held the notion that ICT funding for university agricultural extension services should be provided by the government instead of universities, farmers or farmers' organisations. There was statistically significant difference ($p<0.001$) between university and farmers, and farmers and farmers organisations. Thus, a significant proportion (28.5%) of the respondents was in favour of universities as the main funder for ICT instead of farmers (8.8%). Again, a significant proportion (25.3%) of the respondents perceived farmers organisation as the suitable funder for ICT instead of farmers (8.8%).

9.4.1.6 *Office space*

Academic personnel who render university agricultural extension services are currently located in the office space provided by their respective employers (universities). It is important to decide whether the government, universities, farmers' organisations should fund office space that is required by university personnel who render agricultural extension services. For example, if university extension personnel are fully based in the universities and render extension services from there; it means universities should fund their office space. The same should apply to the government regarding funding for office space in case university extension personnel are provided with office space in government offices. On the other hand, if extension delivery system that was agreed upon required university extension personnel to rent office space for a specific period to improve farmers' access to extension services, the contribution of each stakeholder in the funding of office space should be explored. Hence, farmers' perceptions about the funding model suitable for office space that is required in the provision of university agricultural extension services were investigated. Figure 9.6 presents the results of respondents' perceptions about office space funding for university agricultural extension personnel.

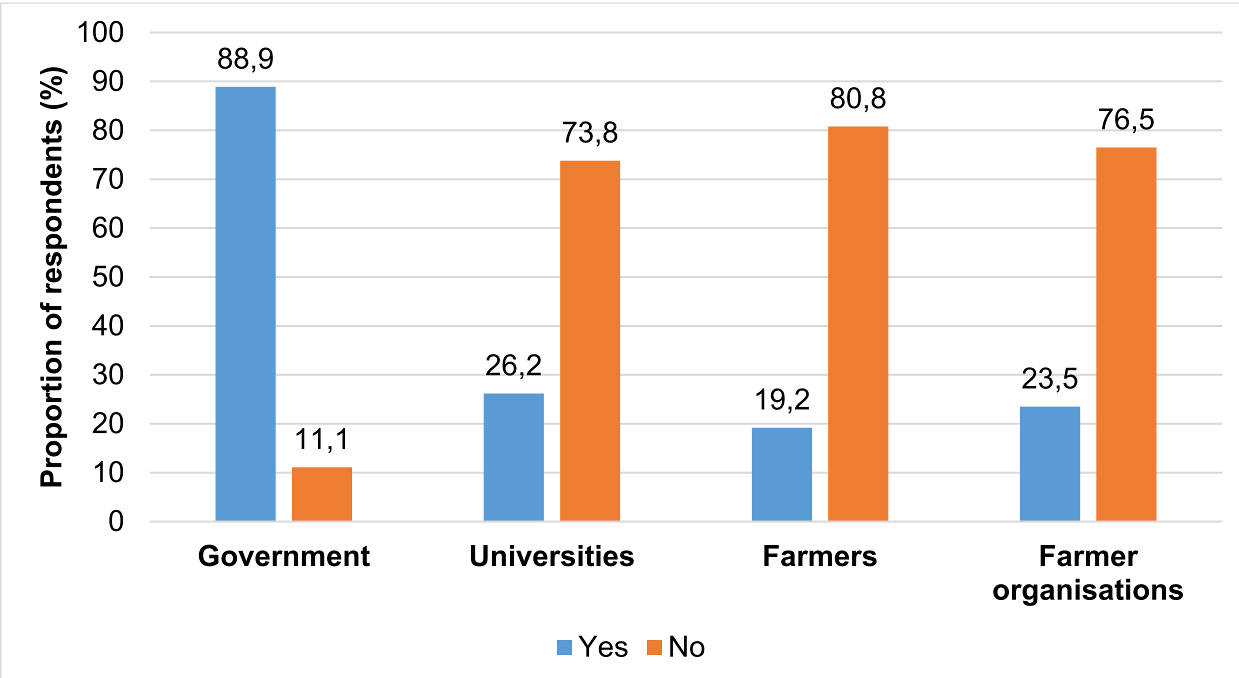

Figure 9.6: Respondents' perceptions about office space funding for university agricultural extension (n=442)

Figure 9.6 shows that the majority (88.9%) of the respondents perceived government as an organisation that should be the main funder for office space for university agricultural extension. More than one-fifth of the respondents were of the view that universities and farmers' organisations should also contribute funds for office space that is required by university extension personnel who are responsible for the provision of agricultural extension services. However, very few (19%) farmers were willing to fund office space for university agricultural extension. The results of Cochran's Q Test (Q=615.792) were statistically significant ($p<0.001$) with degrees of freedom of three (df=3). Because the results of Cochran's Q Test were statistically significant, McNemar Test was performed to identify where the difference existed. Table 9.7 presents McNemar Test results of the pairwise of office space funders for university agricultural extension.

Table 9.7: McNemar Test results of the pairwise of office space funders for university agricultural extension (n=442)

Pairwise	Chi-square	P-value
Government & universities	231.538	<0.001
Government & farmers	257.511	<0.001
Government & farmers' organisations	263.314	<0.001
Universities & farmers	9.677	0.002
Universities & farmers' organisations	1.833	0.176
Farmers & farmers' organisations	4.000	0.046

The results in Table 9.7 and Figure 9.6 illustrate that there was statistically significant difference (p<0.001) between the proportions of the respondents who indicated that the government should fund office space for university agricultural extension instead of universities, farmers and farmers' organisations. It implied that, a significant majority of respondents were in favour of the government as the main funder for office space instead of all the other three stakeholders (universities, farmers and farmers' organisations). In comparison with farmers, a significant (p=0.002) proportion (26.2%) of the respondents indicated that universities should fund office space for university agricultural extension. Again, the results in Table 9.7 show a statistically significant difference (p=0.046) between farmers and farmers' organisations. It meant that, a significant proportion (23.5%) of the farmers were in favour of farmers' organisations as the funder for office space instead of farmers (19.2%).

9.4.1.7 *Office equipment and furniture*

As indicated in section 9.4.3.6, funding for office space where university extension personnel would be housed is important to ensure sustainable and efficient provision of agricultural extension services. Likewise, office equipment and furniture would be required whenever there are offices. So, the primacy of farmers' perceptions about a funding model for office equipment and furniture could not be overlooked because the current study employed a bottom-up approach. The results of respondents' perceptions about funding for office equipment and furniture for university agricultural extension are presented in Figure 9.7.

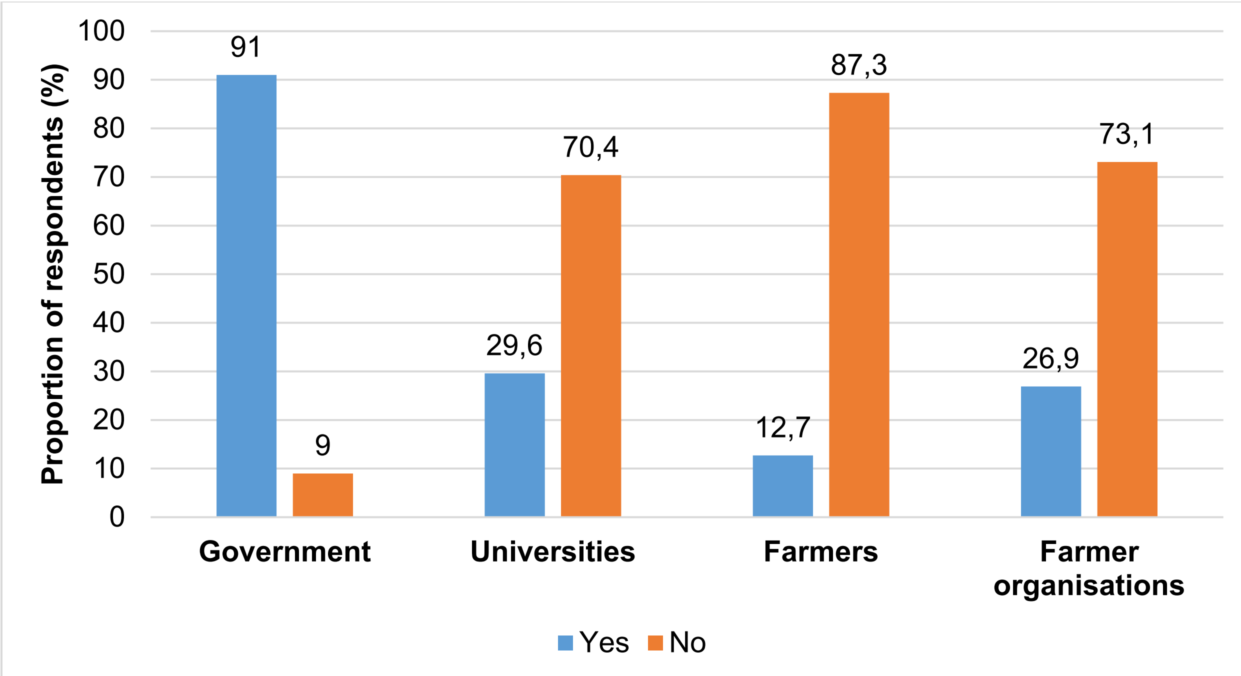

Figure 9.7: Respondents' perceptions about funding for office equipment and furniture for university agricultural extension (n=442)

The descriptive statistical outputs presented in Figure 9.7 indicate that the largest proportion (91%) of the respondents were of the view that the government should provide funding for office equipment and furniture for university agricultural extension. On the other hand, less than one-third of the respondents indicated that universities and farmers organisations should also provide funding for office equipment and furniture. However, very few (12.7%) farmers showed their willingness to contribute to the funding of office equipment and furniture for university agricultural extension. Likewise, Cochran's Q Test was employed to determine the difference that existed among the four variables under investigation (government, universities, farmers and farmers' organisations). The outputs of Cochran's Q Test gave a statistically significant difference ($p<0.001$) Q-value of 678.077 with three as the degrees of freedom (df). It implied that the number of respondents who held the view that the government, universities, farmers and farmers organisations should pay for office equipment and furniture was significantly different ($p<0.01$). Because of the significant difference mentioned above, a Post Hoc Test, precisely McNemar Test was performed. The results of McNemar Test of the pairwise of office equipment and furniture funders for university agricultural extension are presented in Table 9.8.

Table 9.8: McNemar Test results of the pairwise of office equipment and furniture funders for university agricultural extension (n=442)

Pairwise	Chi-square	P-value
Government & universities	221.581	<0.001
Government & farmers	323.438	<0.001
Government & farmers' organisations	259.036	<0.001
Universities & farmers	57.642	<0.001
Universities & farmers' organisations	2.017	0.156
Farmers & farmers' organisations	41.333	<0.001

Table 9.8 and Figure 9.7 illustrate a highly significant difference ($p<0.001$) between the respondents who favoured the government (91%) instead of universities (29.6%), farmers' organisations (26.9%) or farmers (12.7%) as funders for office equipment and furniture for university agricultural extension. Thus, a significant majority of respondents held the opinion that the government should be the main funder of office equipment and furniture. Regarding, universities and farmers, a significant ($p<0.001$) proportion (26.9%) of respondents were in favour of universities as the funder for office equipment and furniture. Again, Table 9.8 shows a statistically significant difference ($p<0.001$) between farmers (12.7%) and farmers' organisations (26.9%). The results showed that a significant proportion of the respondents held the opinion that farmers organisations should fund office equipment and furniture instead of farmers.

9.4.1.8 *Stationery*

Stationery include office supplies such pens, papers, pencils, files, hole punch, books, envelopes and others. Stationery is important because it enables extension personnel to gather, prepare and share information with the farmers. The results of the respondents' perceptions about stationery funding for university agricultural extension are presented in Figure 9.8.

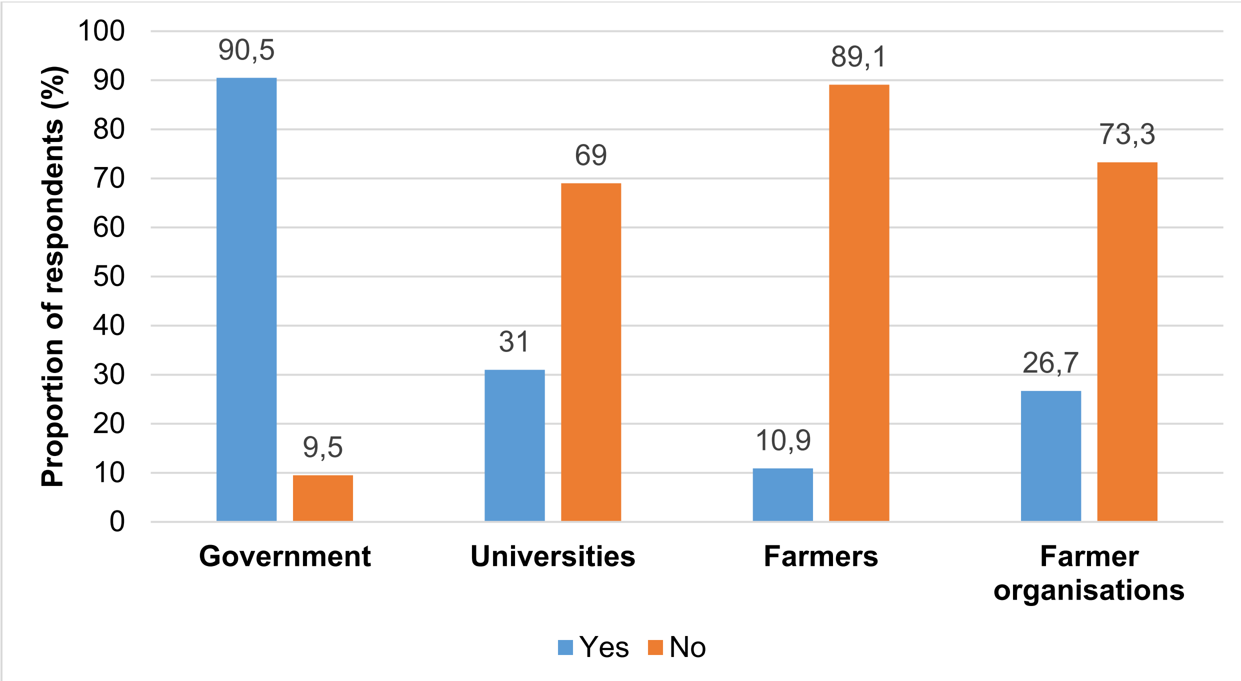

Figure 9.8: Respondent's perceptions about funding stationery for university agricultural extension (n=442)

Figure 9.8 shows that the majority (90.5%) of the respondents perceived the government as an organisation that should fund stationery for university agricultural extension, followed by universities (31%) and farmers' organisations (26.7%). Less than one-fifth of the respondents were in favour of farmers. Because the respondents were farmers, the results implied that majority of the farmers were not willing to contribute funds that are required for stationery. The statistical outputs of Cochran's Q Test were as follows: Q-value=661.0.5, p<0.001 and degrees of freedom of three (df=3). It implied that farmers' perceptions about the stakeholders (government, universities, farmers and farmers organisations) contributions to the funding for stationery were statistically significant (p<0.01). To determine where the statistical difference existed, McNemar Test results of the pairwise of stationary funders for university agricultural extension are presented in Table 9.9.

Table 9.9: McNemar Test results of the pairwise of stationery funders for university agricultural extension (n=422)

Pairwise	Chi-square	P-value
Government & universities	204.907	<0.001
Government & farmers	325.929	<0.001
Government & farmers' organisations	256.367	<0.001
Universities & farmers	75.184	<0.001
Universities & farmers' organisations	4.696	0.030
Farmers & farmers' organisations	45.779	<0.001

The results in Table 9.9 indicate that there was statistically significant difference ($p<0.001$) between all the pairings. The pairing between government and other variables implied that a significant majority (90.5%) of respondents held the view that the government should fund stationery for university agricultural extension instead of universities (31%), farmers' organisations (26.7%) or farmers (10.9%). A significant ($p<0.05$) proportion of the farmers were in favour of universities funding stationery instead of farmers and farmers' organisations. Additionally, the pairing of farmers and farmers' organisations was statistically significant ($p<0.001$). It meant that a significant proportion of the respondents held the notion that farmers' organisations should fund stationery for university agricultural extension rather than farmers.

9.4.1.9 *Farmers training programmes*

Agricultural extension is a source of information for many farmers. In extension, information is shared with farmers using different channels such ICT, extension visits, training workshops, and field days, among others. Regarding farmers training, it is anticipated that universities which render agricultural extension services would organize farmers training workshops and/or short learning programmes (short courses) as part of information sharing. This is because university subject experts are familiar with sharing information through teaching (online and face-to-face), training workshops, and conference presentations among others. Therefore, universities that are involved in the provision of agricultural extension services would require funding for farmers training programmes. Figure 9.9 presents the results of the respondents' perceptions about funding for farmers training programmes for university agricultural extension.

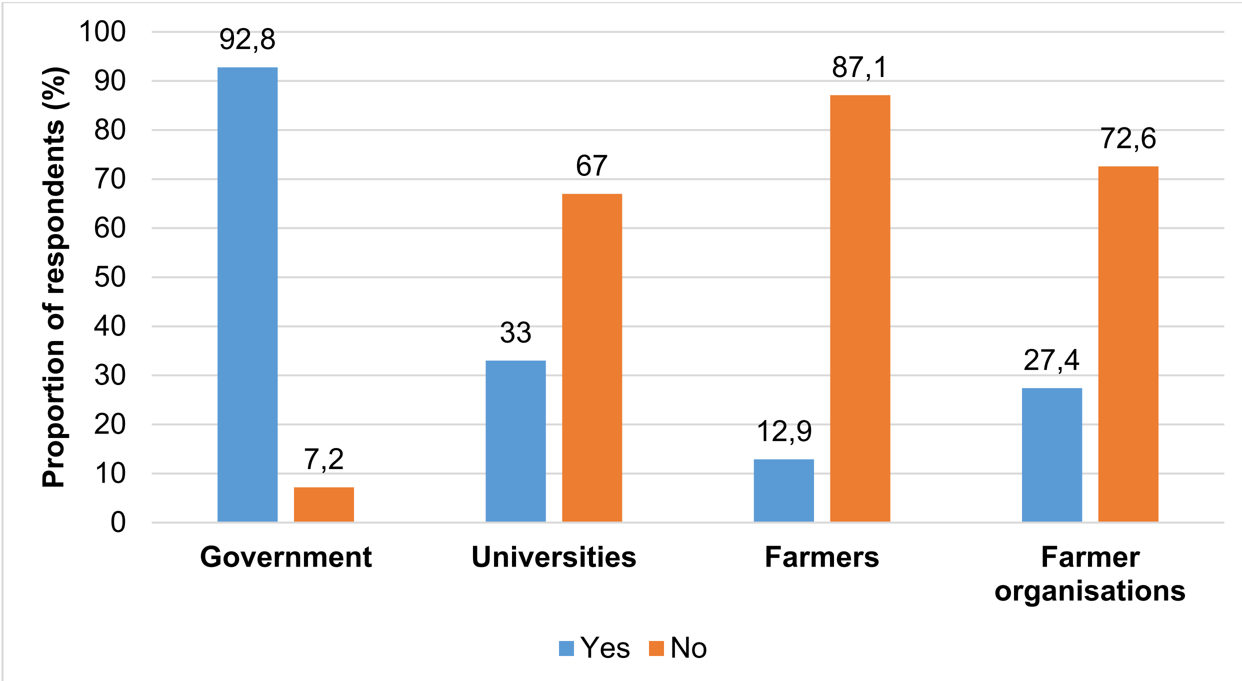

Figure 9.9: Respondents' perceptions about funding for farmers training programmes for university agricultural extension (n=442)

The findings in Figure 9.9 indicate that 92.8% of the respondents were of the view that the government should be the main funder for farmers training programmes associated with university agricultural extension, followed by universities (33%), farmers' organisations (27.4%) and farmers (12.9%). It implied that most farmers perceived the contribution by the government to farmers training programmes as a major necessity in university agricultural extension. Moreover, the results of Cochran's Q Test (Q=692.690, df=3) showed a statistically significant difference ($p<0.001$) between the four variables investigated (government, universities, farmers and farmers' organisations). It implied that farmers' perceptions about who should fund farmers training programmes differed significantly. The results of McNemar Test that measured the differences are presented in Table 9.10.

Table 9.10: McNemar Test results of the pairwise of farmers training programmes funders for university agricultural extension (n=442)

Pairwise	Chi-square	P-value
Government & universities	214.811	<0.001
Government & farmers	328.658	<0.001
Government & farmers' organisations	268.427	<0.001
Universities & farmers	78.222	<0.001
Universities & farmers' organisations	9.443	0.002
Farmers & farmers' organisations	44.100	<0.001

The results in Table 9.10 depict a statistically significant difference (p<0.01) in all the six pairings for funders of farmers training programmes. The majority (92.8%) of the respondents held the view that most funding for farmers training programmes should come from the government instead of universities (33%), farmers' organisations (27.4%) and farmers (12.9%). This is also supported by the results in Figure 9.9 above. A significant proportion (p<0.01) of the respondents were in favour of universities providing most of the funding for farmers training programmes instead of farmers' organisations or farmers. Additionally, a significant number of respondents believed farmers should contribute less funding towards training than farmers organisations.

9.4.1.10 *Research*

In South Africa, institutions of higher learning (Universities) are involved in conducting research. The involvement of universities in the provision of agricultural extension services creates conducive environment for universities to conduct research that is responsive to farmer's needs. Therefore, it is important to investigate farmers' perceptions about a research funding model that is suitable for university agricultural extension. Figure 9.10 presents the results of the respondents' perceptions about research funding for university agricultural extension.

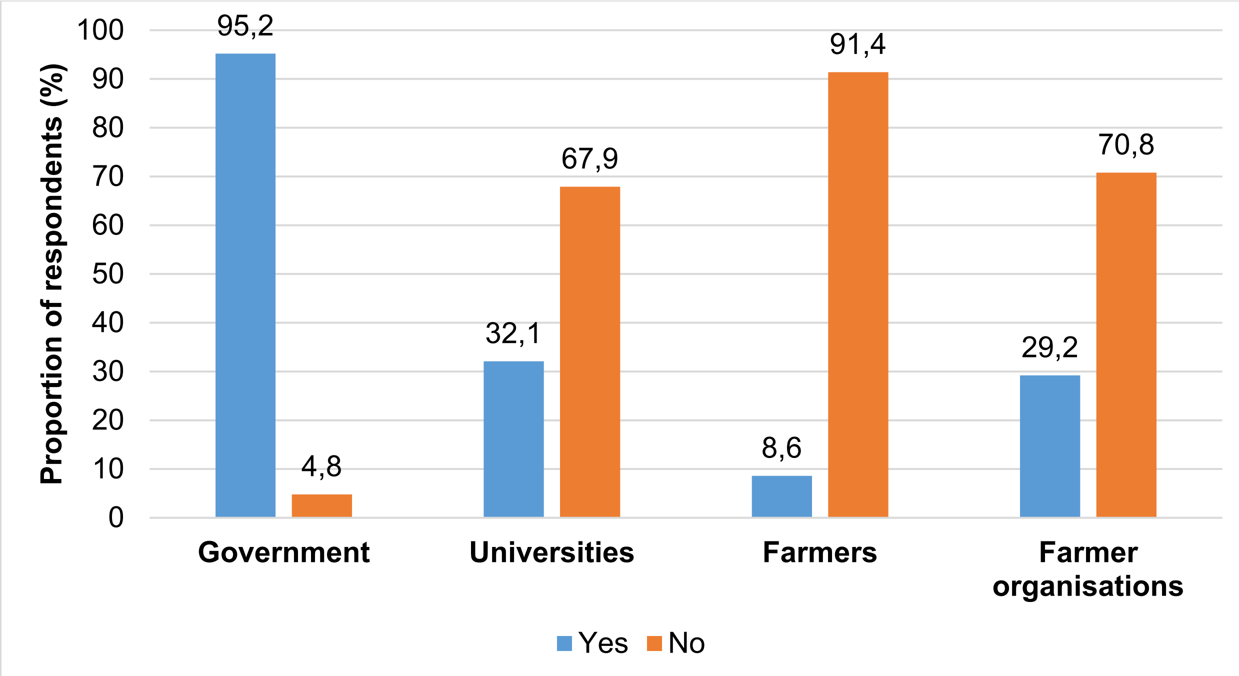

Figure 9.10: Respondents' perceptions about research funding for university agricultural extension (n=442)

Figure 9.10 shows that the largest majority (95.2%) of the respondents held the notion that most research funding for university agricultural extension should come from the government. According to farmers' perceptions, universities, farmers' organisations and farmers should also be contributors of research funds. Thus, most farmers perceived government's contribution to research funding as fundamental for the success of university agricultural extension. Likewise other variables presented in the previous sections, Cochran' Q Test results (Q=761.713) were statistically significant ($p<0.001$) with degrees of freedom of three (df=3). To determine whether there was statistically significant difference between the variables, McNemar Test was performed as part of Post Hoc Test analysis. The results of McNemar Test of the pairwise of research funders for university agricultural extension are presented in Table 9.11.

Table 9.11: McNemar Test results of the pairwise of research funders for university agricultural extension (n=442)

Pairwise	Chi-square	P-value
Government & universities	243.798	<0.001
Government & farmers	367.567	<0.001
Government & farmers' Organisations	278.556	<0.001
Universities & farmers	93.061	<0.001
Universities & farmers' organisations	2.717	0.099
Farmers & farmers' organisations	72.973	<0.001

The statistical outputs in Table 9.11 indicate a statistically significant difference ($p<0.01$) between five pairings out of six. Starting with the first three pairs, it implied that a significant majority (95.2%) of the respondents perceived the government as the main funder for university agricultural extension research instead of universities (32.1%), farmers' organisations (29.2%) or farmers (8.6%). The number of respondents who indicated that universities should also fund research was significantly higher than those who were in favour of farmers contributing to research fund. In addition, a significant proportion of the respondents were of the view that farmers organisations should contribute more to research funding than farmers.

9.4.1.11 *Overall funding and discussion*

The results of overall funding for university agricultural extension include all the averages of all the findings presented in sections 9.4.1.1 to 9.4.1.10. Table 9.12 shows the results of respondents' perceptions about the overall funding for university agricultural extension.

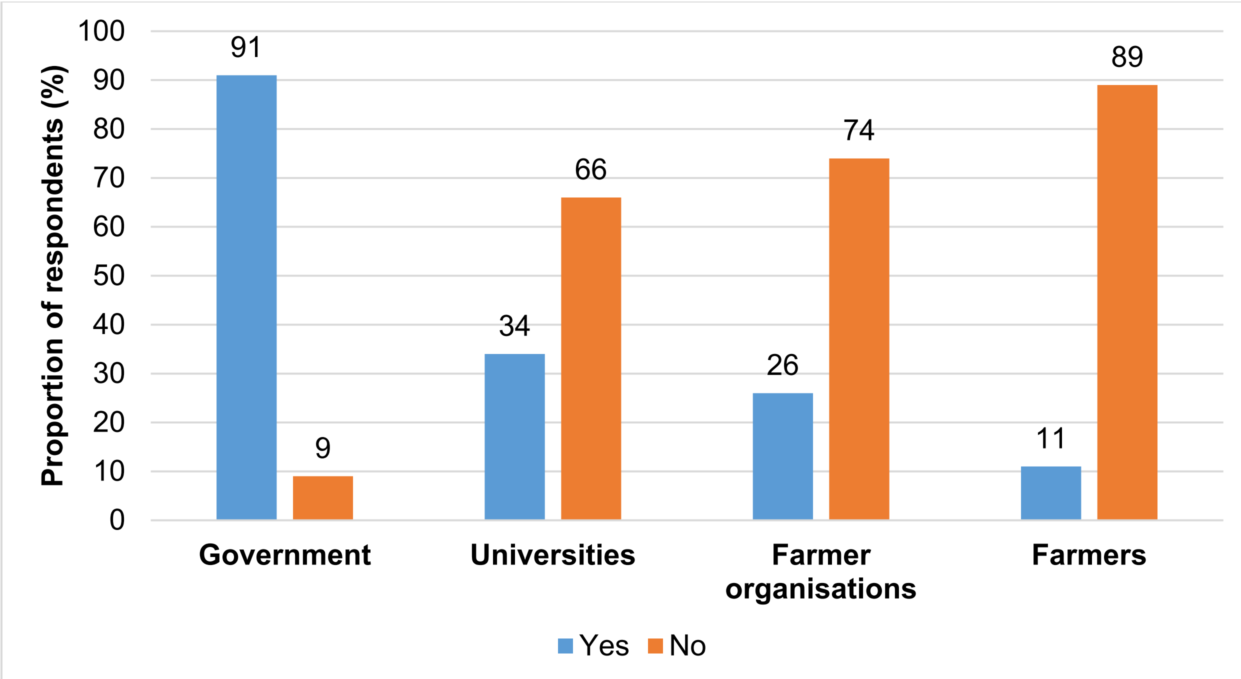

Figure 9.11: Respondent's perceptions about the overall funding for university agricultural extension (n=442)

The results presented in Figure 9.11 show that generally, the majority (91%) of the respondents were of the view that the government should be the main contributor of funds for university agricultural extension followed by universities (34%) and farmers organisations (26%). Very few (11%) respondents agreed that farmers should provide funding for university agricultural extension. The overall results implied that most farmers held the notion that the government should continue to fund extension services even if universities offers extension services through a pluralistic extension system. The results of Cochran's Q Test that measured whether there was a significant difference among the four variables investigated (government, universities, farmers and farmers organisations). A statistically significant ($p<0.001$) Cochran's Q-value of 715.091 with degrees of freedom of three (df=3) was achieved. Thus, it was necessary to perform McNemar Test to establish where the differences between the variables existed. The results of McNemar Test of the pairwise of funders for university agricultural extension are presented in Table 9.12.

Table 9.12: McNemar Test results of the pairwise of funders for university agricultural extension (n=442)

Pairwise	Chi-square	P-value
Government & universities	222.174	<0.001
Government & farmers	344.145	<0.001
Government & farmers' organisations	261.329	<0.001
Universities & farmers	81.186	<0.001
Universities & farmers' organisations	3.521	0.061
Farmers & farmers' organisations	60.500	<0.001

The results in Table 9.12 show a statistically significant difference ($p<0.01$) between five pairing out of six. The results of the first there pairings implied that a significant majority (91%) of the respondents held the view that the government should be the main funder for university agricultural extension instead of universities (34%), farmers' organisations (26%) and farmers (11%). In comparison, a significant proportion of the respondents were of the view that universities should also contribute more to the funding of university agricultural extension than farmers. Additionally, a significant number of farmers perceived farmers' organisations (26%) to be in a good position to provide funding for university agricultural extension. In general, the results implied that the government is perceived as the main source of funding for university agricultural extension.

9.4.1.12 *Discussions for funding of university agricultural extension*

Overall, the study found that majority of the respondents held the opinion that the government should be the main funder for extension services in all the variables measured in the study (transport, gross income, medical aid, UIF and pension fund, office space, office equipment and furniture, Information and Communication Technology (ICT), stationery, farmers training and research). The findings are aligned to the normal practices in other countries where governments provide most funding for university agricultural extension services (Brown *et al*., 2006; Singh *et al.*, 2013; Babu *et al*., 2015; Feldhues & Tanner, 2017; Perry, 2022). It may be difficult for the government to provide funding for gross income, medical aid, and UIF and pension because these items form part of the employment benefits for academics employed at the Universities. The government can contribute to the university staff allowance provided by some universities when academic personnel attend community engagement and outreach programmes that are located above a certain distance from their offices. For example, in some universities, academic personnel receive an allowance for attending community engagement programmes that are located >80 km from the university. Again, funding for office space, office equipment and furniture, ICT and stationery may be a challenge for the government because university extension personnel are in the universities and not in government departments. Thus, universities should provide these basic resources to their academic personnel. However, if university extension personnel would require additional office space apart from their offices that are in the universities, it would be necessary for the government to provide funding for office space, office equipment and furniture, Information and Communication Technology (ICT) and stationery. The provision of additional office space may not be necessary because Gauteng is a very small province; thus, university extension personnel could easily visit farmers from their offices. Again, university extension personnel are mostly located in the universities that provide extension services (National Academy Press, 1996; Franz & Townsend, 2008). Therefore, it would be feasible for universities to continue funding basic resources provided to academic personnel to render community engagement and outreach services as part of their key performance areas. New arrangements could be made if the budget for basic resources increases rapidly due to extension services that might be rendered to the farmers by universities.

Regarding transport, the study found that the respondents agreed that the four important stakeholders (government, universities, farmers' organisations and farmers) should provide funding for transport for university agricultural extension. The largest majority (93%) of the respondents held the view that most funding for transport should come from the government followed by universities (28.3%), farmers organisations (26.9%) and farmers (12.2%). The findings of the respondents' perceptions were similar to what is commonly practiced in USA whereby both the government and universities provide funding for operational costs such as transport that is required to render extension services to the farmers (Franz & Townsend, 2008; Feldhues & Tanner, 2017; Perry, 2022). In the arrangements, the government through the funds allocated to State

Agricultural or Land Grant Universities (LGU), provides funding for transport. Funding for transport is an integral part of extension services because most farming locations are in remote or rural areas; and farming locations are far away from universities. This is also evidence to show that public extension agents (agricultural advisors) in South Africa receive subsidy for vehicles to ensure that they are well equipped to render services to the farmers (Lukhalo, 2017). In addition, the purpose of subsidized vehicles is to improve the mobility and visibility of agricultural advisors; and to enable agricultural advisors to visit farmers. On the other hand, university academic personnel do not receive subsidy to purchase vehicles because the contribution of community engagement and outreach to their key performance areas is low. The main reason could be that transport is not a necessity for academic personnel to execute their key duties. As a result, universities only provide transport for community engagement and outreach programmes. In the current study, transport funding included rental and/or purchase of vehicles (cars) for university extension personnel and transport for farmers to visit universities and other areas where training programmes are offered. Therefore, the interactions between the government, universities, farmers organisations and farmers should consider these reflections when the contribution of each stakeholder to transport funding is explored.

Again, the respondents were of the view that funding for farmers training programmes should come from all extension stakeholders, of which the main funder should be the government. Farmers training programmes form part of operational costs for extension; thus, farmers' perceptions are not far-fetched because the government provides most funding for university agricultural extension in China, India and the USA (Brown *et al*., 2006; Singh *et al.*, 2013; Babu *et al*., 2015; Feldhues & Tanner, 2017; Perry, 2022). On the contrary, farmers and farmers organisations do not contribute to the operational costs of university extension in the aforementioned countries. Therefore, the current findings have shown the necessity of exploring the feasibility of including farmers and farmers organisations in the funding model for farmer's training programmes offered through university extension. The reason is that farmers training is important in South Africa because of land reform programmes that have allocated agricultural land to farmers who have limited farming knowledge and skills, which are required in farming. For example, Lahiff (2007) reported that in South Africa, the failure rate for large commercial agricultural projects allocated to black farmers was high due to lack of experience (farming knowledge and skills).

The findings of research funding for university agricultural extension showed that the respondents were in support of a cost-sharing model that included the government, universities, farmers' organisations and farmers. The Largest majority agreed that the government should be the main funder for research activities, followed by universities, farmers organisations and farmers, in that order. In support to these findings, the government provided most funding for research activities in State Agricultural Universities (SOA) that provide extension services to the farmers in other countries (Brown *et al.*, 2006; Singh *et al.*, 2013; Babu *et al.*, 2015). In addition, universities contribute to research funds through grants, fees and donations because government funding has declined (Feldhues & Tanner, 2017; Perry, 2022). From a South African context, farmers' perceptions were aligned with the national policy on extension and advisory services in South Africa. The policy stipulates that the government would provide funding for extension activities for resource poor farmers and encouraged payment of services by producers and farmers' organisations that could afford (DAFF, 2016). However, there was no commitment from the Department of Agriculture to pay for research activities at universities, even though it encouraged institutions of higher learning (Colleges and Universities) to conduct research for technology development and transfer; and rendered extension services through community engagements and outreach programmes. Thus, the government anticipated universities to contribute to agricultural development without guaranteed research funds from agricultural extension coffers. As a result, universities that render extension services must apply and compete for government grants with other institutions of higher learning. The reason is that research grants provided by the government through National and Provincial Departments of Agriculture are limited to academic institutions whose research proposals are the best. Furthermore, government research funds that are made available from National Department of Science and Innovation through National Research Fund (NRF) are open for various academic institutions and disciplines; thus, funding for agricultural research activities is limited because there is no guaranteed funding from the government. Evidence shows that the government spent 20% of total agricultural research funds on universities compared to 51% it spent on Agricultural Research Council (ARC), 21% on other government agencies involved in research, and 3% on Non-Profit Organisations (Chaminuka *et al*., 2019). The reason is that ARC is assigned the responsibility to conduct most of public agricultural research in South Africa (ARC, 2016); hence, it receives the largest share of agricultural research funds. As a result, ARC receives guaranteed funds for agricultural research from the government, unlike universities. Therefore, it would be reasonable to expect the government to provide research funds to universities participating in a pluralistic extension system through Masters and Doctoral research projects and other agricultural research activities.

9.4.2 Farmers willingness to pay for university agricultural extension services

After determining farmers' perceptions about a funding model that is suitable for university agricultural extension, it was necessary to investigate whether farmers were willing to pay for university agricultural extension services. The results showed that the majority (55.4%) of the respondents were willing to pay for university agricultural extension services, while 44.6% were not. With the assumption that most farmers (>51%) would not be willing to pay for extension and advisory services, a statistically significant p-value of 0.035 was ≤achieved from the results of the Binomial Test. Therefore, a significant proportion of the respondents preferred to pay for university agricultural extension services. Budak *et al.* (2010); Ozor *et al.* (2013); Afful *et al.* (2014); Uddin *et al*. (2016); Loki *et al.* (2019) also found that most farmers were willing to pay for agricultural extension services. In contrast, Foti *et al.* (2007); Ali *et al*. (2008); Oladele (2008) reported that the willingness to pay for extension services was low amongst the farmers. It shows that there is a degree of polarisation about the payment of extension services by farmers. However, the current study has explored a new dimension by focusing on university agricultural extension, whereas most studies focused on government and private extension services. Although majority of the farmers expressed interest in paying for university extension services that is rendered through a pluralistic extension system, it is important to determine whether farmers could afford to pay for such services. The reason is that the average annual net farm income for the respondents was R21 387.56 of whom 67.1% earned ≤ R10 000 per annum. Therefore, most farmers might not afford to pay for extension services, even though they were enthusiastic about the payment for services.

9.4.3 Factors influencing farmers' willingness to pay for university agricultural extension services

To determine factors influencing farmers' willingness to pay for university agricultural extension services, Binary Logistic Regression (BLR) was used to analyse the data. The results of Hosmer and Lemeshow Test that measures model fit generated a statistically insignificant (p=0.160) Chi-square value of 11.800 with degrees of freedom (df) of three (3). An insignificant Chi-square value implied that the model was fit for the data analysed. The values of Pseudo R-Square were 0.050 for Cox and Snell, and 0.067 for Nagelkerke. In Binary Logistic Regression (BLR), the values of Pseudo R-Squares measures have limitations in evaluating the overall model fit unlike in Multiple Regression Models (Hair Jr. *et al*., 2019). Because of the limitation of Pseudo R-Squares explained above, the values of Cox and Snell, and Nagelkerke were accepted without further interpretation. The Binary Logistic Regression results of the factors influencing farmers' willingness to pay for university agricultural extension services are presented in Table 9.13.

Table 9.13: Binary Logistic Regression results of the factors influencing farmer's willingness to pay for university agricultural extension services (n=442)

Variable	B	S.E.	Wald	df	P-value	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Gender	0.180	0.199	0.821	1	0.365	1.197	0.811	1.767
Age	0.128	0.084	2.330	1	0.127	1.136	0.964	1.338
Education level	0.005	0.068	0.005	1	0.944	1.005	0.880	1.147
Farming category	-0.521	0.227	5.272	1	0.022	0.594	0.381	0.927
Farm size	0.027	0.017	2.379	1	0.123	1.027	0.993	1.063
Farming experience	-0.029	0.022	1.821	1	0.177	0.971	0.931	1.013
Main source of income	0.556	0.217	6.589	1	0.010	1.744	1.141	2.667
Annual net farm income	0.001	0.000	0.194	1	0.660	1.000	1.000	1.000
Number of monthly visits by extension officer	0.058	0.061	0.912	1	0.340	1.060	0.940	1.195
Distance from farmland to extension office	-0.010	0.005	3.872	1	0.049	0.990	0.980	1.000
Constant	-0.084	0.502	0.028	1	0.866	0.919		

The results in Table 9.13 show that seven (7) out of ten (10) independent variables fitted in the BLR model had a positive correlation (gender, age, education level, farm size, main source of income, annual net farm income and number of monthly visits by extension officer) with the dependent variables. However, only one positive variable (main source of income) had a statistically significant correlation with dependent variable at 5% level of significance ($p<0.05$). On the other hand, three independent variables (farming category, farming experience, and the distance between the farmland and the extension office) had a negative correlation with dependent variables. Nonetheless, two negative variables (farming category and distance between the farmland and the extension office) were statistically significant at 5% level of significance. The results in Table 9.13 show a positive ($\beta=0.556$) and significant correlation ($p=0.010$) between farmers' willingness to pay for university agricultural extension services and the main source of income. It meant that farmers who had farming as their main source of income were more willing to pay for university agricultural extension services, with all things being equal. This may be because farmers who relied on farming as their main source of income generated sufficient income that would enable them to pay for extension services. The findings were comparable to the findings by Ozor *et al*. (2013); Uddin *et al*. (2016). They revealed that farm income has a positive and significant relationship with farmers' willingness to pay for extension services in Tanzania and Bangladesh. However, Loki *et al*. (2019), found that agricultural income had a negative and significant correlation with farmers' willingness to pay for extension services in KwaZulu Natal province of South Africa.

Farming category had a negative ($\beta=-0.521$) and significant influence ($p=0.022$) on farmers' willingness to pay for university agricultural extension services, with all other factors held constant. It implied that commercial farmers were not willing to pay for university extension services. The findings from Ozor *et al*. (2013); Shausi *et al*. (2019) differed from the current findings; because in their studies, highly commercialized farmers were willing to pay for extension services. The postulation was that commercial farmers in the current study generated insufficient income from farming. Alternatively, commercial farmers were satisfied with public extension services; thus, paying for university agricultural extension services in a pluralistic extension system was not a viable option for them.

The distance from farmland to extension offices was positively (β=-0.010) and significantly correlated (p=0.049) with the respondents' willingness to pay for university agricultural extension services, with all factors held constant. Therefore, farmers who were located far from extension offices were not willing to pay for university agricultural extension services. In contrast to the study findings, Budak *et al*. (2010) found that the distance from extension services had a positive and significant correlation with farmers' willingness to pay for extension services. Thus, farmers located far from extension services were more willing to pay for extension services. The variation could be influenced by the fact that in the current study, farmers located far from government extension offices were not satisfied with the quality of public extension services; thus, they were reluctant to pay for university agricultural extension services before they were satisfied with the services.

9.5 CHAPTER SUMMARY AND CONCLUSIONS

This chapter presented the results of farmers' perceptions about a funding model that is suitable for a pluralistic extension system involving universities; and their willingness to pay for university agricultural extension services. To achieve the research objectives for this chapter, primary data were analysed using five statistical analytical methods namely, descriptive statistics (frequencies, percentages and mean), Binomial Test, Binary Logistic Regression (BLR), Cochran Test and McNemar Test. The results of descriptive statistics showed that the respondents were of the view that the government, universities, farmers' organisations and farmers should provide funding for university agricultural extension. The majority (91%) of the respondents agreed that the government should provide most of the funding for university agricultural extension. Thus, there was a consensus that most funding for transport, gross income, medical aid, UIF and pension fund, office space, office equipment and furniture, Information and Communication Technology (ICT), stationery, farmers training programmes and research; should be provided by the government. Secondly, universities should provide most of the funding for extension services, followed by farmers organisations. Nonetheless, the respondents perceived farmers as the stakeholders who should provide less funding for university agricultural extension services. The findings of McNemar Test showed that a significant majority of the respondents ($p<0.01$) held the opinion that the government should fund most activities for university agricultural extension instead of universities, farmers' organisations or farmers. In addition, a significant majority ($p<0.01$) of respondents favoured universities as the funder for extension services instead of farmers. Lastly, a significant majority ($p<0.01$) of the respondents perceived farmers' organisation as the relevant stakeholder that should fund university extension instead of farmers. It was concluded that the government was perceived as an organisation that should provide most of the funding for a pluralistic extension system that involves universities.

Furthermore, the study findings revealed that more than half (>50%) of the respondents showed their willingness to pay for university agricultural extension services as part of a pluralistic extension system. The results of Binomial test showed a significant majority ($p=0.035$) were willing to pay for extension services. Therefore, the null hypothesis was rejected because a significant proportion (55.4%) of the respondents was in favour of paying for extension and advisory services rendered by universities. The results of BLR showed that only one positive variable (main source of income) was a significant predictor of farmers willingness to pay for extension services. Thus, farmers whose main source of income was farming were more willing to pay for university agricultural extension services. On the other hand, commercial farming and distance from farmland to extension offices were negative and significant factors that influenced farmers willingness to pay for university extension services. In conclusion, commercial farmers and farmers who were located far from extension offices were less willing to pay for extension services offered by universities as part of a pluralistic extension system.

CHAPTER 10: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

10.1 INTRODUCTION

The aim of the study was to explore farmer's willingness to accept university agricultural extension as a complement to public (government) extension in order to develop a demand-driven pluralistic extension system. The study was conducted in Gauteng province of South Africa involving farmers receiving public extension and advisory services. The following research objectives were premised about farmers in Gauteng province:

i. To profile the socio-demographic characteristics of farmers receiving public agricultural extension and advisory services
ii. To determine farmers' perception of public agricultural extension and advisory services with specific reference to
    a. perceived quality of extension services and influencing factors; and
    b. frequency of access to public extension services and its determinants.
iii. To ascertain farmers' access to sources of extension services.
iv. To determine farmers' perceptions of effectiveness of public agricultural extension and advisory services with specific reference to:
    a. the perceived effectiveness and influencing factors; and
    b. explanatory factors associated with the perceived effectiveness.
v. To ascertain farmers' acceptability of university agricultural extension in a pluralistic extension and advisory services with specific reference to:
    a. willingness to accept and the perceived benefits of university agricultural extension; and
    b. factors influencing the acceptability of university agricultural extension.
vi. To determine university agricultural extension delivery system (s) preferred by farmers and factors influencing their choice.
vii. To identify the reasons why farmers preferred different university extension delivery systems.

viii. To ascertain farmers' perceptions about funding model suitable for university agricultural extension services.

ix. To determine farmers' willingness to pay for university agricultural extension services and factors influencing their choice.

To achieve the study objectives, a survey was conducted involving a randomly selected sample of 442 participants. Moreover, literature about agricultural extension, sources of extension, access to extension services, quality and effectiveness of public extension services, pluralistic extension system and funding for extension was explored extensively. Literature reviewed showed that farmers have inadequate access to extension services, the quality and effectiveness of public extension services were not satisfactory, and pluralistic extension systems involving various sources was required. Various descriptive and inferential statistical methods were performed to analyse quantitative data. On the other hand, thematic analysis was employed to analyse qualitative data. The purpose of this chapter is to present summary of the findings, conclusions, recommendations and summary of the contributions.

10.2 SUMMARY OF THE FINDINGS

The summary of the findings in this section is divided according to the chapters that presented the study findings and objectives. Sections 10.2.1 to 10.2.6 present the summary of the study findings.

10.2.1 Socio-economic and demographic characteristics

The study found that majority of the respondents receiving public extension and advisory services in Gauteng province were Black African females, above 35 years old, and farming on small-scale for non-commercial purpose (average farmland of 4.55 ha. Most of the respondents were married, had basic education and higher education (primary to doctoral degree), have been farming for about six years, and had an average annual farm income of R21 387.56. The summary of the null hypothesis is as follows:

Null hypothesis i

The study found that there was no statistical difference ($p>0.05$) between female (51.8%) and male (48.2%) farmers who received public extension and advisory services in Gauteng province, even though females were majority. Therefore, we fail to reject the null hypothesis. The null decision about the null hypothesis is supported by the statistical outputs of Binomial test ($p=0.476$).

Null hypothesis ii

The study findings showed that education level and farm/plot size had positive and significant influence ($p<0.01$) on farmer’s annual net farm income. Thus, the null hypothesis about education level and farm/plot size is rejected. The influence of age, gender and farming experience on farmer’s annual net farm income was negative, but not statistically significant. However, the number of visits by extension officer negatively and significantly influenced farmer’s annual net farm income. Therefore, the study fails to reject the null hypothesis that age, gender, farming experience, number of visits by extension officers and distance from extension office do not positively and significantly influence farmer’s annual net farm income.

10.2.2 Access to extension and quality of public extension services

It was found that on average, the farmland of the respondents was located 42.4 km away from public extension offices, of which majority were ≤50 km away. Regarding access to extension services, the respondents were visited about twice per month by public extension officers, and most of them were satisfied with the quality of public extension and advisory services. Again, pluralistic extension services were available in the study area because nearly half of the respondents had access to extension services from various sources (commodity organisations, mines, local municipalities, NGOs, and universities) apart from government. The summary of the null hypothesis is as follows:

Null hypothesis iii

The study fail to reject the null hypothesis which stipulated that <51% of the farmers in the study areas had access to other sources of extension and advisory services. The null decision about the null hypothesis is supported by the statistical outputs of descriptive statistics (49% of the respondents had access) and Binomial test (p=0.476). The proportions of the respondents with and without access to other sources of extension was not statistically significant (p>0.05), even though majority had no access to other sources of extension services.

Null hypothesis iv

The respondent's main source of income and perceived quality of public extension and advisory services had positive and significant influence on the number of monthly visits by public extension officers (p<0.01); therefore, the null hypothesis is rejected. However, the study fail to reject the null hypothesis about the influence of age, education level, gender, farm/plot size, farming category, farming experience, annual net farm income and distance from farmland to public extension office, on the number of monthly visits by public extension officers. The evidence from MLR statistical outputs showed that the positive and negative influence of the above variables on the number of monthly visits by public extension officers was not statistically significant (p>0.05). Nonetheless, annual net farm income was a negative and significant predictor of monthly extension visits.

Null hypothesis v

The null hypothesis that farming category, number of monthly visits by extension officer and the compliance of public extension services to Batho Pele principle when dealing with people and planning activities do not positively and significantly influence perceived quality of public extension and advisory services is rejected. The statistical outputs of OLR indicated that the variables listed above had positive and statistical significant influence (p<0.05) on the perceived quality of public extension and advisory services. Nonetheless, the influence of age, distance from farmland to extension office, access to other sources of extension and the effectiveness of public extension (promoting equity through subsistence small-scale farmers, women, disabled and commercial farmers, facilitating and providing access to technology, and providing and facilitating advice on skills development in agriculture) on perceived quality of public extension and advisory services was positive; but, not statistically significant ($p>0.05$). Therefore, we fail to reject the null hypothesis. In addition, we fail to reject the null hypothesis about negative variables (education level, farm/plot size, gender, farming experience and annual net farm income) that have statistical insignificant relationship with the perceived quality of public extension and advisory services.

10.2.3 Effectiveness of public extension services

The perceived effectiveness of public extension and advisory services were measured using 16 variables adopted from the principles for advisory services in agriculture in South Africa. In brief, the findings of the study showed that majority of the respondents perceived public extension and advisory services as ineffective. There were three correlated exploratory factors (relevant and good quality extension and advisory services, provision of information which improves agricultural production and provision of technologies required by farmers) associated with farmers' perceptions of the effectiveness of public extension and advisory services. The summary of the null hypothesis is as follows:

Null hypothesis vi

The null hypothesis that education level, age, number of monthly visits by extension officer and the perceived quality of public extension and advisory do not positively and significantly influence farmers' perceptions of the effectiveness of public extension and advisory services is rejected ($p<0.05$). However, we fail to reject the null hypothesis about gender, farm/plot size, farming experience, main source of income, and distance from farm to extension office because their relationship with farmers' perceptions of the effectiveness of public extension and advisory services was not statistically significant ($p>0.05$).

10.2.4 Farmer's acceptability of university extension

The study findings showed that about four-fifths of the respondents accepted the inclusion of university agricultural extension in a pluralistic extension system. The exploratory factors associated with the acceptability of university extension were access to research resources, improved extension services and training, and diffusion of university research. From hypothesis perspective, the summary is as follows:

Null hypothesis vii

The null hypothesis was that most farmers (≥51%) would not accept the inclusion of university agricultural extension in a pluralistic extension system. A significant value ($p<0.01$) was obtained from the results of Binomial test; thus, the null hypothesis was rejected because significant majority (91.2%) were in favour of including universities as part of a pluralistic extension system in the study area.

Null hypothesis viii

The study fails to reject the null hypothesis that farmers' gender, age, education level, farm/land size, farming experience, and land acquisition method do not positively and significantly influence their acceptability of university agricultural extension in a pluralistic extension system ($p>0.05$). However, the null hypothesis about net farm income is rejected ($\beta=0.000$; $p<0.05$).

10.2.5 Delivery systems for university extension

The findings showed that most farmers (>50%) in the study area preferred an extension delivery system that involved public extension (government extension officers) as the coordinator between farmers and universities. There were about sixteen reasons why the respondents were in favour of farmer-public extension-university extension delivery system; nonetheless, the most important were acquisition of more information from various sources and maintaining relationships with the government. Moreover, few farmers were in favour of engaging universities directly; including farmer organisations and government as coordinators; and only including farmer organisations as coordinators. From language perspective, most farmers preferred to receive extension and advisory services from universities in the vernacular languages instead of English and/ a combination of vernacular and English.

10.2.6 Funding for university extension

The study found that most of the respondents were willing to pay for university extension services. However, largest majority (91%) of the respondents agreed that the government should provide most funding for transport, university staff allowances, medical aid, UIF and pension fund, office space, office equipment and furniture, Information and Communication Technology (ICT), stationery, farmers training programmes and research. The summary of the hypothesis is as follows:

Null hypothesis ix

The null hypothesis that farmers' main source of income does not positively and significantly influence farmers' willingness to pay for university agricultural extension services is rejected ($\beta=0.556$; $p<0.05$). However, the study fails to reject the null hypothesis that farmers' gender, age, education level, farming category, farm/land size, farming experience, annual net farm income, monthly extension visits and distance from farmland to extension office do not positively and significantly influence farmers' willingness to pay for university agricultural extension services.

10.3 CONLCLUSIONS

The main hypothesis is that significant majority of farmers receiving public extension and advisory services in Gauteng province would accept the inclusion of university-based agricultural extension in a pluralistic extension system. The conclusions about the main objectives of the study are outlined in the paragraphs below.

Pluralistic extension system is existing in the study area because nearly half of the respondents had access to extension services from various sources. Farmers had adequate access to public extension and advisory especially those who relied on farm income to sustain their livelihoods (main source of income) and those who were satisfied with the quality of public extension services had adequate access to extension services because they received more visits from extension officers. However, farmers who made more profit (net farm income) received less visits from public extension officer; thus, they had inadequate access to extension services. From quality point of view, it is concluded that most farmers were satisfied with the quality of public extension services especially those who received frequent visits from extension officers, commercial farmers, and farmers who regarded public extension services as effective in complying with the principle of Batho Pele when dealing with people and planning activities perceived the quality of public extension services positively.

Public extension and advisory services were perceived as ineffective by most farmers in the study area. Nonetheless, highly educated farmers, older, frequently visited by extension officers and those who were satisfied with the quality of extension services perceived public extension and advisory services to be effective. The conclusion derived from exploratory factors is that public extension and advisory services that provided relevant and good quality services, information that improved agricultural production and access to technologies were perceived as effective by the farmers.

Significant majority of the farmers accepted the inclusion of university-based agricultural in a pluralistic extension system, especially those who made more profit from their agricultural enterprises and perceived their association with universities as an opportunity to access research funding. In addition, the exploratory factors associated with the acceptability of university extension were access to research resources, improved extension services and training, and diffusion of university research. Pluralistic extension system involving universities should involve public extension (government extension officers) as the main coordinators between farmers and universities or keep government informed about the services rendered to the farmers. This will enable farmers to access information from various sources, maintain the existing relationships with the government and avoid duplication of services. The framework for pluralistic extension involving universities should allow farmers to choose their preferred extension delivery system (s). Thus, farmers who prefer to engage universities directly, include both farmer organisations and government as coordinators and only including farmer organisations as coordinators should be allowed to do so. By engaging universities directly (farmer-university extension delivery system) farmers will acquire more knowledge and skills, universities would identify their challenges without interference from other stakeholders. The conclusion about the place and language is that most university extension services should be provided in the farming areas (farmland) using South African vernacular languages. If needs be, farmers can receive university extension services in vernacular and English and visit the universities. The extension policy and framework for pluralistic extension system should include the place for offering extension services, languages and possible extension delivery systems.

The study concludes that farmers in the study area were willing to pay for university extension services especially those who relied on farming as their main source of income. However, commercial farmers and those who were located far from public extension offices were reluctant to pay for university extension services. Although most farmers were willing to pay for university-based agricultural extension services, there is a doubt about affordability because the average annual net farm income of the farmers in the study area is very low. Also in contrast, majority of the farmers wanted government to provide most funding for transport, university staff allowances, medical aid, UIF and pension fund, office space, office equipment and furniture, Information and Communication Technology (ICT), stationery, farmers training programmes and research required in university agricultural extension. Therefore, farmers were willing to contribute less than other stakeholders in the funding for pluralistic extension services. Their perceptions is that government should contribute large proportion for university extension funding, followed by universities and farmers' organisations. This information provides knowledge to anyone with the aim to bring in paid university extension service into South Africa and what they ought to do. From policy perspective, it implies that the funding model for university extension services that forms part of a pluralistic extension system should determine a criteria for farmers to pay for extension services.

Lastly, it is concluded that the limitations and delimitations of the study did not affect the credibility of the results and have no implications on the use of the results. The target population was farmers receiving public extension and advisory services in Gauteng province. All the farmers sampled were accessed through government agricultural advisors (extension officers); therefore, the level of trust was built with the farmers to ensure that they provided reliable information. However, the study findings cannot be generalised to include farmers who do not have access to public extension and advisory services and/ those who only depend on private extension services.

10.4 RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made:

- The current study suggests that, for public extension and advisory services to be effective, extension agents should render relevant, good quality services and provide information that improves agricultural production and facilitates access to the technologies required by farmers.
- Perceived effectiveness of public extension and advisory services was significantly associated with education level, age and extension visits. To improve the effectiveness of extension services, it is suggested that public extension officers should provide more support to less illiterate and younger farmers; and increase their monthly visits to the farmers.
- University extension was widely accepted by farmers as a suitable mechanism for a pluralistic extension system; therefore, it is recommended that a formal framework for a pluralistic extension system should be developed through a participatory process that involves the Ministry of Higher Education and Training, the Ministry of Agriculture, farmers, universities and other stakeholders.

Furthermore, the implementation of a pluralistic extension system should consist of concerted efforts between all the stakeholders to avoid duplication of efforts and waste of resources.

- The framework for a pluralistic extension system should enable universities to provide research resources to the farmers; improve access to extension services and training of farmers; and create a platform for the diffusion of university research outcomes to the farmers.
- Extension delivery system involving public extension as the coordinators should be the main system for pluralistic extension system. Thus, universities should inform government extension personnel about all their extension programmes in order to maintain the relationship that exist between government and farmers; and avoid duplication of efforts. Moreover, universities should be informed about government extension services and programmes offered to the farmers.
- University extension services should be provided to the farmers at their farming places and universities, simultaneously.
- University extension services should be rendered using South African vernacular languages; thus, university personnel who provide extension services should speak at least one of the dominant South African languages (Nguni or Sotho languages). Moreover, extension materials should be translated into various South African vernacular languages.
- It is recommended that farmers should contribute less to the funding for university extension services compared to other stakeholders. Therefore, most of the funding for transport, university staff allowances, medical aid, UIF and pension fund, office space, office equipment and furniture, Information and Communication Technology (ICT), stationery, farmers training programmes and research should come from government, followed by universities and farmer organisations. The contribution of each stakeholder can be negotiated once there is a formal framework for pluralism extension involving universities.

10.5 SUMMARY OF CONTRIBUTIONS TO BODY OF KNOWLEDGE

The study has identified new factors associated with access to public extension services (extension visits), namely farming as a main source of income and satisfactory with quality of extension and advisory services. Moreover, it has demonstrated that net farm income and access to extension services have negative and significant relationship, which is in contrast with most findings in the field of extension. Prior to the study, the guiding principle for extension and advisory services in South Africa were never utilised to measure the effectiveness of public extension services. Moreover, exploratory factor analysis was never employed to extract factors associated with the effectiveness of extension and advisory services. The study has provided new variables and data analysis methods that could be employed to conduct research in the field of agricultural extension. The significant contribution of the study is that the inclusion of university-agricultural extension in a pluralistic extension system is demand-driven. Moreover, payment of extension services from institutions of higher learning is accepted by most of the recipients of public extension services (agricultural producers). This is a new dimension because most scholars have focused on farmers' willingness to pay for public and private extension services. Nonetheless, farmers should pay less proportions for transport, gross income and medical aid for university staff, UIF and pension fund for university staff, office space, office equipment and furniture, Information and Communication Technology (ICT), stationery, farmers training programmes and research compared to other extension stakeholders (government, universities and farmers organisations and others). This information provide knowledge to anyone with the aim to bring in paid university extension services into South Africa and what they ought to do.

In the study, farmers' acceptability of university-agricultural extension was perceived as an innovation. Therefore, the study findings support the framework for the analysis of adoption behaviour in extension developed by Düvel (1991) because important factors associated with adoption of new innovations were identified. The evidence from the study is that farmers who made more income from farming were willing to accept the inclusion of university-agricultural extension in a pluralistic extension system. Moreover, the assumption is that pluralistic extension system involving universities will improve farmer's access to research resources, extension services and training, and diffuse university research. Thus, the study contributes to the existing theory by explaining the factors that will help to explain acceptability of pluralistic extension involving universities. In addition, the study has outlined farmer's expectations from universities, extension delivery and funding system preferred by farmers, language of communication and places of offering extension services to the farmers. Thus, the study makes a practical contribution towards the development of sustainable framework for pluralistic extension system involving institutions of higher learning. This can help government and universities to develop extension programmes that are responsive to farmer's needs.

10.6 SUGGESTIONS FOR FUTURE RESEACH

The study participants were the recipients of public extension and advisory services in Gauteng province of South Africa selected through probability sampling. The study findings can be generalised because they are consistent with other studies that identified factors associated with adoption of agricultural innovations. Therefore, the findings can be used as a basis for future studies in the field of extension and adoption of agricultural innovations, especially the exploration of including various stakeholder in a pluralistic extension system. There is a need to conduct a study involving farmers who have no access to public extension services to determine whether they will accept the inclusion of university extension in a pluralistic extension delivery system. Again, the acceptability of university extension services, extension delivery systems and funding model for pluralistic extension system should be investigated amongst the universities, public extension officers and managers, and farmers' organisations. More research is required to determine farmers' affordability for the payment of university extension services and the free structures.

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APPENDIX 1: RESEARCH QUESTIONNAIRE FOR FARMERS

GENERAL INFORMATION

Questionnaire number	
Date	

A. DEMOGRAPHIC INFORMATION

No.	Participant demography	Code	Answer
1	Gender	0=Female 1=Male	
2	Age	1=less than 35 yrs. 2=35 – 45 yrs. 3=46 – 55 yrs. 4=56 - 65 yrs. 5=Above 65 yrs.	
3	Race	1=Black African 2=Indian 3=Coloured 4=White 5=Other	
4	Home language	1=Afrikaans 2=English 3=isiZulu 4=isiXhosa 5=Ndebele 6=Sepedi 7=Sesotho 8=Setswana 9=Swati 10=Tshivenda 11=Xitsonga 12=Other (Specify)	
5	Level of education	1=No formal education 2=Primary education 3=Secondary education 4=ABET education	

		5=Diploma 6=Bachelor Degree 7=Honour Degree/BTech 8=Master Degree 9=Doctoral Degree 10=Other (Specify)	
6	Marital status	1=Single 2=Cohabitation 3=Married 4=Separated 5=Divorced 6=Widowed 7=Other (Specify)	
7	Farming category	0 = Non-commercial; 1 = Commercial	

B. SOCIO-ECONOMIC FACTORS

No.	Socio-economic characteristics	Code	Answer
8	Farm size	Ha	
9	Farm/land acquisition	1=Inheritance 2=Communal tenure 3= Rented/Leasehold tenure 4=Quitrent tenure 5=Purchased/Freehold tenure 6=Other	
10	Number of years involved in farming	Years	
11	Main source of income	0=Non-farming activities 1=Farming	
12	**Farming commodity**		
a	Vegetables	0=No; 1=Yes	
b	Agronomic Crops	0=No; 1=Yes	
c	Livestock	0=No; 1=Yes	
d	Fruits	0=No; 1=Yes	
e	Flowers	0=No; 1=Yes	
f	Fishery	0=No; 1=Yes	
g	Other (Specify)	0=No; 1=Yes	

13	**Annual net farm income in the previous season**	Rands (R)	
a	Vegetables		
b	Agronomic crops		
c	Livestock		
d	Fruits		
e	Flowers		
f	Fishery		
g	Others (Specify)		
14	What was your annual net farm income in the previous year?	Rand	

C. ACCESS TO AGRICULTURAL EXTENSION AND ADVISORY SERVICES

No.	**Question**	**Code**	**Answer**
15	How often does your extension officer visit you per month?	Days	
16	What is the distance from your farm to the extension office?	Km	
17	How do you rate the quality of the public agricultural extension and advisory services that you receive?	1=Very poor 2=Poor 3=Acceptable 4=Good 5=Very good	
18	Do you have access to other source of agricultural extension and advisory apart from public/government extension?	0=No 1=Yes	
19	If yes, which of the following are your other sources of agricultural extension and advisory services?	1=Private contractor 2=Cooperatives 3=University-based extension 4=Community based extension 5=Other (Specify)……………	

D. PERCEPTIONS ON THE CURRENT PUBLIC AGRICULTURAL EXTENSION AND ADVISORY SERVICES

	Question	Very ineffective 1	Ineffective 2	Average 3	Effective 4	Very effective 5
20	**Indicate your opinion on the effectiveness of public agricultural extension and advisory services in Gauteng Province on the following statements:**					**Answer**
a	Offers high quality extension and advisory services					
b	Uses extension approaches that are relevant to the beneficiaries					
c	It is demand-driven					
d	Is compliance to the principles of Batho-Pele when dealing with people and planning activities					
e	Promote equity through subsistence small-scale farmers, women, disabled and commercial farmers					
f	Flexible to respond to farmers' ever-changing needs					
g	Has effective monitoring and evaluation tools					
h	It prioritise the needs of the beneficiaries					
i	Focuses on human and social capital development					
j	Uses participatory approaches in planning, implementation and evaluation of their project/programmes					
k	Facilitate access to extension and advisory services that lead to sustainable income generation by clients					
l	Provide and facilitate access to agricultural information for improved planning and decision making					
m	Facilitate access to technology and, where possible, provide such technologies					
n	Provide and facilitate access to advice on sustainable (including conservation of natural resources) agricultural production					
o	Provide and facilitate advice on skills development in agriculture					

p	Strengthen institutional arrangements (partnerships, restructuring, corporatisation, funding, establish new entity/ties) for the effective delivery of services	

E. FEASABILITY OF UNIVERSITY-BASED AGRICULTURAL EXTENSION AND ADVISORY SERVICES

21. Do you know any University in Gauteng that offers agricultural programmes/qualifications? (0=No; 1=Yes)

22. Do you support the introduction of university agricultural extension as a complement to public extension and advisory services in Gauteng Province? (0=No; 1=Ye

	Question	**Strongly Disagree 1**	**Disagree 2**	**Neither 3**	**Agree 4**	**Strongly Agree 5**
23	**indicate your opinion on the following possible benefits of university-based agricultural extension and advisory services to farmers:**					**Answer**
a	Farmers will have better access to agricultural extension and advisory services					
b	Farmers will receive advise from subject matter experts					
c	Farmers will have access to formal education and training					
d	Farmers will have access to research journals					
e	Farmers will have access to research innovations					
f	Farmers will have access to research funding					
g	Farmers will have access to research infrastructure					
h	Universities will be linked with practical extension work					
i	Universities will communicate their research findings to the farmers					
j	Universities will conduct research that is responsive to the farmers needs					
k	Universities will develop curriculum that is relevant to the society					
l	Universities will use their community engagement and outreach activities to benefit the farmers					
m	Others (Specify)					

24. What would be the challenges of university-based agricultural extension and advisory services?

……………………………………………………………………………………………………

…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

F. EXTENSION DELIVERY AND FUNDING MODEL

	Question	Code	Answer
25	Which extension delivery model will be suitable for university-based agricultural extension and advisory services in Gauteng Province?	1. Farmer ⟷ University 2. Farmer ⟷ Extension ⟷ University 3. Farmer ⟷ farmers' organisation ⟷ University 4. Farmer ⟷ farmers' organisation ⟷ University Extension 5. Other (Specify)	
26	Provide the perceived benefits and weaknesses of the delivery model chosen in question 28.		

27. Where would you prefer to receive university agricultural extension services?

1. Farming place
2. University
3. Farming place and university

28. Which language would you prefer to receive university agricultural extension services?

1. Home language
2. English only
3. Home language and English

G. EXTENSION FUNDING MODEL

29. Indicate your opinion on the funding model that will be suitable for university-based agricultural extension and advisory services in Gauteng Province on the following variables:		**Payment of agricultural extension and advisory services**				
		Government 1	University 2	Farmers 3	Farmers' organisation 4	Private funder 5
a	Transport costs (0=No; 1=Yes)					
b	University staff allowance (0=No; 1= Yes)					
c	Medical Aid (0=No; 1=Yes)					
d	Unemployment Insurance Fund (0=No; 1=Yes)					
e	Information Communication Technology (ICT) (0=No; 1=Yes)					
f	Office space (0=No; 1=Yes)					
g	Office equipment (0=No; 1=Yes)					
h	Stationary (0=No; 1=Yes)					
i	Training workshops (0 =No; 1=Yes)					
j	Research funding (0=No; 1=Yes)					

30. Are you willing to pay for universities agricultural extension and advisory services of good services? (0=No; 1=Yes)

THANK YOU FOR YOUR PARTICIPATION

APPENDIX 2: PARTICIPANT INFORMATION SHEET

Ethics clearance reference number: **2016/CAES/073**

Research permission reference number: **Research (GDARD reference)**

TITLE: **FEASIBILITY OF UNIVERSITY-BASED AGRICULTURAL EXTENSION AS A COMPLEMENT TO PUBLIC EXTENSION IN GAUTENG PROVINCE OF SOUTH AFRICA.**

Dear Prospective Participant

My name is Matome Simeon Maake, and I am doing research with Prof. M.A. Antwi, a Full Professor in the Department of Agriculture and Animal Health towards a PhD degree in Agriculture at the University of South Africa. We are inviting you to participate in a study entitled Feasibility of University-based agricultural extension as a complement to public extension in Gauteng Province of South Africa.

WHAT IS THE PURPOSE OF THE STUDY?

The purpose of this study is to explore the feasibility of university-based agricultural extension as a complement of public extension in Gauteng Province of South Africa.

WHY AM I BEING INVITED TO PARTICIPATE?

I chose you to participate in the study because you receive extension and advisory services from Gauteng Department of Agriculture and Rural Development/render public extension and advisory services to farmer in Gauteng Province/your institution is offering agricultural science programmes (qualifications). I received permission from Gauteng Department of Agriculture and Rural Development (GDARD) to interview farmers receiving extension and advisory services from the Department. The approximate number of participants targeted is 500 farmers from Gauteng Province.

WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?

The research process for this study requires you;

- to sign the consent form before participating in the study;
- to participate in face-to-face interviews conducted by the primary investigator or his research team; and/or complete the research questionnaire sent by the primary investigator;
- to respond to the questions regarding the feasibility of University-based agricultural extension, and the perceptions towards public agricultural extension and advisory services and;
- to remain anonymous (Not to provide your real name) during the interview and for the completion of the survey questionnaire.

The expected time needed to complete the questionnaire is about 30 minutes. If you opt for interviews, it will take about 35 minutes to conduct the interview.

CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?

Participating in this study is voluntary and you are under no obligation to consent to participation. If you decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason. Participants will participate purely by choice and participants will be free to withdraw at any time without providing reasons for their decision. The confidentiality will be observed professionally, and participant's identity will not be revealed. The names of the participants will not be included in the research publications emanating from the study.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

The potential benefits of participating in this research study are:

- the study may develop a viable university-based agricultural extension model that will complement public extension in Gauteng Province and South Africa at large;
- the information provided will help to profile the opinions of agricultural stakeholders (farmers, government and academics) towards public extension and advisory services in Gauteng Province;

- the results will be useful to agricultural extension policy makers in South Africa.
- it will also identify the areas of potential collaboration between government and academic institutions in research and agricultural extension and advisory services; and
- it will also create a platform for academic institutions to conduct research that seeks to address the problems of the farmers.

ARE THERE ANY NEGATIVE CONSEQUENCES FOR ME IF I PARTICIPATE IN THE RESEARCH PROJECT?

There are no negative consequences for participating in the research project. If you are a farmer, your participation in the study will have no effect on the extension and advisory services you receive from government. If you are government extension personnel or an academic your job will not be affected by your participation in the study.

There are no foreseeable physical risks associated with this study. The interviews conducted will not include emotional or sensitive questions.

WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER AND MY IDENTITY BE KEPT CONFIDENTIAL?

The confidentiality will be observed professionally, and participant's identity will not be revealed. The names of the participants will not be included in the in the research publication. A report of the study may be submitted for publication, but individual participants will not be identifiable in such a report

HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?

Hard copies of your answers will be stored by the researcher for a period of five years in a locked cupboard/filing cabinet in the Department of Agriculture and Animal Health at the University of South Africa, in Florida Science Campus for future research or academic purposes; electronic information will be stored on a password protected computer. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable. Hard copies will be shredded and/or electronic copies will be permanently deleted from the hard drive of the computer through the use of a relevant software programme after a period of five years.

WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?

You will not receive any financial or material compensation for participating in the study. Your participation is voluntary.

HAS THE STUDY RECEIVED ETHICS APPROVAL

This study has received written approval from the Research Ethics Review Committee of the College of Agriculture and Environmental Sciences (CAES) Ethic Committee*,* Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.

HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS OF THE RESEARCH?

If you would like to be informed of the final research findings, please contact Matome Simeon Maake on 082 266 7902 or e-mail: maakems@unisa.ac.za or fax number 011 471 2260. The findings are accessible for a period of five years. Should you require any further information or want to contact the researcher about any aspect of this study, please contact Prof. M.A. Antwi on 011 471 9391; e-mail at antwima@unisa.ac.za

Should you have concerns about the way in which the research has been conducted, you may contact the research ethics chairperson of the College of Agriculture and Environmental Sciences (CAES) Ethics committee, Prof. E.L. Kempen on 011 471 2241 or e-mail at kempeel@unisa.ac.za, if you have any ethical concerns.

Thank you for taking time to read this information sheet and for participating in this study.

Matome Simeon Maake

CONSENT TO PARTICIPATE IN THIS STUDY

I, ___________________ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the **face-to-face interview responses in the research questionnaire and/tape recorder or prefer to complete the research questionnaire.**

I have received a signed copy of the informed consent agreement.

Participant Name & Surname………………………………………… (please print)

Participant Signature…………………………………………..Date…………………

Researcher's Name & Surname………………………………………(please print)

Researcher's signature…………………………………………..Date…………………

APPENDIX 3: UNISA ETHICS APPROVAL LETTER

UNISA | university of south africa

CAES RESEARCH ETHICS REVIEW COMMITTEE

National Health Research Ethics Council Registration no: REC-170616-051

Date: 11/11/2016

Ref #: **2016/CAES/073**
Name of applicant: **Mr MS Maake**
Student #: **57664773**

Dear Mr Maake,

Decision: Ethics Approval

Proposal: Feasibility of university-based agricultural extension as a complement to public extension in Gauteng Province of South Africa

Supervisor: Prof M Antwi

Qualification: Postgraduate degree

Thank you for the application for research ethics clearance by the CAES Research Ethics Review Committee for the above mentioned research. Approval is granted for the project.

Please note that the approval is valid for a one year period only. After one year the researcher is required to submit a progress report, upon which the ethics clearance may be renewed for another year.

Due date for progress report: 31 August 2017

The application was reviewed in compliance with the Unisa Policy on Research Ethics by the CAES Research Ethics Review Committee on 11 November 2016.

The proposed research may now commence with the proviso that:

1) *The researcher/s will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.*
2) *Any adverse circumstance arising in the undertaking of the research project that is*

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Open Rubric

relevant to the ethicality of the study, as well as changes in the methodology, should be communicated in writing to the CAES Research Ethics Review Committee. An amended application could be requested if there are substantial changes from the existing proposal, especially if those changes affect any of the study-related risks for the research participants.

3) *The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study.*

Note:
The reference number [top right corner of this communiqué] should be clearly indicated on all forms of communication [e.g. Webmail, E-mail messages, letters] with the intended research participants, as well as with the CAES RERC.

Kind regards,

Signature
CAES RERC Chair: Prof EL Kempen

Signature
CAES Executive Dean: Prof MJ Linington

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APPENDIX 4: PERMISSION LETTER FROM GDARD

GAUTENG PROVINCE
AGRICULTURE AND RURAL DEVELOPMENT
REPUBLIC OF SOUTH AFRICA

Diamond Building, 11 Diagonal Street, Newtown
PO Box 8769, Johannesburg, 2000
Tel: 011 240 2500
Fax: 011 240 2700

Enquiries : Tefo Phelane
Telephone : (011) 240-2608
Reference : Research

HEAD OF DEPARTMENT

REQUEST TO GRANTS PERMISSION TO MR MS MAAKE TO CONDUCT RESEARCH INVOLVING PERSONNEL AT GDARD

1. PURPOSE

1.1 To request the HOD to:

a) Grants permission to Mr. MS Maake (a Doctoral Degree student in Agriculture in the field of agricultural extension at University of South Africa) to conduct research involving personnel at Gauteng Department of Agriculture and Rural Development (GDARD).

2. BACKGROUND

Mr. Maake's topic is "**Feasibility of University-based agricultural extension and advisory services as a compliment to public extension in the Gauteng Province**". The aim of the research is to determine whether university-based agricultural extension and advisory services can complement public extension in Gauteng Province.

The specific objectives of the study will be to:

- Determine the perceptions farmers/academics/extension personnel towards the current public agricultural extension and advisory services in Gauteng Province.
- Determine the perceptions farmers/academics/ personnel towards the introduction of university-based agricultural extension and advisory services as a complement to public extension in Gauteng Province.
- Determine the capacity of agricultural academics in universities to complement public agricultural extension and advisory services in Gauteng Province.
- Determine the funding model suitable for university-based agricultural extension as a complement to public agricultural extension and advisory services in Gauteng Province.

In order to achieve the objectives, the study will require the participation of the personnel at GDARD. The outcomes of the study will be shared with the participants at GDARD and all other relevant stakeholders.

3. IMPLICATIONS

3.1 Personnel
3.1.1 None

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REQUEST TO GRANT PERMISSION TO MR MS MAAKE TO CONDUCT RESEARCH INVOLVING PERSONNEL AT GDARD

3.2 Financial
3.2.1 None

3.3 Legal
3.3.1 None

3.4 Communication
3.4.1 None

4. OTHER COMPONENTS CONSULTED

4.1 None

5. RECOMMENDATION

It is recommended that the HOD:

a) Grants permission to Mr. MS Maake to conduct research involving personnel at GDARD.

Mr. Dean Hing
Director: Human Resources Development
Date: 25/07/16

RECOMMENDATION IN PAR. 5 SUPPORTED/~~SUPPORTED WITH AMENDMENTS/NOT SUPPORTED~~

Mr. Mmupi Mogoboya
Acting Director: Human Resources Management
Date: 26/7/2016

RECOMMENDATION IN PAR. 5 SUPPORTED/~~SUPPORTED WITH AMENDMENTS/NOT SUPPORTED~~

Mr. Nakampe Mogale
Chief Director: Support Services
Date: 26-07-2016

REQUEST TO GRANT PERMISSION TO MR MS MAAKE TO CONDUCT RESEARCH INVOLVING PERSONNEL AT GDARD

RECOMMENDATION IN PAR. 5 SUPPORTED/S~~UPPORTED WITH AMENDMENTS/~~NOT SUPP~~ORTED~~

Ms. Bola Olowa
Chief Director: Legal Services
Date: 28/7/2016

RECOMMENDATION IN PAR. 5 SUPPORTED/SUPP~~ORTED WITH AMENDMENTS/N~~OT ~~SUPPORTE~~D

Ms. Priscilla Pietersen
Deputy Director General: Transversal Services
Date: 29/07/16

RECOMMENDATION IN PAR. 5 APPROVED/A~~PPROVED WITH AMENDMENTS/N~~OT A~~PPROVE~~D

Ms. Thandeka Mbassa
Head of Department: Agriculture and Rural Development
Date: 29/07/16

APPENDIX 5: PUBLISHED MANUSCRIPT 1

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Agriculture & Food Security

RESEARCH

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Farmer's perceptions of effectiveness of public agricultural extension services in South Africa: an exploratory analysis of associated factors

Matome Moshobane Simeon Maake* and Michael Akwasi Antwi

Abstract

Background: Effective public extension and advisory services have the potential to improve agricultural productivity; net farm income; and food security amongst resource-poor farmers. However, studies conducted to measure the effectiveness of extension and advisory services, offered by the Government of South Africa, have focused on the methods used, instead of the guiding principles, such as demand-driven services; equity; prioritization of farmer's needs; and social and human capital development. The aim of this research paper was to determine farmers' perceptions regarding the effectiveness of public extension and advisory services and associated factors. Perceptions of the effectiveness were measured using sixteen variables. A group of 442 farmers, in the Gauteng province, receiving government agricultural extension and advisory services, were randomly selected to participate in the study. Using a semi-structured survey instrument, primary data was collected through physical interviews and then analysed using computer software.

Results: The study found that public extension and advisory services in Gauteng were perceived as ineffective. Three socio-demographic factors (education level, age and farm/plot size) significantly influenced farmer's perceptions towards public extension and advisory services. Moreover, the Principle Axis Factoring (PAF) results indicated that there were three underlying factors of the perceived effectiveness of public extension services, namely: relevance and good quality services; provision of information on improving agricultural production; and availability of the technologies required by farmers.

Conclusions: Large-scale farmers perceived public extension services to be less effective. The exploratory factor analysis extracted three underlying factors which accounted for 81.81% of the variance of the perceived effectiveness of public extension services. Farmers recommended that public extension and advisory services should be of good quality; relevant; and should improve agricultural production to be considered as effective by the farmers. Moreover, provision of extension and advisory services should be determined by farm/plot size.

Keywords: Effectiveness, Extension, Factor analysis

Background

Agricultural extension is a source of information for most farmers with low literacy levels and poor access to Information and Communication Technology (ICT) in developing countries. Through access to extension and advisory services, farmers receive diverse information

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about cultivation practices; fertilisation; plant protection (pests, weeds and disease control); marketing; livestock and crop management; climate change; and so forth. Because of the important role and benefits of agricultural extension, access to public extension and advisory services is imperative for most farmers, especially those who cannot afford private extension services. As a result, government is the main provider of extension services in most developing countries [1–3]. One of the reasons that the government is highly involved in rendering extension services, is to ensure that farmers receive the support which will enable them to produce adequate and quality produce, and thus enabling the country to be food secure. Therefore, effective public extension services play an important role in agricultural sustainability and food security of a country. Effectiveness of extension services have been widely investigated globally using various methods. Most scholars have measured the effectiveness of extension services using delivery methods, such as farmer trainings, farm/home visits, office calls, field demonstrations, field/farmers days, workshops/open discussions [4–7]. Facilitation of study groups and distribution of printed materials has also been used as a way to determine effectiveness of extension services [4]. The ability of extension personnel to manage orientation, expose farmers to mass media, provide scientific orientation and innovate farmers could be used to determine whether extension services are effective or not [8]. Extension system capable to utilizing Information and Communication Technologies such as televisions, radio, telephones, helpline and social media (Facebook, Twitter, etc.) are considered as effective [5]. Moreover, other scholars have measured the impact of extension services on farmers' income and agricultural production [9, 10]; innovation adoption rate, food safety and nutrition [7]; campaigns, lectures, exhibitions, literature and signboards [11]; and transferring crop production and management knowledge to farmers [12], as measures of the effectiveness of extension services. The above background indicates that different methods have been employed by scholars to measure effectiveness of extension services.

The results of the effectiveness of extension services vary from one place to the other; even though there are some commonalities in some instances. In Ekurhuleni Metropolitan and Sedibeng District Municipalities, Gauteng province of South Africa, the results of a focus group involving smallholder farmers showed that public extension services were not effective in sharing printed information, nor communicating and facilitating workshops, but were, however, effective in utilizing methods, such as trainings, demonstrations, farmers' days, individual farm visits and on-farm trials and research [4]. In an experimental research conducted amongst smallholder poultry farmers in Dakhalia governorate, Egypt, it was found that public extension services were most effective in demonstrations; meetings; and the distributions of pamphlets [13]. However, in Khyber Pakhtunkhwa province, Pakistan, the findings of a survey showed that majority of farmers perceived extension services as ineffective in the following methods farm/home visit, phone office calls, demonstration plots, field days, demonstration plots, farmer trainings, local agriculture fair and workshop/open discussion [6]. The *T* test results of a survey that sampled rice growers (farmers) receiving extension services from government and private sector in Pakistan indicated that public extension services were moderately effective in the dissemination of information through demonstrations and farm/home visits [5]. However, in the said study, it was found that public extension services were less effective in agricultural campaigns; Farmers' days; and signboards aimed at building farmers' capacity. Again, maize growers in Kilindi District of Tanzania held the opinion that agricultural extension agents were ineffective in transferring knowledge about selection of cultivars, choosing planting date, seed treatment, crop protection (weed, pest and disease control), fertilizer application, irrigation and harvesting practices, and demonstration methods [12]. The *T* test results of the experimental research that involved recipients and non-recipient of extension services in Jordan found that net income and agricultural production were not statistically significant ($p > 0.05$); thus, extension services were ineffective in improving farmers' net income an production [9]. On the contrary, survey results from Kaduna state, Nigeria showed that effective extension services enhanced productivity and farmers' income [10]. A survey that involved extension practitioners in the Eastern Cape province of South Africa found that public agricultural extension was ineffective in uplifting farmers from poverty and in providing necessary resources [14]. Literature presented above shows that information about effectiveness of extension services can be collected through a survey, experimental research and focus groups involving farmers and extension practitioners. Moreover, different methods were used to measure effectiveness of extension services.

In addition, several studies that investigated the effectiveness of extension services have also explored factors influencing effectiveness or determinants [6, 8, 15–17]. Information about the determinant of the effectiveness of extension services has been analysed using methods, such as, principal component analysis (PCA); Regression models (Ordered Logistic, Binary Logit; Probit; Ordinary Least Squares; and Multiple logistic); descriptive statistics; *T* test; and qualitative analysis. The results of PCA extracted the following factors underlying factors associated with the effectiveness of extension services, policy-making factors, which accounts for 17.2% of the variance; followed by socio-cultural factors (16.4%); and structural and economic factors which accounts for 14.1% and 13.3%, respectively [18]. In a study whose participants were extension personnel, the findings of Ordinary Least Squares (OLS) regression showed that the effectiveness of extension services is influenced by factors, such as age; marital status; work experience of extension personnel; acquisition of extension education; field of expertise; and number of villages served by extension personnel [15]. Studies that involved farmers and analysed data using various regression methods (Binary Logistic, Multiple regression and Ordered Logistic) found that perceived effectiveness of extension services was positively and significantly influenced by farmers' socio-demographic characteristics, such as age [17]; farming experience [8, 17]; gender [16, 17]; farm size [16] and educational status [8, 17]. Other significant factors influencing farmers' perceptions about the effectiveness of extension services are knowledgeable extension personnel [19]; farmer's attitudes towards extension services, and extension services received [17]. Moreover, training received; contact with extension agents; scientific orientation; information source utilisation; and innovativeness are positive and significant predictors of perceived effectiveness of extension services [8]. In a study that utilised the Delphi Technique and subjected data to descriptive statistical analysis, it was discovered that quality of training and lack of resources influenced the performance of most extension agents [20]. The performance of extension personnel influences access to extension services by farmers. Likewise, access to extension services is a significant predictor of farmers' perceptions about the effectiveness of extension services [17]. Based on the above-mentioned studies conducted on agricultural extension services, it is evident, that globally, scholars have employed various data analysis methods to identify important factors influencing perceived effectiveness of extension services.

In South Africa, the provision of extension services is guided by the principles, norms and standards for extension advisory services in agriculture, as developed by the Ministry of Agriculture. The guiding principles are demand-driven services; promotion of equity; flexibility to changing needs; monitoring and evaluation; participatory approaches; prioritization of farmers' needs; social and human capital development; strengthening structural partnerships; facilitating skills development and access to technology; improved planning and decision-making; sustainable income generation; and the conservation of natural resource [21]. Therefore, it is important to measure the effectiveness of public extension and advisory services against the guiding principles, because they are the key drivers of extension services in South Africa. The above background prompted the researchers to measure the effectiveness of extension and advisory services, using the South African guiding principles as developed by government. The objectives of the study were to determine the perceived effectiveness of public agricultural extension and advisory services and to ascertain the determinants (influencing factors). The theoretical framework of the study is presented in Fig. 1.

Materials and methods

Study area

The study was carried out in the Gauteng province of the Republic of South Africa. Gauteng province covers an estimated 18,179 km^2 [22] of the country and is the smallest of the nine provinces in South Africa. However, it is the most populous province, with an estimated population of 15.4 million [23]. The province is subdivided into three metropolitan municipalities and two district municipalities, namely: the City of Johannesburg Metropolitan Municipality; the City of Tshwane Metropolitan Municipality; the City of Ekurhuleni Metropolitan Municipality; the Sedibeng District Municipality; and the West Rand District Municipality. Gauteng is the economic hub of South Africa, and contributes 35% of the gross domestic product (GDP) in the country, as well as 11% on the African continent [24]. As a result, the province is highly urbanized due to an influx of labour migrants from other provinces of South Africa, as well as the Southern African region. About 25.5% of the 57.7 million people in South Africa, resides in Gauteng [25]. The key economic drivers in the province are government services, manufacturing, trade, mining, transport, finance, electricity, construction, personal services and agriculture. Although agriculture is one of the economic sectors in Gauteng, it contributes only 1% of the GDP in the province [24]. Agriculture in the province mainly consists of livestock and crop production; as well as fishery at both small- and large-scale farming. There are 2291 commercial farming units in Gauteng, which creates about 16,420 skilled and unskilled employment opportunities [26].

Conceptual framework

Conceptual framework refers to the structure developed by the researcher to explain the development of the phenomenon to be studied [27]. Moreover, framework indicate the logic that will be followed to undertake the research [28]. The research approach used in the study was quantitative. Quantitative research approach was adopted, because it enables collection, capturing and analysing of numerical data [29]. In addition, a

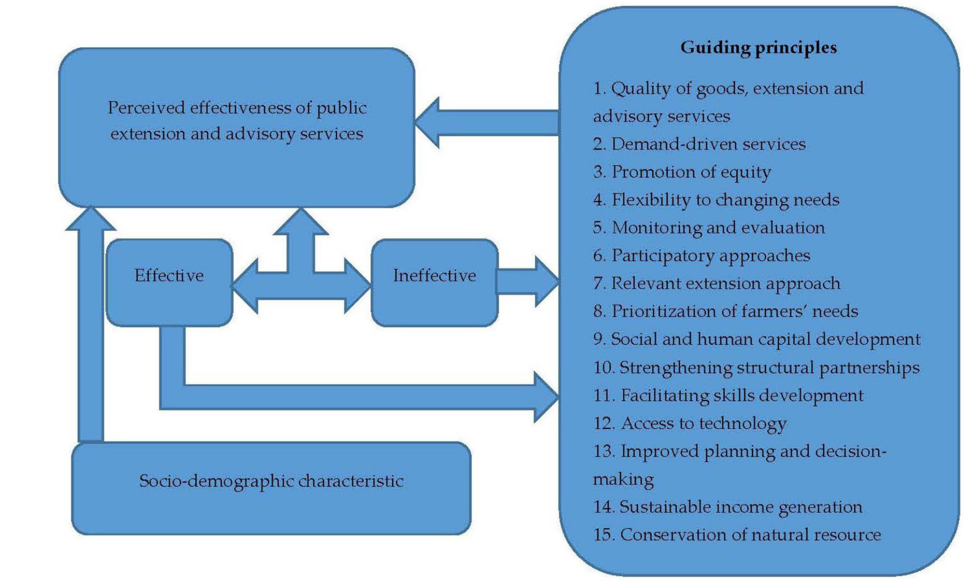

Fig. 1 Theoretical framework of the study

descriptive survey design was employed to undertake the research. A survey was chosen, because it describes how the perceptions of the respondents are associated with their characteristics [30]. The focus of the study was to assess farmers' perceived effectiveness of public extension and advisory services through descriptive assessment. The conceptual framework employed in the study is presented in Fig. 2.

Sampling

There are about 9000 farmers in the Gauteng province of South Africa [31]. A sample (n) of 368 would have had to be drawn from a population (N) of 9000 to achieve a margin error of 5% [32]. Because of the above description, a sample of 368 farmers receiving agricultural extension and advisory services from the Provincial Department of Agriculture, were targeted for participation in the study. However, more farmers showed interest to participate in the study. As a result, a sample (n) of 442 was randomly selected to participate in the study. Participants were selected after the study had received permission from the Gauteng Department of Agriculture and Rural Development (GDARD) as well as ethical approval from the CAES Research Ethics Review Committee at the University of South Africa. The ethics reference number for the project is 2016/CAES/073. The study participants were black African, coloured and white farmers aged 18 years and above.

Data collection

Collection of primary data was carried out using a semi-structured questionnaire (interview guide), which was validated and pilot tested to ensure its reliability. The researcher completed the questionnaire during face-to-face interviews with the participants. The aim of the study, the objectives, the ethical implications, as well as the rights of the participants were explained to the participants before the interviews commenced. Furthermore, each participant was required to give consent for the interview by signing the informed consent form. The questions focused on the effectiveness of the extension services which emanated from the guiding principles for extension support and advisory services as developed by the National Department of Agriculture in the Republic of South Africa. The questions were presented as five-point Likert scale questions: 1 = Very ineffective; 2 = Ineffective; 3 = Average; 4 = Effective; and 5 = Very effective. The measurements of the effectiveness of public extension and advisory services were quality of extension services; relevance of extension approaches used; and rendering of demand-driven, good quality services and goods (Batho Pele); promotion of equity; flexibility

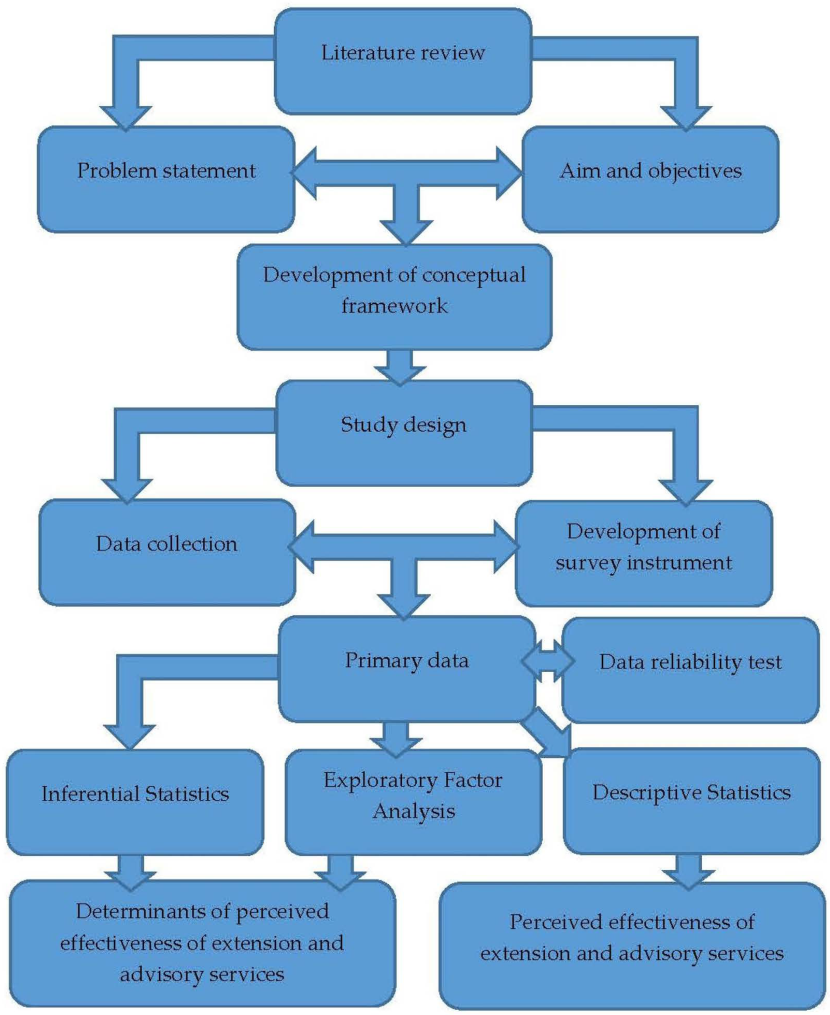

Fig. 2 Conceptual framework of the study

in responding to farmers' changing needs; effectiveness in monitoring and evaluation tools; prioritising the needs of the beneficiaries; focusing on human and social capital development; use of participatory approaches; facilitating access to technology and services which sustains income generation; improving planning and decision-making; sustainability of agricultural production; agricultural skills development; and strengthening of institutional arrangements.

Statistical analysis

The Statistical Package for the Social Sciences (SPSS) version 27, was used to analyse the data. Because a Likert-scale survey instrument was used to collect the data, the data was treated as interval data. The first analysis, performed in SPSS, measured the reliability and internal consistency of the survey scale used to collect the data. To achieve this, Cronbach's alpha's coefficient was determined. All 16 variables which measured perceived effectiveness of extension and advisory services in the survey instrument (questionnaire), were loaded for analysis in the reliability test. The Cronbach's alpha coefficient value obtained in the analysis, was 0.97. Because of that, the internal consistency was satisfactory; and thus, the questionnaire was reliable. Cronbach's alpha coefficient values between 0.58 and 0.97 are considered satisfactory [33]. Furthermore, the mean scores for all the variables ranged between 3.12 and 3.45. As a result, all the questions in the survey instrument were retained for principal Exploratory Factor Analysis (EFA) and descriptive statistical analysis. After it was found that the survey instrument was reliable, the descriptive and inferential statistical analyses were performed. The descriptive statistical analysis included mean, median, frequencies, percentages and interquartile range (IQR). The proportions of very ineffective and ineffective, were grouped together and categorised as ineffective, whereas average was considered as moderately effective. Furthermore, the proportions of effective and very effective, were grouped together and defined as effective.

In addition, the following inferential statistical analyses were performed: Ordered Logistic Regression (OLR); and PAF analysis and correlation. OLR was used to analyse data of the socio-demographic factors influencing farmers' perceptions about the effectiveness of public agricultural extension and advisory services. The average mean score was used as a dependent variable in the OLR model. In OLR, a polychotomous-ranked dependant variable is predicted as a function of explanatory factors, describing individual or unit characteristics [34]. The basic principle of estimating OLR descried by [35], is as follow:

$$\Pr(Y_\mathrm{i} \leq j) = \Pr\left(\beta_1 X_{1\mathrm{i}} + \beta_2 X_{2\mathrm{i}} + \ldots + \beta_\mathrm{k} X_{\mathrm{ki}} + u_\mathrm{i} \leq \alpha_j\right).$$

In the aforementioned equation, the probability is that Y_i (dependant variable) is within category j and below. Therefore, Y_i is in category 1, 2, ..., or j, whereas u_i is the error term. In the current study, the empirical model estimated, using OLR is as follows:

$$\begin{aligned}&\Pr(\mathrm{PEPEAS} \leq 5)\\&\quad = \Pr(\beta_1 \mathrm{EL} + \beta_2 \mathrm{G} + \beta_3 \mathrm{AG} + \beta_4 \mathrm{FS} + u_\mathrm{i} \leq \alpha_5).\end{aligned}$$

whereby PEPEAS = perceived effectiveness of public extension and advisory services; E = education level; G = gender; AG = age group; FS = farm/plot size; U = error term.

The perceived effectiveness of public extension and advisory services was categorised as 1 = Very ineffective; 2 = Ineffective; 3 = Average; 4 = Effective and 5 = Very effective.

Exploratory Factor Analysis (EPA) was performed to reduce the number of variables and to assess multicollinearity that exists between the correlated factors [19]. The type of EPA employed in the study was PAF. PAF is used to determine the underlying factors related to a set of items [36]. The purpose of the PAF analysis in the study was to determine underlying dimensions of the perceived effectiveness of public extension services. The first step was to determine the adequacy of the sample size for PAF analysis using the Kaiser–Meyer–Olkin (KMO) measure. Bartlett's test of sphericity, was also performed as part of the analysis of variance. Bartlett's test of sphericity is used to test whether the data is suitable for factor analysis [37]. Again, Bartlett's test measures the correlation matrix. The value of the KMO measure obtained was 0.97, which indicates that the sample size was adequate for PAF analysis. A value of ≥ 0.90 is considered excellent for factor analysis [38]. The results of the Bartlett's test were as follows: the Chi-square value obtained was 7262.68 with 120 degrees of freedom (df), and the significant value was 0.00. This means that the Bartlett's test of sphericity was statistically significant at 120 degrees of freedom. Because Bartlett's test of sphericity was statistically significant ($p < 0.01$), the data was suitable for factor analysis.

Thereafter, all 16 variables which measured perceived effectiveness of extension and advisory services in the survey questionnaire, were loaded for PAF analysis. PAF with oblique promax rotation was employed. Oblique rotations (direct oblimin, quartimin and promax) gives more accurate results in social science research compared to orthogonal rotations (Varimax, quartimax and equamax) which may lose valuable information [39]. Moreover, oblique promax rotation was selected, because it gives better results than oblimin [40]. Different criteria was used to retain the factors for further analysis. A scree plot was used to select the total percentage variance accounted for (PVAF) in the transformed variables. In the scree plots, factors located, where the size of the eigenvalues started to make an elbow, or break, were retained [39, 41]. Factor loadings above 0.50 were also retained [41, 42]. After retaining the factors which met the above-mentioned criteria, a correlation analysis of the factors was performed.

Results

Socio-demographic characteristics of the respondents

The socio-demographic information of the respondents collected in the study was racial affiliation, gender, age, educational background and farm/plot size. The results of socio-demographic characteristics of the respondents are presented in Table 1. The results showed that largest proportion of the respondents were black Africans. Thus, the recipients of public extension and advisory services in the study area were black African farmers of which majority (51.8%) were females. The findings of educational level

Table 1 Socio-demographic characteristics of the participants ($n = 442$)

Variable name	Frequency	Percent (%)
Race		
Black African	429	97.0
Whites	11	2.5
Coloured	2	0.5
Gender		
Male	213	48.2
Female	229	51.8
Age		
<35	86	19.5
35–45	86	19.5
46–55	105	23.8
56–65	94	21.2
>65	71	16.0
Level of education		
No formal education	61	13.8
Primary education	72	16.3
Secondary education	219	49.5
Abet education	31	7.0
Diploma	16	3.6
Bachelors degree	19	4.3
Honour degree/BTech	10	2.3
Masters	12	2.7
Doctorate	2	0.5
Variable name	**(Min–Max)**	**Mean**
Farm/plot size (ha)	0.001–72	4.6

indicated that more than two-thirds (72.8%) of the participants had basic education (primary, secondary education and ABET), less than one-fifth (13.8%) had no formal education and 13.4% had acquired tertiary qualifications (diploma, bachelor's degree, honours degree/BTech, master's and doctoral degrees). It implied that most farmers could read and write, because they had formal education (tertiary and basic education). The results of farm/plot size showed that on average, the respondents occupied farming land of 4.6 ha with a minimum of less than one hectare (<1 ha) and maximum of more than seventy hectares (>70 ha). Therefore, the recipients of government extension and advisory services in Gauteng province were both large and small-scale farmers.

Effectiveness of public extension and advisory services

The perceived effectiveness of public extension and advisory services were determined using different variables derived from the South African norms and standards for extension and advisory services in agriculture. The results of the farmers' perceived effectiveness of public extension and advisory services in the study area are presented in Table 2. The results showed that, of the 16 variables measured in the study, public extension and advisory services were perceived as effective in five variables. This is shown by more than half (>50%) of the respondents who agreed that public extension services were effective and very effective. A median of five (5) also support the notion that public extension services were perceived to be effective in all five variables. Moreover, all five variables had IQR between 3.2 and 3.6 for 95% CI lower bound and upper bound, respectively. Most importantly, public extension and advisory services were perceived by 55.0% as effective in complying with the principles of Batho Pele (rendering good quality services and goods) when dealing with people and planning activities; followed by promoting equity through subsistence small-scale farmers, women farmers, disabled farmers and commercial farmers with 54% of the respondents. About 53% of the respondents perceived public extension services as being effective in providing and facilitating advice on skills development in agriculture. Furthermore, 52% and 51% of them held the opinion that public extension services were effective in providing and facilitating

Table 2 Perceived effectiveness of public extension and advisory services in the Gauteng province ($n = 442$)

Variable (Item)	Proportion of the participants (%)					Median (IQR)
	Very ineffective	Ineffective	Average	Effective	Very effective	
Renders high quality extension and advisory services	8.8	9.3	31.4	38.9	11.5	4 (3.3–3.5)
Uses extension approaches that are relevant to the beneficiaries	9.0	8.8	31.2	38.5	12.4	4 (3.3–3.5)
Is demand driven	8.6	13.1	29.6	36.9	11.8	3 (3.2–3.4)
Is compliant with the principles of Batho Pele when dealing with people and planning activities	8.8	7.0	29.2	39.8	15.2	4 (3.3–3.6)
Promotes equity through subsistence small-scale farmers, women farmers, disabled farmers and commercial farmers	10.0	10.9	25.6	37.3	16.3	4 (3.3–3.5)
Is flexible in responding to farmers' ever-changing needs	11.1	13.6	28.7	35.7	10.9	3 (3.1–3.3)
Has effective monitoring and evaluation tools	10.6	11.1	31.7	36.0	10.6	3 (3.1–3.4)
Prioritises the needs of the beneficiaries	10.4	13.6	30.1	36.9	9.0	3 (3.1–3.3)
Focuses on human and social capital development	10.0	12.9	29.4	35.1	12.7	3 (3.2–3.4)
Uses participatory approaches in planning, implementation and evaluation of their projects/programmes	12.2	8.4	29.4	36.0	14.0	3.5 (3.2–3.4)
Facilitates access to extension and advisory services that lead to sustainable income generation by clients	10.2	13.1	30.8	34.8	11.1	3 (3.1–3.3)
Provides and facilitates access to agricultural information for improved planning and decision-making	8.8	10.2	29.4	41.2	10.4	4 (3.2–3.4)
Facilitates access to technology and where possible, provides such technologies	11.8	14.7	32.1	32.1	9.3	3 (3.0–3.2)
Provides and facilitates access to advice on sustainable agricultural production (including conservation of natural resources)	10.2	9.0	30.8	36.2	13.8	3.5 (3.2–3.5)
Provides and facilitates advice on skills development in agriculture	11.1	7.2	28.3	37.8	15.6	4 (3.3–3.5)
Strengthens institutional arrangements (partnerships, restructuring, corporatisation, funding, establishment of new entity/ties) for the effective delivery of services	12.9	13.1	25.1	35.5	13.3	3 (3.1–3.4)
Average	10.3	11.0	29.6	36.8	12.4	–

IQR interquartile range

access to agricultural information for improved planning and decision-making, and using extension approaches that are relevant to the beneficiaries, respectively. Finally, 50.4% of them were of the opinion that the government was effective in rendering high quality extension and advisory services. In general, public extension and advisory services in the Gauteng province, were perceived as ineffective, because 49% of the respondents indicated that the services rendered were average. The median score of 3.3 is also in support of the above explanation. In support, extension services were perceived to be ineffective in most of the variables, with a median of ≤ 3.5 and $< 50\%$ of the respondents who perceived the services as effective.

Factors influencing effectiveness of public extension and advisory services

The overall effectiveness of public extension services was measured using the average score of all 16 variables which measured the perceived effectiveness of public extension and advisory services. The descriptive statistic results showed that, in general, about 43.7%, 33.5%, 10.2%, 7.2% and 5.4% of the respondents perceived public extension services as effective, average, ineffective, very ineffective and effective, respectively. It implied that a minority (49.1%) of the respondents' perceived public extension services as effective, as shown by the proportions of very effective and effective combined. A median value of 3 and IQR (3.2–3.4) indicates and supports the notion that public extension services were perceived as ineffective. Moreover, 33.5% of the respondents held the opinion that public extension and advisory services were moderately effective, while 17.4% indicated that the services were ineffective. The results of the OLR model fitting, achieved a chi-square value of 37.994 with a degrees of freedom (df) of four (4). Moreover, the model was statistically significant at 1% interval level ($p < 0.01$). It implied that the model could significantly predict the threshold [$p < 0.00$; $\chi^2(4) = 37.99$]; therefore, the model is suitable for the data. Again, the chi-square outputs of Pearson and Deviance achieved for goodness-of-fit were 1489.20

Table 3 Parameter estimates of the OLR results of the factors influencing perceptions towards the effectiveness of public extension and advisory services ($n = 442$)

Variables	Estimate (β)	Std. Error	*P* value
Threshold			
1 = very ineffective	−1.48	0.37	0.00
2 = ineffective	−0.43	0.34	0.21
3 = Average	1.26	0.34	0.00
4 = Effective	4.21	0.42	0.00
Location			
Education level	0.35	0.06	0.00
Gender	−0.26	0.18	0.15
Age	0.16	0.07	0.02
Farm/plot size	−0.04	0.01	0.00

[a] Dependent variable: perceived effectiveness of public extension and advisory services

and 925.44, respectively. The degrees of freedom (df) for both chi-square outputs (Pearson & Deviance) was 1252. However, Pearson chi-square was statistically significant ($p = 0.00$), while Deviance was insignificant ($p = 1.00$). According to [43], non-significant results of Pearson and Deviance chi-square implied that the data fit the model well. However, they do not always have to be similar. Therefore, the model fit the data, because Pearson chi-square was not statistically significant. The values of Pseudo *R*-Square were 0.082, 0.089 and 0.033 for Cox and Snell, Nagelkerke, and McFadden, respectively. Unlike in Multiple Regression Models, the Pseudo *R*-Squares measures have limitations in evaluating the overall model fit [44]. As a result, the values are accepted as they are, without further interpretation.

The results of the parameter estimates of the Ordered Logistic Regression (OLR) model of the factors influencing perceptions towards the effectiveness of public extension and advisory services are presented in Table 3. The results showed that only two of the four independent variables (education level and age), fitted in the regression model, were positive, while the others were negative (gender and farm/plot size). Both positive variables (education level and age group) were statistically significant at 1% and 5% levels of significance (99% and 95% confidence interval), respectively. Education level had a positive ($\beta = 0.35$) and significant relationship ($p < 0.02$) with perceived effectiveness of public extension and advisory services, with all other factors being constant. Furthermore, there was a positive ($\beta = 0.35$) and significant correlation ($p < 0.00$) between age and perceived effectiveness of public extension services. Therefore, when farmers' age increased, they perceived extension services as more effective.

Nevertheless, the relationship between farm/plot size and farmers' perceptions toward public extension and advisory services, was negative ($\beta = -0.04$) and statistically significant ($p < 0.00$). It means that when farm/plot size increases, farmers perceive public extension services as less effective, with all things being equal.

Exploratory factor analysis

This section presents the results of the exploratory factor analysis which was performed using PAF. The purpose was to identify underlying factors regarding the perceived effectiveness of public extension and advisory services in the study area (Gauteng province). First, the results of the adequacy of the sample size for PAF analysis and the test of sphericity are presented, followed by the scree plot; the cumulative column explaining total variance; the exploratory factor analysis; and the factor correlation matrix. After the first analysis, three factors were extracted from the exploratory factor analysis. Furthermore, 12 variables were retained for further analysis after dropping those with loadings less than 0.50. The KMO score obtained was 0.96, which implied that the sample size was still adequate for factor analysis. Furthermore, Bartlett's test of sphericity was statistically significant ($p < 0.01$), meaning the data was also appropriate for factor analysis. The Chi-square value obtained, was 5113.89 with 66 degrees of freedom (df).

Figure 3, presents the scree plot that indicates how eigenvalues were plotted against factors. The results in the scree plot showed that the elbow started to decrease at Factor 4 with an eigenvalue of 0.35. Therefore, the first three factors on the slope, before the graph started decreasing to form an elbow, were retained. A detailed explanation regarding the names of the factors that were retained is provided in Table 4.

The results of the cumulative column explaining total variance is presented in Table 4. The results depict that the three extracted factors contributed 81.81% of the variance. Individually, factors 1, 2 and 3 contributed 70.72%, 6.10% and 5.00% to the total variance, respectively. Factor 1 demonstrated the highest eigenvalue with 8.49, followed by Factor 2 with 0.73 and 0.60 for Factor 3. Descriptions of all the factors, loading values and their communalities are presented in Table 5.

Table 5 presents the results of the exploratory factor analysis of the effectiveness of public extension and advisory services. The results show that the analysis extracted three factors for the effectiveness of public extension and advisory services, in the study area. Factor 1 consisted of six variables, followed by Factor 2 and Factor 3 with four and two variables, respectively. The three extracted

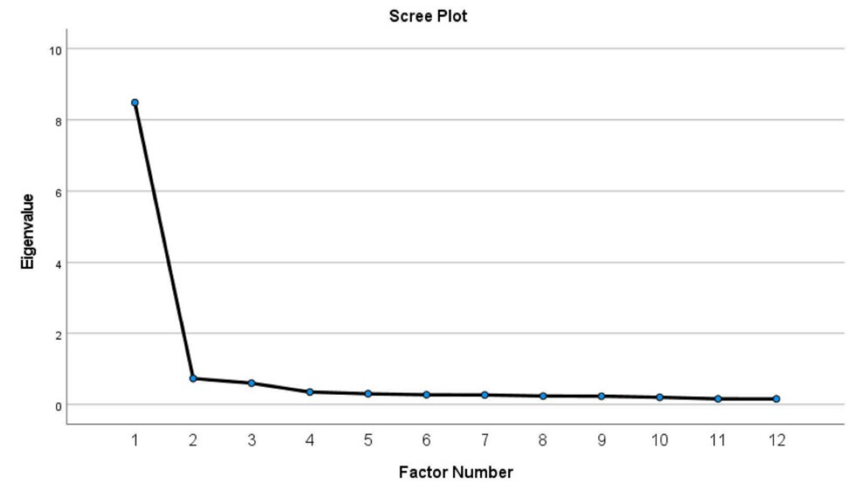

Fig. 3 Scree plot for factor analysis

Table 4 Cumulative column explaining total variance

Total variance explained							
Factor	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total
1	8.49	70.72	70.72	8.24	68.69	68.69	7.35
2	0.73	6.10	76.81	0.48	4.03	72.72	6.57
3	0.60	5.00	81.81	0.31	2.61	75.33	6.47
4	0.35	2.91	84.72				
5	0.30	2.52	87.24				
6	0.27	2.28	89.52				
7	0.27	2.23	91.75				
8	0.24	1.98	93.73				
9	0.23	1.94	95.67				
10	0.20	1.69	97.36				
11	0.16	1.32	98.69				
12	0.16	1.31	100.00				

factors are labelled as follows: Factor 1 is relevant and good quality extension and advisory services (Promoting equity when rendering relevant and good quality extension services; and using appropriate approaches that are flexible and effective in monitoring and evaluation). Factor 2 is the provision of information which improves agricultural production (Facilitating and providing access to information which improves agricultural skills; planning and decision-making; and which sustains agricultural production and strengthens institutional relationships). Factor 3 is providing technologies required by farmers (Facilitating and providing access to technology that prioritises farmers' needs). Factor loading for a large proportion of the participants was more than 0.60; therefore, the correlation between the extracted factors and the items associated with them was high. In addition, most variation was extracted, because the communalities of all the items were between 0.63 and 0.79. The results of the communalities showed that 63–79% of the variability in the perceived effectiveness of public extension and advisory services, is explained by the three factors (1–3).

Table 5 Results of the exploratory factor analysis of the effectiveness of public extension and advisory services ($n=442$)

Variables	Factor			Communalities
	Factor 1	Factor 2	Factor 3	
Promotes equity through subsistence small-scale farmers, women farmers, disabled farmers and commercial farmers	0.80			0.77
Is compliant with the principles of Batho Pele when dealing with people and planning activities	0.80			0.79
Offers high quality extension and advisory services	0.67			0.79
Uses extension approaches that are relevant to the beneficiaries	0.65			0.77
Has effective monitoring and evaluation tools	0.65			0.78
Is flexible in responding to farmers' ever-changing needs	0.52			0.74
Provides and facilitates advice on skills development in agriculture		0.74		0.74
Provides and facilitates access to agricultural information for improved planning and decision-making		0.68		0.75
Provides and facilitates access to advice on sustainable agricultural production (including conservation of natural resources)		0.68		0.76
Strengthens institutional arrangements (partnerships, restructuring, corporatisation, funding, establishment of new entity/ties) for the effective delivery of services		0.60		0.63
Facilitates access to technology and where possible, provides such technologies			0.69	0.74
Prioritises the needs of the beneficiaries			0.65	0.78
Eigenvalue	8.49	0.73	0.60	9.82
Cumulative variance explained (%)	70.72	6.10	5.00	81.81

Therefore, the factor analysis explains the variation in eleven of the twelve (11 out of 12) variables very well.

After extracting all the factors and their individual variables, the factor correlation matrix was generated. The results indicated that relevant and good quality extension and advisory services (Factor 1) was positively correlated with provision of information that improves agricultural production (Factor 2), $r=0.74$. This implied that participants, who were of the opinion that public extension and advisory services were effective in rendering relevant and good quality extension services, perceived the provision of relevant information that improves agricultural production as an important measure of effective extension services. Factors 1 (rendering relevant and good quality extension and advisory services) and 3 (Providing technologies required by farmers) were correlated ($r=0.74$). This means that farmers who perceived relevant and good quality extension and advisory services as a measure of effectiveness, held the opinion that extension services should provide technologies required by farmers to be considered effective. Finally, factors 2 (providing information that improves agricultural production) and 3 (Providing technologies required by farmers) were positively correlated ($r=0.71$). Therefore, farmers who perceived public extension and advisory services as effective in providing information that improves agricultural production, held the opinion that extension services that provide technologies to the farmers are effective.

Discussion

The aim of the study was to determine farmers' perceived effectiveness of public extension and advisory services in the Gauteng province and the underlying factors. The study found that in general, farmers perceived public extension and advisory services in the province as ineffective. However, extension services were perceived to be effective in six out of sixteen variables (6/16) measured in the study (see Table 2). Therefore, government extension officers did not meet all the expectations in the the norms and standards for extension and advisory services in agriculture developed by the Ministry of Agriculture in South Africa. The implications of the perceived ineffective extension and advisory services, in some of the variables measured, may negatively affect agricultural activities of farmers. For example, ineffectiveness in rendering demand driven services, inflexibility, and poor prioritisation of farmers' needs, may result in rendering extension services that are irrelevant to farmers. A demand-led and flexible system will enable government to render services that are responsive to farmers' needs. In addition, the perceived ineffectiveness of public extension in facilitating and providing access to technology and advice that sustains agricultural production, is a major concern. In support, it has been reported that in Kilindi District of Tanzania, public extension services were not effective in transferring information that improved maize production of the farmers [12]. Parallel to that, access to extension services had insignificant impact on agricultural production of farmers in Jordan [9]. In contrast, farmers in Kaduna State, Nigeria indicated that effective extension services enhanced their agricultural productivity [10]. Extension services that do not promote adoption of innovations that sustain agricultural production may negatively affect farmers' productivity. Research has shown that the adoption of agricultural innovations and farm production, have a positive and significant correlation [45]. Meaning, farmers who adopt innovations are more likely to achieve higher agricultural outputs. Furthermore, adoption of new technologies has a positive and significant relationship with farm income [46]. Thus, in the current study, extension services were unlikely to help farmers achieve higher agricultural productivity through adoption of new technologies.

On the other hand, public extension services were effective in addressing some of the farmers' needs. This is an indication that public extension officers effectively rendered some of the expected services to the farmers in the study area. For example, effective in compliance with the principles of Batho Pele (good quality services and goods) when dealing with people and planning activities; as well as rendering high quality extension and advisory services, is positive. The findings by [12, 47] were in disagreement, because they found that in Tanzania and Pakistan, most farmers held the opinion that government was not effective in rendering extension services of good quality. In addition, studies conducted in South Africa (West Coast and Amathole District Municipalities) showed that public extension services were not satisfactory to most farmer [48, 49]. Thus, farmers perceived the quality of public extension services to be poor. Moreover, the study findings in Table 2 showed that farmers perceived public extension services to be effective in providing and facilitating access to agricultural information for improved planning and decision-making, and using relevant extension approaches. Similarly, studies conducted in South Africa [48, 49]; Ghana and Zambia [7]; Egypt [13] found that most farmers perceived public extension services as effective in the dissemination of information. On the contrary, farmers in South Africa and Pakistan indicated that public extension services were not effective in the dissemination of information through print material [9]; agricultural campaigns, farmer's days, and signboards [5]. Moreover, in Pakistan it was also discovered that agricultural extension services provided insufficient information to most farmers [47]. Information access enables farmers to make decisions that improve their farming and solve problems [50]; moreover, information is essential in improving agricultural outputs, marketing and distribution strategies [51]. Thus, through public extension and advisory services, farmers in the study area held the opinion that they were able to make informed decisions when planning their agricultural activities. In addition, the majority of the farmers held the opinion that government extension officers were not discriminating when rendering extension services. This is evident, because public extension services were perceived to be effective in promoting equity through subsistence small-scale farmers, women farmers, disabled farmers and commercial farmers. This is in contrast to the study that discovered that female farmers were less likely to receive extension services of good quality [52]. Thus, the respondents in the current study were of the opinion that public extension services did not exclude farmers because of scale of operation, gender and physical abilities. It showed that the respondents have full confidence about the approaches used by government extension officers to promote equality through extension and advisory services.

Through the OLR model, education level and age were identified as the factors that positively and significantly influenced farmers' perceptions about the effectiveness of public extension services in the study area. It implied that farmers with higher education levels perceived public extension services as `effective compared to those who had lower education levels. The reason could be that highly educated people are well informed about the role of extension services; hence, they do not have high expectations from government extension officers. As a result, they were satisfied with the extension and advisory services rendered and considered public extension effective. On contrary, education had a negative and significant correlation with perceived effectiveness of extension services in promoting modern technologies [47]. Again, with all things being equal, older farmers perceived public extension services to be more effective than younger farmers did. This may be because older farmers are well experienced about farming, thus, they have less expectations from extension officers. Moreover, they may be unaware about the kind of services that should be rendered to them in accordance with the norms and standards for extension and advisory services prescribed by the Ministry of Agriculture. In support to the study findings, [17] also reported a positive and significant relationship between age and perceived effectiveness of extension services. However, in another study, age was found to be positive and insignificant on farmers' perceptions towards the effectiveness of extension services [15]. On the other hand, farm/plot size had a negative and significant correlation with perceived effectiveness of extension services. Thus, large-scale farmers perceived public extension services as less effective, with all things being equal. The motivation could be that large-scale farmers expected extension officers to visit them regularly, allocate more resources in accordance with their farm size and give them special preference. Therefore, when such expectations were not met, such farmers perceived extension services to be less effective. In contrast to what was discovered in the study, farm size had a positive and significant influence on the perceived effectiveness of extension services [16].

The results of PAF analysis generated three important factors underlying the perceived effectiveness of public extension and advisory services (see Table 5). The findings showed that relevant and good quality extension and advisory services (factor 1) was the most important predictor of the perceived effectiveness of public extension services. It was followed by the provision of information which improves agricultural production (factor 2), and providing technologies required by farmers (factor 3). In contrast to the current findings, [18] found that the important factors influencing the effectiveness of extension services were structural, socio-cultural and economic factors, as well as factors relating to policy-making. In the current study, the most important predictor (factor 1) included providing appropriate, good quality and flexible extension and advisory services to all farmers using relevant extension approaches and effective monitoring and evaluation tools. It implied that extension services using flexible approaches that have clearly defined and effective monitoring and evaluation systems, were perceived to be the most effective. Therefore, farmers in the study area perceived a participatory extension approach as effective compared to a top-down approach, which is not flexible. This is not surprising, because globally, agricultural extension has been shifting from top-down towards participatory approaches. Participatory approaches enable farmers to play a critical role in the generation of knowledge and change of practice [53]. The approach involves farmers in the planning of activities and ensures that their needs are catered for, as opposed to the needs perceived by government [54]. Moreover, monitoring and evaluation of the extension services was an important variable that determined the perceived effectiveness of public extension services in factor 1. The reason could be that monitoring and evaluation enables farmers and extension agents to identify the shortfalls of the services, to revise the extension methods, and to improve the services rendered. Factor 2 shows that extension and advisory services which enabled farmers to acquire farming information and skills that improve and sustain their agricultural production and relationships with stakeholders, and were perceived as effective. This could be motivated by the fact that access to agricultural information has a positive correlation with agricultural production [10, 51]. Again, the respondents perceived their relationship with various stakeholders as an important variable that determines the effectiveness of extension services in factor 2. It implied that farmers expected extension officers to link them with various stakeholders that play an integral role in farming. Therefore, extension officers who linked farmers with corporate, financial institutions and other relevant stakeholders were perceived as effective. Measuring the effectiveness of extension services, by evaluating the relationship with various stakeholders, is an indication that farmers are in favour of a pluralistic extension delivery system. Globally, a pluralistic delivery system has gained popularity, because extension approaches have evolved from linear approaches to an agricultural innovation system that requires participation of various stakeholders. Agricultural innovation systems bring all potential public and private sectors in creation, diffusion, adoption and use of all types of agricultural knowledge relevant to production and marketing of produce [55]. Factor 3 is providing technologies required by farmers. Thus, farmers perceived extension services that facilitate and provide access to technology that prioritises farmers' needs, as effective. Transfer of technology through extension agents to the farmers, include critical information from research and development [56]. Hence, farmers in the study area valued the role that extension agents can play in the transfer of technology. Adoption of technology has the potential to improve agricultural production of the farmers [57]. However, not all technologies brought to the farmers, improve agricultural production, because some of them are irrelevant. As a result, farmers noted the importance of providing technologies that prioritizes their needs as an important measure to determine effectiveness of extension services.

Conclusions

The study found that, in general, public agricultural extension and advisory services in the Gauteng province were perceived as ineffective. However, extension services were effective in six principles in the norms and standards for extension advisory services in agriculture, as developed by the Ministry of Agriculture. Through the OLR model, the study identified three socio-demographic factors (education level, age and farm/plot size) that significantly influenced farmers' perceptions about the effectiveness of public agricultural extension and advisory services. The identified socio-demographic factors had positive (education level and age) and negative (farm/plot size) influences on farmers' perceptions. Large-scale farmers were of the opinion that public extension and advisory services were less effective; however, highly educated and older farmers perceived extension services to be more effective. Moreover, three underlying factors (dimensions) of the perceived effectiveness of public extension services were extracted through PAF analysis. The three underlying factors accounted for 81.81% of the variance of the perceived effectiveness of public extension services. The three underlying factors may serve as a basis for informed policy decisions to improve agricultural extension and advisory services. The current study suggests that, for public extension and advisory services to be effective, extension agents should render relevant, good quality services and provide information that improves agricultural production and facilitates access to the technologies required by farmers. Again, farmers should receive extension and advisory services that are proportional to their scale of operation (farm/plot size). Moreover, other researchers could use the identified underlying factors to develop detailed survey instruments that measure the effectiveness of public extension and advisory services.

Abbreviations

CAES: College of Agriculture and Environmental Sciences; DoA: Department of Agriculture; DF: Degrees of Freedom; EFA: Exploratory factor analysis; GDARD: Gauteng Department of Agriculture and Rural Development; ICT: Information and Communication Technology; KMO: Kaiser–Meyer–Olkin; MS: Mean Score; PAF: Principal axis factoring; PCA: Principal component analysis; PPP: Public–private partnership; SPSS: Statistical Package for the Social Sciences; Unisa: University of South Africa.

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Author contributions

Both authors (MMSM and MAA) give consent for the manuscript to be published. Paper conceptualisation: MMSM, methodology: MMSM and MAA, data analysis: MMSM and MAA, writing: MMSM, editing and review: MA. Both authors read and approved the final manuscript.

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Availability of data and materials

The data used for the manuscript is attached in the documents submitted. The primary data is in Microsoft Excel. Furthermore, the statistical outputs from SPSS are attached. The names of the attached files for data and SPSS outputs are Primary data and SPSS Output_BMC.

Declarations

Ethics approval and consent to participate

The study received permission and ethics approval from GDARD and CAES Research Ethics Review Committee at the University of South Africa. The ethical clearance number for CAES Research Ethics Review Committee is 2016/CAES/073. All the selected participants were requirement to sign informed consent form before they were interviewed during data gathering.

Consent for publication

Not applicable.

Competing interests

All the authors declare that they do not have financial interests.

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Determinants of the acceptability of university agricultural extension in the Gauteng province of South Africa

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Abstract: Universities offering agricultural programmes have the potential to complement public agricultural extension and advisory services because they are at the centre of knowledge generation—through research, teaching and community outreach programmes. The purpose of this study was to determine farmers' acceptability of university agricultural extension and the factors influencing their decision. Using probability sampling, a sample of 442 participants from Gauteng Province were selected for inclusion in the survey to collect data through face-to-face interviews. Primary data were subjected to descriptive statistical analysis and Exploratory Factor Analysis (EFA) found in IBM SPSS version 27. The results showed that a significant proportion of the respondents favoured the introduction of university agricultural extension to complement public extension services as part of a pluralistic extension system. Furthermore, most of the farmers were willing to pay for extension services and were optimistic about the perceived benefits of associating with universities. The exploratory factor analysis revealed that access to research resources, improved extension services and training, and diffusion of university research were the three factors underlying the acceptability of university agricultural extension. It is suggested that a formal framework for pluralistic extension system should be developed through a participatory process that involves all stakeholders.

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1. Background and introduction

In most countries throughout the world, government has been the main provider of agricultural extension services (Ajayi, 2006; Anderson & Feder, 2004; Cary, 1993; Kidd et al., 2000; Magoro & Hlungwani, 2014; Maoba, 2016). However, many countries have been reforming their public extension services because they are struggling to meet the demand for services due to high costs, limited resources, changes in extension philosophies or approaches, and slow increase in public funding activities (Afful & Lategan, 2014; Anderson & Feder, 2004; Picciotto & Anderson, 1997). In some countries, reforms are propagated by financial discipline implemented by the state; and agricultural extension has become a victim (Bennett, 1996; Kidd et al., 2000; Qamar, 2005). Generally, the main purpose of these reforms is to ensure that farmers are provided with the best agricultural extension services that are financially sustainable (Afful & Lategan, 2014; Kidd et al., 2000). Many countries have come up with agricultural extension reform strategies; these reforms are either market or non-market strategies (Laurent et al., 2006; Rivera et al., 2000). Market reforms include pluralism, cost recovery, total privatisation and revision of public-sector extension services, while non-market reforms comprise decentralisation/devolution (transferring power to local government) and subsidiary (Rivera et al., 2001). In general, market reforms are adopted in developed countries, whereas non-market reforms are common in developing countries—mainly because most farmers in developing countries are not willing to pay for agricultural extension services that form part of market reform (Afful, 2012; Ali et al., 2008; Foti et al., 2007; Oladele, 2008; Qamar, 2005). Agricultural extension reforms have yielded positive results in some countries but failed in others. In general, participatory reforms have been successful compared to fee-for-service, especially in low-income countries where there has been evaluation of the reforms (Davis, 2008). Participatory extension reforms have succeeded because they involve farmers and various stakeholders in planning and decision-making. On the other hand, fee-for-service extension systems may have failed because farmers cannot afford to pay for the services due to the low income earned from agricultural activities. For example, the willingness of the farmers to pay for extension services has been reported to be positively and significantly correlated with income (Ajayi, 2006; Loki et al., 2019; Oladele, 2008; Shausi et al., 2019; Uddin et al., 2016). Therefore, farmers with low farm income are reluctant to pay for extension services and are likely to contribute less.

In South Africa, the reform of agricultural extension started in 1994, after the new, democratically elected government came into power; the reform was aimed at correcting the dualistic agricultural extension services created by the apartheid government (Department of Agriculture DoA, 2005; Düvel, 2004; Koch & Terblanché, 2013; Ngomane, 2010; Phuhlisani, 2008). The dualistic system mainly benefited white farmers because the majority of them were commercial farmers, compared to black farmers who were farming on small-scale settings. For example, 90 000 white farmers were allocated about 3 000 agricultural extension officers with easy access to credit, marketing and guaranteed prices whereas 600 000 black farmers had less than 1 000 extension officers allocated to them (Lipton, 1972; Phuhlisani, 2008). Smallholder farmers who are mainly blacks, were oppressed by the apartheid system which segregated them from their white counterparts (Düvel, 2004). As a result, white farmers had better access to extension services compared to black farmers. Because of that, extension services offered to black farmers were characterised by poor quality, low effectiveness due to unqualified extension personnel, outdated extension methods and approaches, lack of coordination between government and agricultural corporations, insignificant relationship between extension and research; and low utilisation of farmer's training centres (Hayward & Botha, 1995). Extension services offered to white farmers were of good quality because most of them are large-scale commercial farmers. Nonetheless, the reform changed agricultural extension services in South Africa from dualistic services (separate services for commercial and small-scale farmers) to amalgamated services focused on both small-scale farmers and large-scale commercial farmers after 1994 (Department of Agriculture DoA, 2005; Koch & Terblanché, 2013). The amalgamated system increased the number of extension personnel and improved access to extension services amongst black farmers who were previously disadvantaged by the dualistic agricultural extension. For example, Phuhlisani (2008) found that South Africa had about 2 155 extension agents in January 2007; about a year later, the number of extension officers increased to 2 800 (Williams et al., 2008). Few year later, it was reported that South Africa has about 3 369 extension officers employed by government in various provinces (Ngaka & Zwane, 2018). Despite the high number of extension agents in the country, Agricultural Research Council (ARC) reported that the average ratio was 1:873, which is above government's recommended ratio (Agricultural Research Council ARC, 2011). According to the Department of Agriculture, Forestry and Fisheries (DAFF), the low extension to producer ratio is due to the rapid increase in the number of smallholder farmers accessing land through land reform programmes and lack of clear definition of the target recipients of extension services (Department of Agriculture, Forestry and Fisheries DAFF, 2016). As a results, there is assumption that all rural people are involved in agricultural production and entitled to public extension and advisory services. Because of the change in policies that governed agricultural extension services in South Africa in the post-apartheid government era, small-scale farmers started to depend heavily on public extension services as they could not afford private extension services (Ngomane, 2002). This change in policy created a burden on the public extension system because there were high expectations from government extension services. It has been reported that South African public extension services are not coping with the demand for extension services because the support provided to small-scale and resource-poor farmers is limited; this is hindering their aspirations to develop from emerging into commercial farmers (Phiri, 2009). As a result, these farmers are not satisfied with the public extension services (Agholor et al., 2013; Ngomane, 2000; Phiri, 2009). Therefore, there is a need to reform agricultural extension services in South Africa in order to improve the quality and effectiveness of the extension and advisory services rendered to the farmers.

Globally, the reform of agricultural extension has shifted towards pluralistic extension delivery systems (Alimirzaei et al., 2019; Gemo et al., 2013; Knierim et al., 2017; Masangano et al., 2017; Nahdy et al., 2002; Rivera & Alex, 2004). A pluralistic extension system is about the provision of extension services by different organisations such as government, private sector and non-profit organisations (Klerkx & Proctor, 2013; Phillipson et al., 2016). Moreover, the system acknowledges the need to alleviate farmers' challenges using different approaches because of the diversity of the farming systems used by different farmers (Gemo et al., 2013). In South Africa, the pluralistic extension system includes stakeholders such as government through the Ministry of Agriculture, agricultural cooperatives, commodity organisations and the private sector (Koch & Terblanché, 2013; Zwane, 2009). Moreover, Zwane (2009) reported that research organisations, academic institutions, farmers' unions and non-governmental organisations provide extension services to the farmers in South Africa. However, government is the main service provider of agricultural extension services in South Africa (Magoro & Hlungwani, 2014; Motiang & Webb, 2015; Nkosi, 2017; Zwane, 2009). Private agricultural extension services are profit driven and thus exclude poor farmers (Koch & Terblanché, 2013). This means that extension services rendered by the private sector are only accessible to commercial large-scale farmers and highly profitable agricultural enterprises. However, farmers' unions and commodity organisations provide services to the farmers affiliated to them. Parallel to that, it is not mandatory for academic institutions such as universities to render agricultural extension services in South Africa. The provision of agricultural extension services by universities occurs at a limited scale through community engagement and outreach programmes. Nonetheless, from a societal perspective, university agricultural extension appears to be an attractive complement to public extension in South Africa. Universities may provide a viable option for pluralistic extension system because they are public-funded; besides, most of the universities offer agriculture and life sciences programmes. Again, university agricultural extension services can be accessible to poor farmers if there is a government framework for pluralistic extension delivery systems.

Internationally, university agricultural extension (cooperative extension) has been successful in many countries including the United States of America (USA), India, Nigeria and others (McLean, 2007; Okolo, 2010; Rodgers, 1992). For example, in the USA, university extension seated in land-grant universities has been the agent of innovation through research that improved the livelihoods of the beneficiaries (Franz & Townson, 2008). State agricultural universities and colleges in India have been successful in rendering extension and advisory services to their surrounding communities (Van den Ben & van den Ban, 2003). In South Africa, there is evidence that university agricultural extension played a critical role in the success of white commercial farmers during the apartheid era before the year 1994 (Ngomane, 2010). During that era, farmers had easy access to agricultural research and information from universities through the Department of Agriculture; however, the cordial relationship that existed between universities and the Department of Agriculture has weakened in recent years (Koch & Terblanché, 2013). As a result, university agricultural extension services have slowly diminished in both small-scale and commercial farming settings. The low participation of universities in rendering extension services is worrying because agricultural scholars at the universities are involved in agricultural development activities such as teaching, research, knowledge generation, curriculum and module development, and other academic activities. For example, universities generate knowledge about new agricultural innovations, ethnoveterinary medicine, farming practices, livestock and crop management, marketing of agricultural commodities, animal and crop breeding, adoption of innovations, land use planning, soil fertility and management and other important farming aspects. Knowledge generated by institutions of higher learning can be promoted by creating platforms that will link farmers with those institutions. It is because of that backdrop that university extension is perceived as an important stakeholder for pluralistic extension system in South Africa. Even though universities have the potential to participate in the provision of agricultural extension services in collaboration with government, it is unknown whether farmers are in favour of the pluralistic extension system that involves academic institutions. According to Pye-Smith (2012), a pluralistic delivery system should be demand-led and should follow a participatory approach. Thus, the farmers' acceptability of university agricultural extension is crucial because farmers are the main beneficiaries of extension services. To fill this knowledge gap, the research is aimed at exploring the acceptability of university extension as a complement to public extension services. The specific objectives of the study are as follows: to determine farmers' acceptability of university agricultural extension as a complement to public extension; and identifying the important factors (predictors) influencing their decisions.

2. Methodology

The study was conducted in the Gauteng province of South Africa through a survey research design. The population of analysis consisted of farmers in Gauteng receiving agricultural extension and advisory services from government. Gauteng province was selected because there are about three universities offering various agricultural qualifications (agribusiness, agricultural economics and management, agricultural extension, animal production and science, agronomy, crop/plant production and science, entomology, plant pathology, pasture management and science, soil science and others). Moreover, about five of the universities in the province offer life science and other programmes that are related to agriculture. Therefore, most universities in Gauteng province are important stakeholders in agriculture through teaching, knowledge generation and development of agricultural innovations. Gauteng is the smallest province of South Africa; however, it has the highest population because it is the economic hub of the country with mining and industries. It contributes 35% of the gross domestic product (GDP) of South Africa, and 11% in Africa (Gauteng Enterprise Propeller GET, 2020). The province is multiracial because of labour influx from other provinces and African countries. According to Krejcie and Morgan (1970), a sample size of 368 is appropriate for a population of 9 000 to achieve a margin error of 5%. However, 442 participants were sampled because more farmers expressed interest to participate in the study during data collection. Most of the interested participants were found in community gardens where they are farming in groups. Although simple random sampling was used to select the targeted participants (368), an additional group of 74 farmers who showed interest were included in the study. Random sampling was chosen because it gives all the individual an equal opportunity to be selection for participation in the study (Acharya et al., 2013). The participants were farmers in community gardens, on agricultural plots and on large-scale farms. Before the data collection started, permission and ethical clearance were obtained from the Gauteng Department of Agriculture and Rural Development (GDARD) and the College of Agriculture and Environmental Sciences (CAES) Research Ethics Review Committee of the University of South Africa (Unisa), respectively. A semi-structured survey instrument was utilised to collect data from the participants during face-to-face interviews. The survey instrument collected information about socio-demographic information (age, gender, marital status, education level, farmland size, farming experience and annual net farm income and farming category); acceptability of university agricultural extension and perceived advantages; access to extension services; perceptions about quality of extension services; and preferred extension delivery system and funding model for university extension; and perceived challenges of university extension. For the purpose of this paper, only information about farmer's socio-demographic characteristics, acceptability of university extension and its advantages were selected to analysis. The other information was presented in the report for the main study that had different objectives. The survey instrument consisted of dichotomous, Likert-scale type, continuous and open-ended questions. However, for the purpose of this paper, only data from dichotomous and Likert-scale type questions was considered for analysis. A dichotomous question was asked about the acceptability of university agricultural extension as a complement to public extension. The possible responses to the question were "No" and "Yes", denoted by zero (0) and one (1), respectively. Moreover, a five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, 5 = strongly agree) was used to measure the perceived benefits of university agricultural extension. The five-point Likert scale consisted of 12 questions, which were later reduced to 10 – after performing exploratory factor analysis.

The study employed different methods of data analysis found in the IBM Statistical Package for the Social Sciences (SPSS) version 27. The statistical analyses performed were a reliability test, Exploratory Factor Analysis (EFA), descriptive statistics and binomial test. The first analysis involved determination of Cronbach's alpha coefficient aimed at measuring internal consistency, and therefore an indicator of internal structure validity of the five-point Likert scale used to collect data. The analysis included all 12 Likert-scale type questions in the study. The coefficient value of Cronbach's alpha obtained was 0.95. Thus, the internal consistency of the likert scale was satisfactory (Hair et al., 2006). There were no alpha values for each of the components extracted from the rotated matrix because the questions in the likert scale were not categorized. The factors and their items were extracted during rotation. All twelve (12) of the Likert-scale type questions were considered for exploratory factor analysis and descriptive statistics. Descriptive statistical analysis included frequencies, percentages, median, mean and interquartile range (IQR). The type of exploratory factor analysis used was Principal Axis Factoring (PAF). EFA was used to establish new variables associated with the acceptability of university extension and their correlation. EFA was chosen because it can reveal complex relationships that exist in a dataset by exploring it and testing predictions (Child, 2006). In the current study, one of the objectives was to identify important factors associated with the acceptability of university extension and their correlation. Thus, EFA was appropriate because it can extract the important predictors associated with a phenomenon. In addition, the study intended to develop a scale containing important factors that should be considered when investigating university extension services. Because of that, the questions in the Likert-scale were not grouped; thus, allowing EFA to do the classifications of the important factors and their items. According to Costello and Osborne (2005), in social science research where exploratory factor analysis is applied, oblique rotations such as promax, direct oblimin and quartimin give better results than orthogonal rotations (Varimax, quartimax and equamax). Furthermore, oblique promax rotation was chosen because it gives better results than oblimin (Dien, 2010). As a result, Principal Axis Factoring (PAF) with promax rotation was employed in EFA. After performing exploratory factor analysis, all factor loadings above 0.50 were retained (Costello & Osborne, 2005; Hair et al., 2006). Subsequently, three factors with ten individual variables (items) were extracted. Two of the extracted factors had two or more variables (items); thus, they met the minimum requirements of three item factor. However, one factor had two items. The factor with two items was accepted because the variables were highly correlated ($p < 0.001$; $r_s = 0.70$). According to Yong and Pearce (2013), a rotated factor with two variables should be considered reliable if the variables are highly correlated with each other. All 10 of the variables that constituted three retained factors were subjected to internal consistency test. Thus, all ten items extracted were grouped according to the factors they were associated with. The coefficient values of Cronbach's alpha obtained for factors 1, 2, and 3 were 0.91, 0.88 and 0.86, respectively. Therefore, the internal consistency of the likert scale was satisfactory for all the three factors. According to Taber (2018), alpha values of 0.84–0.90 are considered reliable, whereas 0.91–0.93 is strongly reliable.

Furthermore, a binomial test was performed to test the hypothesis for dichotomous data. The purpose of the binomial test was to determine the significant difference between the respondents who were willing to accept university agricultural extension against the hypothesised proportions. The same principle was applied to the proportions of the respondents willing to pay for university extension services. The significant difference was determined at a 5% significance level ($p \leq 0.05$).

3. Results

3.1. Socio-demographic characteristics of the participants

The results of socio-economic information showed that 68.1% of the respondents were non-commercial farmers and 31.9% classified themselves as commercial farmers. Therefore, more than two-thirds of the farmers who receive public extension and advisory services did not sell all their produce for income generation to sustain their livelihoods. This may be due the fact that most farmers were found in community gardens where sharing of produce and selling were common. In such settings, the purpose of farming is to sell some of the produce to earn income, while saving some of the produce for home consumption. Therefore, such farmers cannot categorize themselves as commercial farmers because they do not sell all their produce. From farmland perspective, it was found that on average, farm/plot size of the respondents was 4.55 ha with a minimum of 0.001 ha and a maximum of 72 ha. The standard deviation and standard error of mean achieved were 8.17 and 0.39, respectively. The Coefficient of Variation (CV) percentage achieved was 179.6%, which showed that the variation in the farm/plot size occupied by the respondents was extremely high. It implied that there were farmers who occupied very small farms/plots while others had large-scale farms. Most of the farmers with plot/farm size of less than one hectare (<1 ha) were found in community gardens located in the schools, open spaces in the community, clinics and municipal land. Community gardens were in urban areas where land is limited because of high population density. The current study found that on average, farmers who received public extension and advisory services in Gauteng province have been farming for six years (actual is 6.3). The minimum and maximum farming experience of the farmers was 0.2 years (two months) and 34 years, respectively. A standard deviation of 5.35 and standard error of mean of 0.25 were achieved. The variation of farming experience was high because the CV% obtained was 84.9%. The study measured the annual farm income and found that the average annual net farm income of the respondents in the previous year was R21 387.56 with a minimum of R0 and a maximum of R410 000. Farmers who had R0 as their farm net income in the previous year were mostly from vegetable gardens and those who lost their products. Some of the farmers in community gardens shared vegetables rather than selling them to earn an income, hence, their income was zero from farming activities. The standard error of the mean and standard deviation were 2404.61 and 50,553.95, respectively.

3.2. Acceptability of university agricultural extension and perceived benefits

The results of the farmers' acceptability of university agricultural extension showed that 91.2% of the respondents were in favour of including universities as part of a pluralistic extension system in the study area, whereas 8.8% were against the idea. The assumption (alternative hypothesis) was that most farmers (≥51%) would accept university agricultural extension as a complement to public agricultural extension and advisory services. A significant value ($p < 0.001$) was obtained from the results of the binomial test; thus, the alternative hypothesis is accepted. Moreover, the majority (55.4%) of the respondents were willing to pay for extension and advisory services offered by universities, while 44.6% were not. With the assumption that most farmers would be willing to pay for extension and advisory services, a statistically significant p-value of 0.035 was achieved from the results of the binomial test. Therefore, the hypothesis is accepted because a significant proportion of the respondents were in favour of paying for extension and advisory services rendered by universities.

The results regarding perceived benefits of university agricultural extension are presented in Table 1. The descriptive statistical outputs in Table 1 indicate that on average, 79.3% of the respondents accepted university agricultural extension and advisory services as part of the pluralistic extension system. This is shown by the proportion of "agree" and "strongly agree" combined. An average median score of 4.0 also supports this. All the variables that measured perceived benefits of university agricultural extension achieved a median score of 4.0. Furthermore, the findings in Table 1 depict that more than four-fifths (>80%) of the respondents perceived five benefits of university agricultural extension and advisory services as the most important. In chronological order, the three most important benefits are better access to agricultural extension and advisory services (86.7%), access to formal education and training (85.1%), and receiving advice from subject matter experts (84.1%). The other important benefits perceived by the respondents were creating an environment for universities to conduct research that is responsive to the farmers' needs (83.3%), allowing universities to communicate their research findings to the farmers (81%) and enabling universities to develop a curriculum that is relevant to the society and to benefit the farmers (80.7%). About three-quarters of the respondents held the notion that university agricultural extension and advisory services will enable universities to use their community engagement and outreach activities to benefit the farmers (78.3%) and to provide farmers with access to research infrastructure (75.4%). Again, the same proportional representation (about three-quarters) of the respondents perceived university agricultural extension and advisory services as a system that will enable farmers to access research innovations (75.3%) and link universities with practical extension work (75.1%). On the other hand, less than three-quarters of the respondents perceived university extension as a system that will provide farmers with access to research funding (73.6%) and research journals (73.3%). In general, the results show than nearly four-fifths (79.3%) were optimistic about the perceived benefits of university agricultural extension and advisory services presented in Table 1. Therefore, most of the farmers in the study area are aware of the potential benefits of allowing universities to render agricultural extension and advisory services in collaboration with government. In addition, the respondents were well informed about some of the happenings at the universities that offer agricultural programmes (qualifications). Hence, a large proportion of the farmers were in agreement with the statements that measured the perceived benefits of university agricultural extension and advisory services.

3.3. Exploratory factor analysis of underlying factors

As explained in the methodology section, Principal Axis Factoring (PAF) with promax rotation was conducted using the data presented in Table 1. The purpose of exploratory factor analysis was to categorise the underlying factors (dimensions) of the acceptability of university agricultural extension in the study area. The results of Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity were 0.92 and 3392.38 (chi-square value), respectively. Moreover, the KMO results were statistically significant at 1% ($p < 0.001$). According to Kaiser (1970), a KMO value of ≥ 0.90 implies that the data is suitable for factor analysis. Therefore, the sample size and data were appropriate for factor analysis because there was internal coherence of the data. To select Total Percentage of Variance-Accounted-For (PVAF) in the variables, a scree plot was utilised. The scree plot in Figure 1 indicates that the decrease of the elbow starts at factor 4 with an eigenvalue of 0.40. As a result, the first three factors before the graph started forming an elbow (decreasing) were retained.

Table 1. Perceived benefits of the acceptability of university agricultural extension (n = 442)

Variable (Item)	Proportion of the respondents (%)					Median (IQR)
	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	
Farmers will have better access to agricultural extension and advisory services	5.0	2.3	6.1	63.6	23.1	4.0(3.9–4.1)
Farmers will receive advice from subject matter experts	1.6	6.1	8.1	55.4	28.7	4.0(4.0–4.1)
Farmers will have access to formal education and training	4.5	2.0	8.4	56.6	28.5	4.0(3.9–4.1)
Farmers will have access to research journals	3.6	8.8	14.3	55.4	17.9	4.0(3.7–3.8)
Farmers will have access to research innovations	7.0	3.6	14.0	52.7	22.6	4.0(3.7–3.9)
Farmers will have access to research funding	6.6	5.7	14.3	54.8	18.8	4.0(3.6–3.8)
Farmers will have access to research infrastructure	7.7	7.5	9.5	55.0	20.4	4.0(3.6–3.8)
Universities will be linked with practical extension work	3.4	7.9	13.6	55.2	19.9	4.0(3.7–3.9)
Universities will communicate their research findings to the farmers	5.2	4.3	9.5	60.2	20.8	4.0(3.8–4.0)
Universities will conduct research that is responsive to the farmers' needs	3.2	4.8	8.8	61.8	21.5	4.0(3.9–4.0)
Universities will develop curriculums that are relevant to the society	4.3	4.3	10.6	58.8	21.9	4.0(3.8–3.9)
Universities will use their community engagement and outreach activities to benefit the farmers	3.4	6.1	12.2	59.3	19.0	4.0(3.8–3.9)
Average	**4.6**	**5.3**	**10.8**	**57.4**	**21.9**	**4.0(3.8–3.9)**

Figure 1. Scree plot for factor analysis.

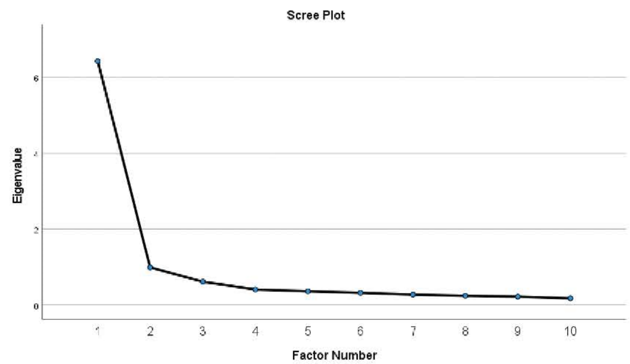

Table 2 presents the results of the exploratory factor analysis of the acceptability of university agricultural extension. The results in Table 2 depict that three extracted factors contributed 80.241% of the variance. The three extracted factors have been named 1) Access to research resources, 2) Improved extension services and training; and 3) Diffusion of university research. Factor 1 consists of five items (variables) that account for 64.32% of the total variance. Factor 2 and Factor 3 contributed to 9.84% and 6.09% of the total variance, respectively. Both Factor 2 and Factor 3 had less than four items, and Factor 2 had the lowest number of items (2). Factor 1 had the highest eigenvalue of 6.43, followed by Factor 2 with 0.98 and 0.61 for Factor 3. The factor loading for most of the items in Table 2 was greater than 0.60; therefore, there was correlation between the extracted factors and their items. The variables (items) for Factor 1 (Access to research resources) were farmers' access to the following: research infrastructure, funding, journals and innovations; and linking universities with practical extension work. It shows that most farmers were aware that research is one of the core functions of universities in the society. Better access to agricultural extension and advisory services; and access to formal education and training were the items that constituted Factor 2 (Improved extension services and training). Even though factor 2 has two items, it was accepted because the two variables were highly correlated (r_s = 0.70) . On the other hand, Factor 3 (Diffusion of university research) consisted of the following items: the capabilities of universities to communicate their research findings to the farmers, universities conducting research that is responsive to the farmers' needs, and farmers receiving advice from subject matter experts. Furthermore, the communalities of the items ranged between 0.66 and 0.83; therefore, most variation has been extracted. It implied that 66%–83% of the variability in the perceived benefits of university agricultural extension is explained by factors 1–3.

After extracting and naming three important factors underlying the acceptability of university agricultural extension, factor correlation was performed. The results of the factor correlation matrix showed that Factor 1 was positively correlated with Factor 2 ($r_s = 0.658$). The results implied that those respondents who held the opinion that university agricultural extension would provide access to research resources believed that they would gain improved access to extension services and training. Furthermore, the same farmers perceived improved access to research resources as a way of diffusing university research to the farmers ($r_s = 0.702$). Again, Factors 2 and 3 were positively correlated ($r_s = 0.704$). It implied that the respondents who perceived university agricultural extension as a way of improving access to extension services and training held the notion that universities will improve diffusion of research from institutions of higher learning.

Table 2. Results of the exploratory factor analysis of the acceptability of university agricultural extension (*n* = 442)

Variables	Factor loading for components			Communalities
	Factor 1 (F1)	Factor 2 (F2)	Factor 3 (F3)	
Farmers will have access to research infrastructure	0.86			0.74
Farmers will have access to research funding	0.84			0.70
Farmers will have access to research journals	0.72			0.66
Farmers will have access to research innovations	0.70			0.71
Universities will be linked with practical extension work	0.59			0.71
Farmers will have better access to agricultural extension and advisory services		0.88		0.83
Farmers will have access to formal education and training		0.74		0.76
Universities will communicate their research findings to the farmers			0.71	0.75
Universities will conduct research that is responsive to the farmers' needs			0.71	0.69
Farmers will receive advice from subject matter experts			0.52	0.68
Eigenvalue	**6.43**	**0.98**	**0.61**	**8.03**
% of variance	**64.32**	**9.84**	**6.09**	**80.24**
Number of items	**5**	**2**	**3**	**10**

4. Discussion

The study discovered that a significant proportion of the respondents accepted university agricultural extension as a complement to public (government) agricultural extension and advisory services. Most of the farmers were willing to pay for pluralistic extension services that include universities. It showed that farmers were familiar with the differences that exist between government and institutions of higher learning about the provision of extension and advisory services. Furthermore, the farmers held the notion that to receive quality extension and advisory services it is necessary to pay universities to render the services in collaboration with government. It implied that farmers in the study area were in favour of a pluralistic extension system offered by government and institutions of higher learning; therefore, introducing pluralistic extension in the study area is demand-driven. Pye-Smith (2012) reported that a pluralistic delivery system should be demand-led and participatory—to enable universities to render services that are responsive to farmers' needs. In support of the study findings, Chowa et al. (2013) found that farmers accepted pluralistic extension because it provided access to extension services from various sources, as well as diversified information. Thus, acceptability of a pluralistic extension system can be influenced by the perceived benefits of receiving support from different institutions and practices. For example, Kabir et al. (2020) reported that a pluralistic support system is responsive to farmers' needs and demands. In the current study, the need to include universities in the pluralistic extension system is demand-led and this shows that farmers know what they need from institutions of higher learning to improve their farming activities. As a result, the system is more likely to respond to the needs of the farmers and to ultimately succeed in the delivery of extension services. However, that could only happen if farmers are involved in the planning and implementation of pluralistic extension systems that are suitable for the study area and responsive to the farmers' needs. The participation of farmers in developing a sustainable framework for a pluralistic extension system cannot be overlooked because the success of extension services is measured on the progress made by the farmers (beneficiaries). Besides, farmers' willingness to pay for extension and advisory services offered by universities is an indication that their participation in the development of a pluralistic extension system is crucial. Again, the findings implied that most farmers wanted to deviate from solely depending on free extension and advisory services from government because they were willing to pay for university agricultural extension services. Determining farmers' willingness to pay for extension services has been widely explored in contexts where the feasibility of privatising extension services was evaluated. There is a degree of polarisation on the payment of extension services by farmers. Similarly, Budak and Budak (2010); Ozor et al. (2013); Afful et al. (2014); Uddin et al. (2016); and Loki et al. (2019) found that most farmers are willing to pay for agricultural extension services. In contrast, Foti et al. (2007); Ali et al. (2008); as well as Oladele (2008) discovered that the willingness to pay for extension services was low amongst the farmers. Although most of the farmers expressed interest to pay for university extension services rendered through a pluralistic extension system, it is important to determine whether farmers can afford to pay for such services. Determining farmers' financial capability is important because payment for extension services can be influenced by income, access to services and other factors. Several scholars have reported a positive and significant correlation between farmers' income and their willingness to pay for extension services (Ajayi, 2006; Loki et al., 2019; Oladele, 2008; Shausi et al., 2019; Uddin et al., 2016). Therefore, even farmers who have expressed their willingness to pay for university extension services may be reluctant to do so if the prices are unaffordable.

The exploratory factors that influenced the acceptability of university agricultural extension included access to research resources, improved extension services and training, and diffusion of university research. The most important factor was access to research resources and it consisted of four items namely infrastructure, funding, journal innovations and linking universities with practical extension work. Farmers' expectation of universities to provide access to research funding is not far-fetched because most universities are involved in research projects funded by various stakeholders. In South Africa, government provides core funding for research at universities through the Ministry of Higher Education (Luruli & Mouton, 2016). Considering that most of the universities in South Africa are public institutions, it is not surprising that farmers perceive their association with universities as a way to access research funds. According to Cloete et al. (2015), the role of universities is to conduct research and to provide services to the public. In this context, universities can utilise their research funds to conduct some of their research on the farms of the recipients of university agricultural extension services. By so doing, universities will undertake research that is responsive to the needs of the farmers and will link universities with practical extension work. In terms of research journals, farmers who accepted university agricultural extension did not perceive access to research journals as a benefit associated with access to extension services from universities, although institutions of higher learning are affiliated with databases that provide access to academic journals. University personnel can easily access research articles from academic journals and share them with farmers. Besides, scholars have the capacity to explain academic and scientific information in the language that farmers can understand. However, access to research journals did not influence the farmers' perception positively. The reason could be that most academic research documents are limited to peer review rather than transferring knowledge to the main beneficiaries (Atchoarena & Holmes, 2005). As a result, some of the scientific jargon utilised in academic journals may be difficult for farmers to understand without the help of subject experts. Besides, farmers in the study area may be unfamiliar with the advantages of how access to information from academic journals can improve their productivity.

The second important exploratory factor was improved extension services. The respondents held the notion that universities would offer better access to agricultural extension and advisory services and provide them with access to formal education and training. It was envisaged that farmers would expect universities to provide access to extension services and education because the common role of universities is to facilitate access to education in the society. In some instances, universities provide agricultural extension services and access to higher education simultaneously (Douglass, 2007). That is applicable in countries where agricultural universities are expected to generate and apply knowledge to improve agricultural production (Gornitzka & Maassen, 2007; Okolo, 2010). In South Africa, however, the provision of university agricultural extension services is not mandatory because universities are housed in the Ministry of Higher Education and Training, whereas the Ministry of Agriculture is responsible for extension and advisory services. Thus, to meet the farmers' expectations, universities in the study area could establish community engagement and outreach programmes that create a conducive environment for the provision of extension services and informal educational programmes that provide for the farmers' needs. Informal educational programmes will deviate from normal university admission requirements that may exclude most of the farmers. In addition, a formal framework for a pluralistic extension system could remedy the envisaged problem.

Diffusion of university research was the last exploratory factor that influenced the willingness of farmers to accept university agricultural extension services. The assumption was that university agricultural extension services would create a platform for universities to communicate (share) their research findings with the farmers. By so doing, farmers will receive advice from subject matter experts working at the universities. As a result, universities will conduct research that is responsive to the farmers' needs.The results of the exploratory factor analysis indicated diffusion of university research as the underlying factor associated with farmers' acceptability of university agricultural extension services. According to Cloete et al. (2015), it is mainly because the role of universities is to produce scientific knowledge through research and to provide expertise that resolve persistent developmental issues in the society. Through research, universities have contributed to agricultural development in many countries (Atchoarena & Holmes, 2005; Johanson et al., 2008; Liu & Tao, 2020; Okolo, 2010). Universities' research can only contribute to development if the findings are communicated to the target audience (beneficiaries), though. Hence, farmers in the study area perceived their association with universities as a way to access the research outcomes of universities. Farmers' expectations are parallel to the traditional role of agricultural extension, which is diffusion of the research results to the farmers.

5. Conclusion and recommendations

The provision and payment of university agricultural extension services are widely accepted by farmers as a suitable mechanism for a pluralistic extension system in the Gauteng province of South Africa. The study findings implied that the necessity for a pluralistic extension system in the study area is demand-driven because most of the farmers were in favour of the proposal.

The theoretical contribution of the study is that the need for pluralistic extension and payment of services from institutions of higher learning is widely accepted by the recipients of extension services (agricultural producers). The assumption is that pluralistic extension system involving universities will improve farmer's access to research resources, extension services and training, and diffuse university research. Thus, the study contributes to the existing theory by explaining the factors that will help to explain acceptability of pluralistic extension involving universities. In addition, the study makes a practical contribution towards the development of sustainable framework for pluralistic extension system involving institutions of higher learning. In conclusion, there is a need for universities to render extension services in collaboration with government to improve farmer's access to extension services and research resources. Most importantly, the agricultural extension services of universities should enable farmers to access the required funding as well as research articles from journals. It is recommended that a formal framework for a pluralistic extension system should be developed through a participatory process that involves the Ministry of Higher Education and Training, the Ministry of Agriculture, farmers and other stakeholders. Furthermore, the implementation of a pluralistic extension system should consist of concerted efforts between all the stakeholders to avoid duplication of efforts and waste of resources. The framework for a pluralistic extension system should enable universities to provide research resources to the farmers; improve access to extension services and trainfarmers; and create a platform for the diffusion of university research outcomes to the farmers. Other extension studies may use EFA to explore factors associated with the acceptability of pluralistic extension services. The limitation of the study is that it only focused on farmer's acceptability of university extension and perceived advantages using structured questions. Therefore, is a need to determine whether universities have capacity to render extension services required by farmers. In addition, the benefits and perceived challenges of university extension can be investigated from farmers, government personnel and university academic staff members.

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