ESTABLISHING EFFECTIVE COMMUNICATION BETWEEN THE AGRICULTURAL RESEARCHER AND THE FARMER WITH SPECIAL REFERENCE TO THE LARGE-SCALE SUGARCANE, SOYBEANS AND MAIZE INDUSTRY - A COMPARATIVE CASE STUDY IN SOUTH AFRICA

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DECLARATION

I declare that this thesis hereby submitted for the degree of Doctor of Philosophy at the University of the Free State, is my own independent work, and has not been submitted for degree purposes to any other university. I hereby forfeit any copyright of this thesis to the University of the Free State.

29 November 2023

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LIST OF ABBREVIATIONS AND ACRONYMS

AD	Anno Domini ("in the year of our Lord")
ADAS	Agricultural Development and Advisory Service
AIMS	Agricultural Information Management Standards
AKIS/RD	Agricultural Knowledge Information System for Rural Development
ARC	Agricultural Research Council
ARD&E	Agricultural Research, Development and Extension
ASA	American Society of Agronomy
AVCASA	Association of Veterinary and Crop Associations of South Africa
BBC	British Broadcasting Corporation
BC	Before Christ
CAS	Commercial Agricultural Sector
CC1	Crop Commodity Organisation 1
CC2	Crop Commodity Organisation 2
CCA	Certified Crop Advisor
CEO	Chief Executive Officer
CPS	Crop Production Sector
CropLife	Crop Life South Africa
DAFF	Department of Agriculture, Forrest and Fisheries
DALRRD	Department of Agriculture, Land Reform and Rural Development
DOA	Department of Agriculture
DSI	Department of Science and Innovation
DST	Department of Science and Technology
FAO	Food & Agriculture Organization of the United Nations
FERTASA	Fertilizer Association of South Africa
FOKIS	Forestry Knowledge and Information Systems
Grain SA	Grain South Africa
IPM	Integrated Pest Management
ISFM	Integrated Soil Fertility Management
IWM	Integrated Weed Management
KM	Knowledge Management
KPIs	Key Performance Indicators
NAMC	National Marketing Council
NPO	Non-Profit Organisation

NRF	National Research Foundation
NWU	Northwest University, Potchefstroom, South Africa
OAC	Oilseeds Advisory Committee
OPDT	Oil & Protein Seeds Development Trust
PRF	Protein Research Foundation
R&D	Research and Development
RD&E	Research, Development and Extension
SACNASP	South African Council for Natural Scientific Professions
SASA	South African Sugar Association
SASAE	South African Society of Agricultural Extension
SASMA	South African Sugar Millers Association
SASRI	South African Sugar Research Institute
SGS	Summer Grain Sector
SPSS	Statistical Package for Social Sciences
SSSSA	Soil Science Society of South Africa
UFS	University of the Free State, Bloemfontein, South Africa
UK	United Kingdom
UKZN	University of Kwa-Zulu Natal, Pietermaritzburg, South Africa
UP	University of Pretoria, Pretoria, South Africa
US	University of Stellenbosch, Stellenbosch, South Africa
USDA	United States Department of Agriculture
WCDA	Western Cape Department of Agriculture

ABSTRACT

Sustainable global food production is non-negotiable and can only be achieved by applying sustainable agricultural practices to ensure the longevity of our natural resources, such as soil and water. Research and subsequent dissemination of the results form the basis of agricultural development in the small-scale and large-scale commercial farming sectors. Nature, climate, industry, and agriculture are all integrated systems of our world. It is a complex and dynamic system that has required innovative thinking for the survival and progress of humankind since its inception. The delivery of scientific and technological information has always been crucial for developing sustainable systems, and delivery methods must continuously be evaluated to ensure effective communication and knowledge transfer. Communication breakdown between the researcher and the producer or target audience could have disastrous consequences.

This study aimed to investigate the environment in which the agricultural transfer of knowledge takes place, focusing on South Africa's crop production sector. It also intended to research current methods and models used for disseminating information, identify the key role-players, determine levels of communication between stakeholders and recognise the shortcomings and qualities of such models. It is therefore important to investigate and evaluate current, modern approaches and older models of knowledge transfer in an attempt to provide guidelines along which the delivery of scientific information can be developed.

The entire world faces a situation of information overload in most sectors of industry and social environments. Filtering through this enormous amount of information is an almost impossible task and requires the guidance and expertise of scientists and specialists within a specific field of knowledge. The alternative scenario is where borders between credible, factually based knowledge and “fake science” become blurred, creating confusion and distrust. The participants' perceptions of research, communication, effectivity of knowledge transfer, and relevancy of current methods must be explored to redirect or redesign models, and means of scientific information delivery. This comparative study used a mixed methods approach where the perceptions regarding information dissemination from researchers, advisors and research coordinators in the crop production sector, and researchers, advisors and knowledge management in the sugarcane production sector were obtained using questionnaires complimented by semi-structured in-depth interviews. Descriptive and inferential statistics were applied to analyse and discuss the generated data.

The crop researchers, advisors and research coordinators confirmed unsatisfactory levels of communication throughout the research process and subsequent dissemination of the results. Pseudo-science was a serious concern for all the role-players in this sector. The same

participants felt that research funding and the source of funding was a potential problem that could even influence the results generated. The SASRI model, however, was found to be very effective throughout the process of identifying research topics, prioritising projects, funding, and disseminating results. Communication between researchers, extension specialists and sugarcane growers was effective and well-coordinated by knowledge management. The existince of well-established communication channels and feedback ensured the sugarcane production sector's awareness of fake science but confidence that most of the scientific data generated reached the intended target and therefor regarded pseudo-science as a minor problem. It was further found that although the crop commodity organisations performed well in research, they needed closer collaboration with advisors in the crop production sector to ensure effective dissemination of the generated research results.

It was concluded that the South African Sugarcane Research Institute employed a highly respected and effective model of knowledge transfer and dissemination of results to the target audience. Acceptable levels and channels of communication enabled all the stakeholders in the dissemination chain to network, even on an interdisciplinary level. Well-structured measures of effectivity, such as feedback and adoption rates on the farm-level, create confidence and trust within the SASRI system and contribute most to sustainable production and utilisation of natural resources.

Keywords: Sustainable food production, research, dissemination, information overload, dissemination models, communication

CHAPTER 1: BACKGROUND TO THE STUDY

1.1. INTRODUCTION

Innovation, development and the subsequent application of innovative ideas have become a significant part of all facets of modern life and even more so in agriculture. This is largely due to the interaction between agricultural production and our natural resources, such as land and water. According to the Food and Agricultural Organisation (FAO) of the United Nations estimates, the global population is expected to grow by more than a third, or 2.3 billion people, between 2009 and 2050. Agricultural productivity would have to increase by about 70% over this period to feed the global population of 9.1 billion people (Chatterjee *et al*., 2018). More recent sources predict that the population could even exceed 10 billion (The World Bank, 2021). Sustainable agricultural practices are thus non-negotiable.

Land as a primary natural resource and the usage thereof is under enormous pressure for basic needs such as agriculture, urbanisation, conservation and recreation, to name a few. This pressure may limit the availability of fertile agricultural land and force food production to marginal lands, compromising food production. Halperin *et al.* (2023) suggest that balancing needs between societal and urbanisation of agricultural land lies in the differentiation of quality farmland and prioritising preserving the highest quality land for agriculture. However, there is no common definition of "high-quality agricultural land". One alternative could be to increase production on available land by applying various research results and agronomical practices. Another important option is improving soil quality and crop production potential. One such example is the Eastern Highveld of Mpumalanga, South Africa, where large grasslands were considered too marginal for crop production as the soil lacked most of the characteristics of fertile soil. Most of these areas have been converted to highly productive crop farms by applying scientific research results and a professional soil management approach. Other studies have shown that newer agronomical practices and a combination of a variety of species had a significant impact on water retention, soil fertility and the mitigation of soil loss in a maize and soybean production system (Jacobs *et al.*, 2022). Continuous research is therefore encouraged to keep agriculture and food production sustainable, and thus, the interaction between the researcher and farmer remains important. The agricultural researcher is arguably the most important role-player in the agricultural production of food, fibre, timber and other products.

Although the Oxford Learner's Dictionary (n.d.) defines a researcher simply as a person who studies something carefully and tries to discover new facts about it, agricultural research organisations and their researchers are increasingly being called to also work on complex societal challenges (Turner *et al*., 2023). These challenges create a different definition and

dimension to research compounded in agriculture because of the interaction between the land and its people. It illustrates the importance of innovative research and effective communication to ensure the application and adoption of the results.

This study will attempt to address the communication issue between the researcher and the large-scale farmer. It will also investigate the shortcomings, identify the tools available and those used for communication, the preferred ones and the reasons why there seems to be a breakdown of bilateral communication between researcher and farmer within specific sectors of this industry. With bilateral, it is implied that communication that previously flowed from the researcher to the farmer (the top-bottom approach) must also flow *vice versa* so that farmers can inform researchers of their specific needs, called the bottom-up approach.

Agricultural extension efforts, particularly in developing countries, have not always achieved the desired results of effectively and timeously presenting the farmer with the latest research results to ensure sustainable agriculture (Hunter, 1970). The extent of the problem was further explained by Arnon (1989), who believes that one of the areas in which humankind has been most unsuccessful was in the development of cost-effective means for the delivery of scientific and technical knowledge to the millions of farm producers in the third world. This would undoubtably also apply to the large-scale agricultural sector in the world and South Africa. This sector is often referred to as the commercial agricultural sector.

Although small-scale and large-scale or commercial farming refers to the relative size of the operation, it is difficult to define a farmer or an operation as such. The extent of the operation usually has less to do with the surface area utilised for production than with the number or biomass of the product and frequency of production. In some crop production industries, however, the surface area remains a reference as to whether a farmer is classified as a small-scale or commercial farmer. This is primarily true for the summer grains such as maize and soybeans. Bruwer (2021) found that amongst maize crop producers, it was generally accepted that a farmer with more than 500 hectares of maize was considered a notable grower and would, therefore, be a commercial farmer.

On the other hand, a sugarcane grower with more than 50 hectares of sugarcane would be seen as a commercial farmer (M. Binedell, personal communication, March 04, 2022). However it may be, all farmers are heavily depended on the results generated by researchers. Here, the importance of a third party becomes evident, namely the advisor and extensionist. The definition of an advisor is “a person who advises in a specific field” (Oxford Languages, n.d.). For this study, the definition refers to a person advising in agriculture and, more specifically, the large-scale summer grains crop farming industry.

Since the earliest times, one of the primary tasks of an agricultural researcher has been to generate results. An advisory officer has communicated these results to farmers and producers who can apply the agricultural research findings (Van den Ban, 1964). This principle also applies to the South African agricultural sector. This is confirmed through a study by Chepape and Maoba (2020) on farmers in the Bronkhorstspruit region. Intervention through extension services increased accessibility to technical and advisory services by more than 98%.

Furthermore, results demonstrated that only 25% of smallholder farmers could receive information and knowledge management through their means before implementing these developmental initiatives involving extension. Thus, extension and advice are important. Effective extension and dissemination of research results should include finding new innovative ways or revisiting older reliable means to relay scientific information and research results to the farmer (Carter & Paulus, 2010).

Across the world, several organisations, institutions, and, in many cases, teams of commercial farmers and qualified advisors, together with soil scientists, plant pathologists, entomologists and other specialists, generate agricultural knowledge through research and trials. Organisations conducting research are producers' organisations, non-profit organisations (NPOs), and institutions such as universities, private sector research institutions, public experiment stations, and agri-business firms (Van den Ban, 1987). Recently, in the crop farming industry, teams of farmers together with researchers, agronomists and other specialists are becoming more popular for several reasons such as objectivity, combined experience, and to ensure the application of scientific principles in research and field trials, to name a few. A similar model named "integrative, farmer participatory research" was provided by Van de Fliert and Braun (2002), proposing a systematic framework of participation from research and development (R&D), together with extension and implementation.

In most developed countries, agricultural extension has followed the same path of evolution. In Australia, a study done by Hunt *et al*. (2014) regarding the history of research, development and extension (RD&E) in that country's agriculture sector since the late 1980s describes "the transition" from a system dominated by the public sector agencies to a position where rural industries, the private sector and producers sometimes partner with government, through which they then manage investments around RD&E efforts. Agricultural extension services in South Africa have followed the same path, with the most defining period of change being the democratic election in 1994. Never in the history of a country has RD&E undergone such radical and quick changes than in South Africa during the five to seven years leading up to the elections and, more specifically, the period afterwards. Liebenberg (2015) also confirms that

changes in the extension structure started some time before the election. The post-apartheid era (since 1994) saw drastic changes in agricultural organisation (Koch & Terblanche, 2013). The evolution of South African research and extension services describing its development and focus over decades, the drivers behind change and the current state thereof has been well documented by Van Niekerk (2012) and Liebenberg (2013, 2015).

In most cases, political events significantly affect policies and implementation irrespective of country or region. Hunt *et al*. (2014) analysed some of those changes and the impact on the capacity and resilience of Australian agriculture in this case and discussed the current and future repositioning of research, development and extension (RD&E). This study aims to have the same purpose for the large-scale summer grains crop sector of South Africa. Not all countries implement the same policy regarding extension, but there are similarities. Smith and Rockett (1983) researched England and Wales and found that extension is divided into the state-funded and private-funded sectors. In many countries, the private sector has taken over the advisory and extension role where farmers can employ several qualified and accredited advisors and, in some cases, even researchers. Initially, distrust between these two groups may exist, which can be a serious concern, but it seems to even out over time as mutual trust develops (Gaymer *et al*., 2014). Although there are many kinds of advisors and extensionists, Maister, Green & Galford (2021) describe the importance of specific groups of advisors in business and agriculture as recognised "trusted" advisors. In other countries, the evolution of agricultural extension mostly followed a natural and gradual process from public to private. This is not the case in South Africa, where extension services have been subjected to a sudden change of focus and responsibility. Liebenberg (2015) explains that major changes started as early as 1988 when it was reported that about 40 percent of the extension positions in the then Department of Agriculture, Forest and Fisheries (DAFF) were vacant at the time and that this public service needed nearly 300 posts in addition to the existing staff plan. This contradicts the popular belief that post-1994 election politics was the main driver behind the shift in public extension focus. South Africa did not escape the changing international trend in agricultural advisory services, which is a definite shift from public extension to private extension. It won't happen overnight and won't be without "growing pains". Bruwer (2021) reports that although 93% of crop farmers in the Eastern Highveld of South Africa preferred advice from a qualified advisor (a concept later discussed as the trusted advisor), only 48% of the same respondents were prepared to pay for private extension services, which leaves extension in South Africa in a transitional phase between public and private advisors. During this uncertain and sensitive period, effective communication between researcher and farmer becomes critical to minimise

and prevent the exploitation of farmers. Cambridge Dictionary (n.d.) defines exploitation as "unfair treatment of other people (or a situation) for one's advantage.

Recently, a vast number of new products accompanied by recommendations from so-called experts have been introduced into the agricultural market, with special reference to crop farming, where terms such as "regenerative farming" and "soil health" have become trending topics. Although such terms *per se* are valid principles, the problem seems to be that many of these practices and advice, accompanied by certain products, are often promoted with little or no regard for context (Giller *et al*., 2021). This comprehensive study involving regenerative farming found that this phenomenon has had almost no following for many years since its inception in the 1970s but showed a sharp increase following awareness campaigns and publications since around 2013. This may be true for the South African agricultural environment and a genuine concern for advocates of truly sustainable food production. However, it is important to note that sustainable agriculture mostly supports the principles and practices of regenerative agriculture on the condition that scientific principles are never compromised under the pretence of sustainability. Although these concerns were reported many years ago by Vanlauwe & Giller (2006), scientists today are still concerned about the misuse of these terms by individuals or companies to further their interests (Miles, 2019).

This communication breakdown may be one reason farmers are increasingly being exposed or subjected to "suspect recommendations". Miles (2018) defines "suspect recommendations" as those not supported by research findings that are most unlikely to have a beneficial effect on plant growth or soil health and involve unnecessary expenditure on the part of the farmer. Suspect recommendations are a result of pseudo-science (Miles, 2018). The definition of pseudo-science is "a collection of beliefs or practices mistakenly regarded as being based on scientific methods" (Oxford Languages, n.d.) and Merriam-Webster (n.d.) defines it as "a system of theories, assumptions, and methods erroneously regarded as scientific".

Lastly, this study will attempt to find solutions to these communication issues and make recommendations on how to re-establish effective channels of communication between researchers and farmers through which scientific research results and topics, tried-and-trusted or new, can be relayed in support of sustainable agriculture - best described as follows: "sustainability encompasses issues that refer to what must be sustained, for whom and for how long, for whose benefit, at whose cost and according to which criteria (Van Niekerk, 2012).

1.2. LAYOUT OF THE CHAPTERS

A framework of analysis is used for this study, as well as the development of an effective dissemination model for the large-scale summer grain crop production sector in South Africa. Although there are a few exceptions, the chapters and paragraphs roughly follow the order in which the topics appeared in the interview schedules. This framework, adopted from Van Niekerk (2012), explains the stages of the development and provides a layout of the different chapters (Figure 1.1).

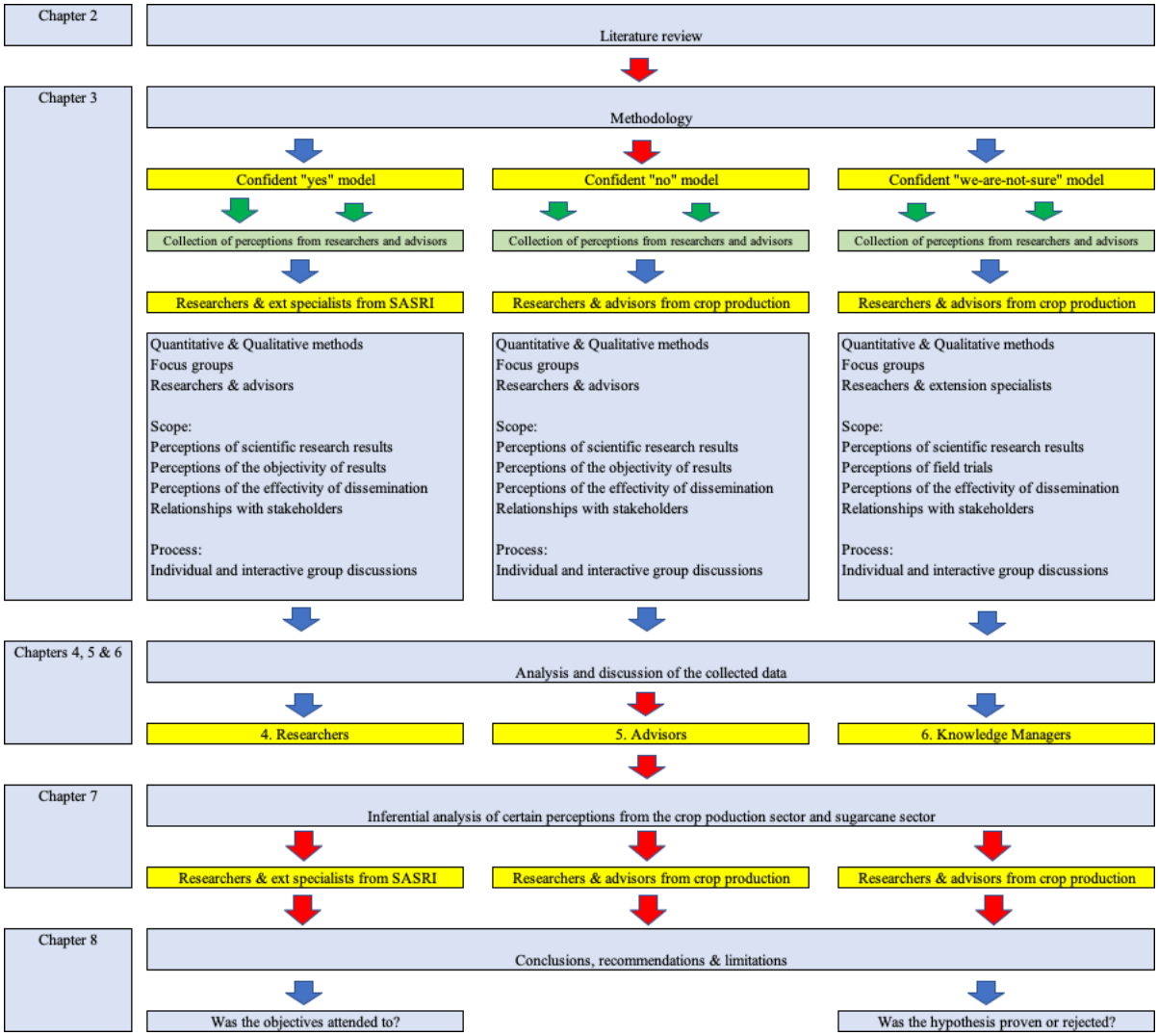

Figure 1.1: Logical Framework Analysis

1.3. RESEARCH PROBLEM / PROBLEM STATEMENT

Current and existing methods for effective communication between agricultural researchers and farmers in South Africa seem questionable. Some studies have found particularly low linkages between researchers and farmers, which could lead to confusion and distrust between farmers, extension specialists and researchers (Modirwa & Oladele, 2017; Carter & Paulus, 2010). This environment and information overload allow unscientific information (pseudo-science or fake science) to appear as scientific advice. Pseudo-science is a serious concern in many sectors and most industries worldwide. Information overload and its effect on sustainable agriculture should require further study. Identifying the factors that allow pseudo-science access to the agricultural environment is also important. Many farmers are exposed to pseudo-science and may feel overwhelmed by a bombardment of information. Improved

communication between the researcher and the farmer can combat this phenomenon and its detrimental consequences (Ansar & Goswami, 2021).

Technology and how people communicate is a rapidly evolving science (Carter & Paulus, 2010). Research on communication in agriculture is not uncommon, but the relevance of communication and dissemination methods should be an ongoing process. Vanlauwe and Giller (2006) say that misconceptions, ineffective communication and low levels of interaction are reasons for sustained dissemination failure.

1.4. THE PURPOSE OF THE STUDY (AIM)

The research sector needs an extension organisation and network to communicate results to farmers effectively. Smith and Rockett (1983) state that researchers and advisors rely on each other, although they work independently. It's all about communication. The purposes and aims of this study can be summarised as follows:

- To identify the different role players in agricultural research institutions, their responsibilities, opinions and perceptions on communication with producers.
- To identify the different role players in effective agricultural advisory services, their responsibilities, opinions and perceptions on communication with producers.
- This study also aims to identify and investigate different dissemination management models and the stakeholders' opinions and perceptions.
- Lastly, the study aims to determine why, despite some new and innovative ways of communication, results often do not reach the target audience.

1.5. RESEARCH OBJECTIVES

1.5.1. Overall Objective

The overall objective is to establish effective communication between the agricultural researcher and the end-user and to investigate different models of dissemination and the flow of information from the researcher to the end-user.

1.5.2. Sub-Objectives

Many farmers are exposed to pseudo-science and may feel overwhelmed by a bombardment of information. Therefore, the additional objective was to find ways to improve communication between the researcher and the farmer to combat this phenomenon, which can only have detrimental consequences (Ansar & Goswami, 2021).

- Describe the agricultural dissemination models in South Africa's large-scale sugarcane, soybeans and maize production sectors.
- Determine the perceptions of researchers involved in the different dissemination models.
- Analyse the opinions and perceptions of advisors in the different dissemination models.
- To develop an effective agricultural dissemination model for the large-scale summer grain sector.
- Lastly, to develop a structured communication tool which can be applied to ensure stakeholders in the dissemination chain stay informed and involved during the entire process, from identifying a research topic right down to adoption and application of the results.

By achieving the abovementioned objectives, it is believed that this study will be relevant and have theoretical and practical value.

1.6. RESEARCH QUESTIONS

Some institutions are unsure whether the research results always reach the intended target audience. This could result from a lack of sufficient key performance indicators to measure the effectivity of dissemination.

- What agricultural dissemination models are available and applied by stakeholders in certain agricultural sectors of the sugarcane production area and the summer grains crop production area of South Africa?
- What are the perceptions of researchers involved in these different models?
- What are the perceptions of advisors and extension specialists in the different dissemination models?
- What are the perceptions of knowledge managers and research coordinators in these different models?
- Which agricultural dissemination model is recommended for the large-scale summer grain sector?

1.7. SIGNIFICANCE OF THE STUDY

Dissemination is all about communication. There are different ways in which role players, such as advisors and extension specialists, obtain research results from researchers and their role in conveying this information to farmers. Whether these are unilateral or bilateral systems has always been important, as Van den Ban (1964) reported. In a study done by Khwidzhili and

Worth (2020) investigating the perceptions of public extension practitioners, it was found that most of these practitioners still preferred "from-bottom-to-up" extension approaches, where farmers identify problems and seek help from extension services. The significance of this study lies in determining the relevancy of similar models. Much research has been published about extension in the small-scale farmers' environment of this country and the rest of Africa (Arnon, 1989; Blum *et al*., 2015; Chepape & Maoba, 2020; Khwidzhili, & Worth, 2020; Modirwa & Oladele, 2017; Van Niekerk, 2012; Abdu-Raheem & Worth, 2012). However, the current situation in South Africa's large-scale farming sector is unclear, and the concerns of stakeholders in this sector justify research on this topic. Personal observations have also, over time, contributed to the belief that an in-depth study of successful and less-successful dissemination models could positively contribute to sustainable large-scale agriculture. In the publication "Research Matters", Du Plooy-Cilliers *et al*. (2014) state that personal experiences and observations may be important when the researcher chooses a topic. It is true in this case and what initiated the need for this research.

Channels of communication have been researched for many years, and as technology has developed, so have some of these communication channels. Mass media channels such as radio and television have always played a major part in influencing the public's awareness of innovations, even in agriculture. It also tends to provide general information to a large audience with considerable speed and efficiency (Schramm, 1973). However, personal communication, such as farm visits, is typically viewed as more effective in reducing uncertainty amongst the target audience, such as a farmer, because the presence of the advisor provides social support that enhances confidence in suggested practices and outcomes (Albrecht & Adelman, 1987). During these visits, advisors can address special individual needs and questions. Feedback from the farmer and to the farmer is immediate due to the channel characteristics of the situation and the specificity of their communication (Schramm, 1973).

There are at least four groups or groupings that will benefit from the results of this study:

- All research institutions and researchers, whether they are private, public or academic. Sometimes, researchers tend to see their specific field as most relevant but should develop a more holistic idea of agriculture and results dissemination to the farmer (B. Flett, personal communication, February 15, 2022).
- Commodity-based organisations conduct research through their researchers, academic institutions, public institutions and private researchers. Farmers are becoming more involved in research, and Abdu-Raheem & Worth (2012) stated that when farmers reach a

state of self-reliance in terms of their skills and knowledge, they are willing to fund research and extension and commodity-based support organisations are formed, as mentioned earlier. The crop commodity organisations should strive towards participatory research.

- Agricultural supply companies offer some extension and advisory services, mostly limited to a specific area of expertise with strong connections to the range of products on offer. Although this is to be expected, the recommendation of successful dissemination models may significantly improve their advisory capacity and promote responsible application of their products.
- Advisors and extension specialists. The concept of private agricultural consultants and advisors in South Africa is fairly new. Although the scope of their services is often very diverse, it can be difficult to find advisors who are experts in certain fields (Liebenberg, 2015). Thus, there is significant potential for more private consultants in this country as the demand for specialist advice is far greater than the number of established companies or individuals operating as consultants presently (C. Burger, personal communication, May 19, 2021).

These organisations, supply companies, consultants and individuals are all potential partners in the ideal researcher-to-producer communication model and only by involving these role-players in this research and by collecting opinions and data from them can a model be constructed that will benefit the summer grain industry and possibly, other agricultural sectors as well. This study should be about suggestions for improving communication between researchers and farmers and *vice versa* (B. Flett, personal communication, February 15, 2022).

Possible conclusion and recommendations: this study tried to determine alternative and more effective dissemination models to be recommended for the large-scale summer crop sector. It further attempted to suggest how an awareness campaign can be driven amongst all stakeholders in the respective agricultural fields and eventually throughout the entire South African agricultural industry. The agricultural sector should know the importance of communication and feedback throughout the dissemination chain. The critical importance of communication between the researcher (the scientific results) and the producer (the practical application of these results) is for the sustainability of our resources without compromising agricultural food production.

1.8. HYPOTHESIS

A breakdown of effective communication between agricultural researchers and the summer grains crop producer in South Africa leaves the door open for unscientific results and advice (pseudo-science) to reach the producer. This situation creates confusion and distrust in this farming sector, potentially devastatingly affecting the sustainability of large-scale crop farming. Qualified agricultural advisors could be an effective communication link to filter through this information overload and confirm the sustainability of scientific agricultural dissemination.

CHAPTER 2: LITERATURE REVIEW

2.1. INTRODUCTION

This chapter covers the definitions of research and extension-related topics, the evolution of these important agricultural disciplines and attempts to provide a background of related studies and findings. It discusses the origins and evolution of the agricultural dissemination of research results and information and its ever-changing environment. It covers some fundamental differences between small-scale and large-scale farming operations and the similarities and contrasts of the research, development and extension services (RD&E) between these sectors. The researcher generates fundamental agricultural science, but this knowledge is useless if it does not reach the intended target audience. For many years, in fact, for generations, the extension specialist or advisor has been the link between the researcher and producer to ensure that scientific research results are disseminated to the agricultural target audience. This study focused on areas of the large-scale crop production sector in South Africa where the farmer is also known as the commercial crop producer or, in the case of the sugarcane industry, the grower. This chapter further discusses the concepts of identification and prioritising of research topics, the sources of funding for these projects and the possible involvement of the producer. It will provide an international and local perception of agricultural issues, such as measuring the effectiveness of dissemination, objectivity of extension specialists or advisors and their commitment to sustainable agriculture. There seems to be a perception that communication between the researcher and crop producer has deteriorated (M. Farina, personal communication, July 21, 2020; Modirwa & Oladele, 2017). There may be many reasons for this perception, and it's not a phenomenon unique to agriculture. Almost every other industry sector in the world is affected by this breakdown in communication. It is closely linked to the enormous amount of information that has become so easily accessible nowadays. The problem with information overload lies within scientific validation– something that is not necessarily within the capability of the ordinary citizen or, in this case, the producer. A situation of international proportions that has become so confusing and critical that some studies have even attributed violent behaviour and serious health concerns to the phenomenon of information overload (Fan *et al*., 2021).

The Oxford Language Dictionary (n.d.) defines information overload as "exposure to, or provision of, too much information or data". This over-exposure to information is a serious challenge for consumers and producers. Information overload allows pseudo-science and fake science to blend in with true science. This chapter will also cover the meaning of these terms,

the reasons why they may affect sustainable agriculture, and, more importantly, why crop producers are susceptible to information not based on true scientific principles.

Information exchange is based on communication, and Van Niekerk (2012) states that communication, although not always recognised as very important, is paramount to the success of any extension operation. Communication should generally be a two-way process, which means that such a communication breakdown between researcher and farmer could also be linked to a lack of feedback between interested parties. The question remains whether this feedback process is monitored and, if so, how the results are implemented to improve communication and, subsequently, the dissemination model. Furthermore, this chapter will discuss the importance of regulatory authorities to ensure the credibility of research institutions, researchers and extension specialists or advisors. Lastly, it will cover the importance of an awareness campaign to inform all the stakeholders in the dissemination chain about the importance of accreditation with reputable and relevant authorities or bodies.

Communication plays an important role in establishing good cooperative relationships between the agents and farmers and greatly influences the achievement of agricultural goals. Communication has three components: Communicators, Recipients, and Messages (Faqi & Aisyah, 2019).

2.2. AGRICULTURAL ADVISORY SERVICES: DEFINITIONS, HISTORY AND EVOLUTION

2.2.1. Background and Definitions

Before a short version of extension and advisory services can be discussed, it is important to establish a few crucial definitions in the Oxford Language Dictionary (n.d.). For this study, the term researcher means “a person who carries out academic or scientific research”. The definition of extension specialists is “trained individuals whose aim is to assist farmers and give instructions where and when necessary”. An agricultural advisor would be a professional problem-solver and an advisor employed by the agricultural community. The advisor is known as “someone who advises in a particular field (Oxford Language Dictionary, n.d.). Lastly, according to the Collins Dictionary (n.d.), the meaning of an agriculturist is “someone who is an expert in agriculture and advises farmers”. Although the crop production sector and sugarcane sector have different names for these individuals, both extension specialists and advisors formed part of the respondents, and it must be noted that for this study, they performed the same task in their respective fields of expertise. Clients and target audiences may include producers, growers, landowners, conservation organisations and public bodies (Gradireland,

2023). It is also important to note that for this study, producers, farmers and growers fall in the same category on the production side. In contrast, unless specified otherwise, advisors, crop advisors, agronomists and extension specialists belong to the same category on the advisory side.

2.2.2. Ancient History of Extension

For as long as mankind has produced even the most basic food items, research and extension have been an integral part of agriculture. One of the first known examples was found in Mesopotamia, originating from roughly 1800 B.C. Later, archaeologists unearthed clay tablets from biblical times in which advice on watering crops was inscribed (Jones & Garforth, 1998). In a publication by Luo *et al*. (2017), based on the available historical records and satellite images, it was discovered that Milan's "tuntian" systems, where agricultural settlements were promoted on frontiers, were continuously used from the Han Dynasty to Tang Dynasty (618–907 AD). It further reports of "extension notes" from the same era. The oldest fully surviving Chinese agricultural treatise, *Essential Techniques for the Peasantry,* dating from 535 AD, aimed to show landowners how to improve their estate management through the advice they gave to their tenants. The Sung and Yuan Dynasties (960-1368), with their firm local government administrations, were notable in organising and promoting agricultural research, extension work, and the teaching of agriculture and sericulture, much facilitated by the invention of woodblock printing, which allowed agricultural treatises and practical handbooks to be widely distributed (Jones & Garforth, 1998).

2.2.3. Modern Extension

Since its inception, agricultural extension services have been shaped by research, natural disasters, and famine. One such disaster, known as the Irish Potato Famine of Ireland, occurred from 1845 to 1852, when more than one million people died, and another one million emigrated, causing the Irish population to decline by 25%. As the cause of the rotting crops was potato late-blight *(Phytophthora infestans),* a fungal disease, the world soon realised the importance of species variation, genetic variation, crop rotation, alternate food sources and the importance of knowledge to accompany these new varieties and practices (Berkeley University of California, 2023). Thus, a complex process started, known today as extension and knowledge management.

Jones and Garforth (1998) describe the evolution of modern agricultural extension accurately when they report that earlier in the 20th century, extension services were in their formative

stage, relatively small in scale and limited in the scope of their work and contact with farmers, their organisation was often somewhat haphazard even though primarily based on legislation. They were organised predominantly by central or local governments or agricultural colleges, usually closely associated with experiment stations, or by farmers' organisations, agricultural societies, cooperatives, farmers' unions and the like. As time progressed, the organisations matured. Also, according to Jones and Garforth (1998), changes often occurred to the parent affiliations, government funding became relatively more important, their objectives became broader, and the extension workers became better trained and more professional. In addition, several other kinds of organisations have developed comparable work: agriculture-related commercial companies, agricultural commodity marketing boards and various non-governmental organisations involved in agricultural and rural development.

During the past quarter century, extension services have often become more diversified. In less developed countries, the main focus remains on agricultural (mainly food) production. Still, there has been a growing recognition of the need to reach, influence, and benefit the multitudes of small, resource-poor farmers. Substantial efforts have been made in this direction, notably through the training and visit system. A system is also used in South Africa, as confirmed by Van Niekerk (2012).

Agricultural extension has now become recognised as an essential mechanism for delivering information and advice as an "input" into modern farming. Since commercial farmers can derive direct financial benefits from these inputs, there is a trend towards privatising extension organisations, with farmers being required to pay for services they had previously received free of charge (Jones & Garforth, 1998). This trend in the commercial agriculture sector is confirmed by Bruwer (2021), not only in South Africa but internationally.

The pace of change in the organisation, functions, strategies, and approaches of agricultural extension is accelerating (Jones & Garforth, 1998).

2.2.4. Evolution of Agricultural Extension in South Africa

Agricultural extension in South Africa is changing in two ways: changes in extension practices and the extension organisation. Both these concepts will be discussed below.

In South Africa, both types of reforms are common. Large-scale commercial farmers' public extension services have been withdrawn, and private consultants and agribusinesses have filled the gap; thus, one can say that the extension has been privatised for these farmers. Small-scale and communal farmers, on the other hand, still obtain public extension services - although these services have undergone decentralisation (Van Niekerk, 2012).

During the past 25 – 30 years, major changes to the agricultural sector of South Africa have had a severe impact on all aspects of this industry; politics have played a more prominent role in the changes to the agricultural sector than elsewhere in the world as the local environment was faced with the unique situation where the commercial agricultural sector (CAS) predominantly consisted of white farmers. The post-1994 era significantly changed the agricultural extension scene as the new government shifted its focus to the previously disadvantaged small-scale farmers and established new black farmers on re-distributed land (Bruwer, 2021).

Various sources cover the origins and evolution of agricultural extension in South Africa, which provide a complete picture (Khwidzhili & Worth, 2019; Liebenberg, 2013; Liebenberg, 2015). Liebenberg states that the early history of agricultural extension services in South Africa dates to the years following the Anglo-Boer War at the end of the 19th century. The British Government then imported scientists from England to assist in developing local agriculture (Liebenberg, 2015). This was a difficult time as these scientists were unprepared for the vast differences in all aspects of South African agriculture compared to their experience abroad.

In 1925, the Department established a separate Division of Extension to link farmers and the Department's specialist technical services, with only six scientists serving all four provinces. Personal contact proved the value and importance of a more integrated approach to farmer support (Liebenberg, 2015).

Soon afterwards, the faculties of the Department of Agriculture accepted responsibility for agricultural training. Under the 1926 Stellenbosch University and Elsenburg Act, they were managed in close collaboration with the scientific capacity at the regional centres. This was also the first official phase of scientific agricultural research as it was closely coordinated with the service focus of the Department (Liebenberg, 2015).

As personal contact between these parties and the farmers developed, advisors became aware of the interaction of various disciplines on a farm. This lead to the establishment of a whole-farm approach within the context of a specific climatic and economic region. In 1948, a decentralised approach to extension was formed, eventually becoming eight regional offices (Liebenberg, 2015). These offices incorporated agricultural technical services (research and specialist services). Various disciplines and services could focus on farmers' problems within a certain region. This structure formed the basis of what was to become the Agricultural Research Council (ARC) in 1992 (Liebenberg, 2015).

Much research has already been published about the state and capability of the government's agricultural extension services before and after the election in 1994 and the impact this has had

on the sustainability of emerging small-scale farmers. However, not much research has been conducted about the impact on the large-sector agricultural sector, mainly after the shift in focus by world-class institutions such as the ARC and the effect this has had on research, development and extension. Commercial farmers increasingly relied on private companies and, often, suppliers of agricultural products who offer advisory services (Bruwer, 2021); in response to the growing dissatisfaction with the expertise level of the extension services of the department, the private input supply companies, farmer co-operatives and specific producer/commodity organisations began to create their own advisory services (Liebenberg, 2015).

The very important contributions of universities and other tertiary institutions to agricultural research should not be overlooked. These institutions have not been directly involved in extension and advisory services until recently. It is important to note that the mentioned shift in focus by the ARC could have been one of the main drivers for these institutions to intensify their research capabilities and, more importantly, design certain curricula towards a formal qualification in agricultural extension. A significant development in the evolution of extension in South Africa (M. Farina, personal communication, July 21, 2020). Today, most universities that offer these qualifications produce young, knowledgeable people with a unique ability to address extension in the commercial and small-scale agricultural sectors. The role of tertiary institutions will become exponentially more important to keep up with the rapid development of technology in agriculture. Kőmíves *et al*. (2019) confirm this by saying that the agricultural higher educational system must continuously reform to keep it updated and that without the needed reform, higher education will not be able to serve the needs of the agricultural labour market (Kőmíves *et al*., 2019).

2.3. THE CONCEPT OF KNOWLEDGE MANAGEMENT (KM)

Since information and knowledge, *per se*, have become readily available on so many platforms, the need for true science has grown, and much debate has been spent on topics that include independent research and advisory services, amongst many others. Knowledge management (KM) efficiently handles information and resources within a commercial organisation (Oxford Languages, n.d.). Knowledge management programs are typically tied to organisational objectives. They are intended to achieve specific outcomes such as shared intelligence, improved performance, competitive advantage, or higher levels of innovation (Inmon *et al*., 2008).

Knowledge management also captures, retains, organises, and shares knowledge (Malak, 2023). The concept of independent knowledge management and coordination of extension service is an effective means to coordinate different yet objective functions crucial to agriculture's sustainability. A combination of specialists working together as a team (M. Binedell, personal communication, March 4, 2022).

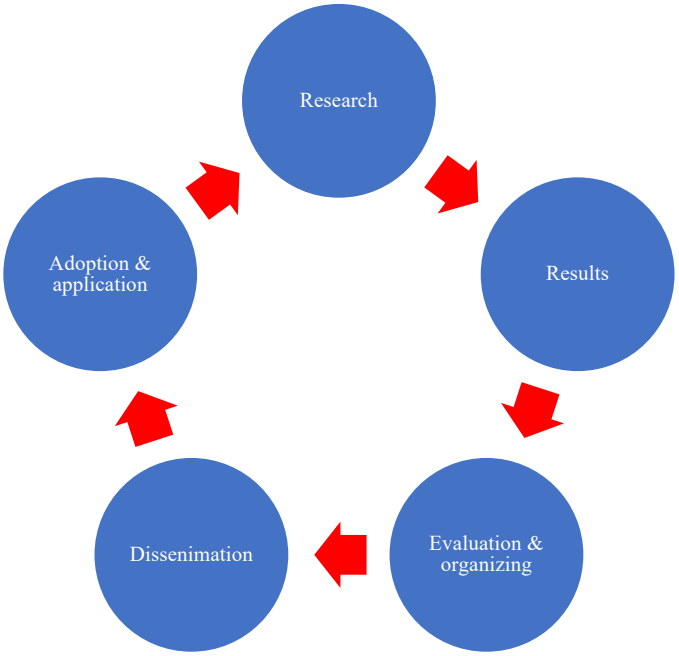

Figure 2.1: The Knowledge Management Lifecycle (Adapted from Malak, 2023)

The five stages of the life of KM are displayed in Figure 2.1 and should be a continuous process. The ideal situation would be where all the stakeholders in the research knowledge management and dissemination process would be ethical and remain objective towards the research outcome and, to a great extent, the adoption rate amongst producers, as confirmed by L. Du Toit (personal communication, May 17, 2021).

It is important to note that there are many knowledge management models, and some research has been done on the topic (Ingram *et al*., 2017; Sumberg *et al*., 2013). However, this study does not focus on all the different models but on the effective transfer of information within some of these models. It draws comparisons between effective and less-effective models.

This paper also considers different means and interactive approaches and the application thereof to ensure scientific research-based knowledge is transformed into accessible and meaningful information for producers.

2.3.1. Evolution of Knowledge Transfer and Agricultural Knowledge Management

This study focused on communication between the researcher and the producer, where the transfer of knowledge, its different aspects, and an understanding of the stakeholders are considered very important. As discussed in the chapter describing the different dissemination models, a linear knowledge and technology transfer model has been used for a long time. Technology transfer is the process of disseminating innovations and/or practical technologies resulting from research and development efforts in the different fields of agriculture (Swanson & Rajalahti, 2010).

This technology transfer model was the typical extension model used in post-independence countries and is based on the linear concept of technology transfer. It served as the link between research, extension and the farmers (Van Niekerk, 2012), confirmed by Swanson and Rajalahti (2010).

The evolution of knowledge management has been a gradual process to accommodate the changing face of research and extension worldwide, albeit faster in some countries than others. Several initiatives, such as the Agricultural Knowledge Information System for Rural Development (AKIS/RD), saw the light to assist stakeholders in this change process. A concept designed by the FAO and World Bank to serve as a guiding framework for conceptualising agricultural knowledge systems (Food and Agriculture Organisation/World Bank, 2002). An interesting study that draws parallels between AKIS and the private forestry sector was completed by Lawrence *et al*. (2020) where they proposed the term FOKIS (Forestry Knowledge and Information Systems) as both a system (a purposeful and interdependent group of bodies) and a method for understanding such systems. They found five trends across Europe: increasing flexibility, openness and participation of owners as sources of information; increasing reliance on information and persuasion rather than enforced compliance; a shift of attention from timber to a wider range of ecosystem services such as biodiversity and recreation; a shift of funding and providers from public to the private sector; and the emergence of new virtual communication tools. At least two of these findings are very relevant to this study: owners as sources of information and a shift of funding and providers from the public to the private sector.

Although a long list of stakeholders either contributed to or gained by this process, only the ones with the greatest impact or who have undergone the most radical change will be discussed.

2.3.2. Major Dissemination Models in Agriculture

As stated before, communication is a fundamental part of extension (Van Niekerk, 2012), and this study will attempt to investigate the basic models of the flow of information between the researcher and the producer. The minimum quantity of information required to move from any stage will depend on the producer's perception of the quality or reliability of the information. In this case, quality is measured by the level of uncertainty about the relevance of the information to agribusiness (De Oca Munguia *et al*., 2021). To a great extent, agricultural development depends on successfully implementing disseminated agricultural research information to the farmers (Ofuoko *et al*., 2008). Most notable are the channels for feedback within these dissemination models, and Wang and Chen (2009) believe that it is crucial to the model's success or failure. Although there are many different channels for communicating research results and ensuring the correct scientific information reaches the target audience, the models used by stakeholders can be grouped into three major models.

- Top-to-Bottom Dissemination Model

When referring to the model mentioned above, it is generally accepted that the researcher is at the top and the producer (the end user of the results) is at the bottom (Figure 2.2). Stakeholders in this chain of events include the research institute, the researcher, the knowledge manager or team, the extension specialist or advisor, and the crop producer or grower. The information flows between the researcher and the knowledge manager, then the extensionist or advisor and eventually the producer. The researcher's results are usually published as a source of scientific information available to all interested parties.

Figure 2.2: Bottom-to-Top Approach

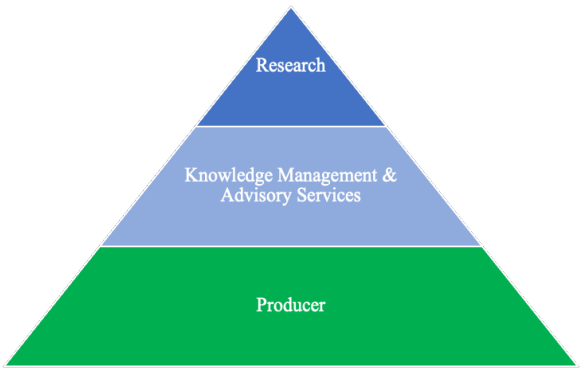

Figure 2.3: The Top-to-Bottom Approach

However, how this academic information is published in most cases makes it difficult to understand and apply on the farm. B. Flett (personal communication, March 01, 2021) also believes that not all researchers can communicate directly with producers.

- Bottom-to-Top Dissemination Model

This model is the inverse of the previous model (Figure 2.3), where the stakeholders remain in the same position. Still, the flow of information is in the opposite direction, namely from the crop producer through the extensionist—the knowledge manager to eventually reach the researcher or directly from the producer to the researcher. The latter is a situation least preferred by the individuals involved (A. Van Schalkwyk, personal communication, March 08, 2022). Stakeholders in this chain of events may include the research institute, the researcher, the knowledge manager or team, the extension specialist or advisor, and the crop producer. This model could serve as a source of information towards feedback, adoption rates and research needs and should not be regarded as less important. In a study done by Wageningen University regarding soil awareness, the bottom-up approaches from the local to the national level were found to be very much needed in raising soil awareness in addition to top-down approaches from the international to the national level (Bouma *et al*., 2012).

- Lateral or Bi-Lateral Dissemination Model

Although each sector in agriculture may prefer its own model of knowledge transfer, the preliminary research for this study has indicated that there may be a preference towards this model in the commercial or large-scale production sector for disseminating information (Briese, 2019; G. Keun, personal communication, July 22, 2021; C. Prinsloo, personal communication, May 18, 2021) and is increasingly being used across the world. It is also a model that has shown effectiveness in small-scale and large-scale agricultural sectors (Figure 2.4).

Figure 2.4: The Bi-Lateral Model of Dissemination

The researcher requires an understanding of each farmer's challenges (Bernacchi & Wulfhorst, 2017; Coquil *et al*., 2018), but in most instances, obtaining information directly from scientists

is not the most efficient, practical or popular method. The information needs of the large-scale and small-scale sectors may appear the same, but the socio-economical differences between these sectors can complicate dissemination needs. Therefore, no single extension model or approach is suited to all socio-economic situations in South Africa (Van Niekerk, 2012).

2.3.3. The Trusted Advisor

Oakley (2023) says that science communication, in the general sense of the term, is the primary link between knowledge production and knowledge consumption. Credibility and trust in the communicator (the advisor or extension specialist) are highly important attributes in science communication, arguably even more critical than in most other areas of life. The credibility of science depends on the credibility of science communication (Oakley, 2023). Briese (2019) describes the "trusted advisor" concept in a comprehensive study and proposes some sub-divisions to the above-mentioned model. The trusted advisor concept changes the traditional dissemination models and adds two more models that this study will investigate. The trusted adviser has the knowledge and skills to assess the entire system, has access to scientists and has a full comprehension of the research, including the results. They must also understand the needs and challenges faced by the stakeholder farmers and gain their trust. These trusted advisers play a pivotal role in the capability of agriculture to respond to variables such as climate change and population increase and establish sustainable systems. Our future depends not only on the discovery of scientific knowledge but also on its application (Briese, 2019).

2.3.3.1. Trusted Adviser to Producer

This model is commonly known as the middle-to-down model. The flow of information starts from the advisor or extensionist to the producer, the end user. Neither the researcher nor the knowledge manager is involved in this process; it may be that the information relayed is older results, proven results or knowledge gained on the farm and shared amongst producers through the advisor. Stakeholders in this particular chain of events may include the extension specialist or advisor and the crop producers who share their own knowledge and experience. As a rule, knowledge that proves useful to farmers is rapidly and widely adopted and shared from farmer to farmer (Kanime *et al*., 2018; Vietor, 2018).

A different need for a different part of the dissemination chain could exist in other countries. In some cases, it is not the absence of knowledge that causes concern but rather the need for assistance in the on-farm application of the information. A study conducted in France involving farmers during their transition to a more ecologically based agricultural system revealed that

the challenges faced by the farmers were more related to the application of knowledge rather than a lack thereof (Coquil *et al*., 2018). To modify the system, the farmers needed to buy, build or change existing equipment to perform the new tasks. They also needed to adjust their management to facilitate different work periods. For example, adding additional crops or cover crops requires a more extended planting period, thus changing the farm's workflow and labour needs and increasing timeous and focused information. Local producers and advisors raised similar concerns during the preliminary research phase of the study (J. Dreyer, personal communication, June 17, 2022; M. Du Preez, personal communication, July 22, 2021; G. Keun, personal communication, July, 22, 2021). In France, farmers needed more observations of biological interactions within specific fields on their farms (Coquil *et al*., 2018). This is a role where the skills of crop advisers are well suited. Observations of plant growth, plant health, pest populations, beneficial organism populations and the anticipated response to predicted weather conditions are key skills crop advisers could transfer to producers.

2.3.3.2. Trusted Adviser to Knowledge Manager, Researcher and Policy-maker

The middle-to-up model, as it is called, enables the information to flow from the advisor and extensionist to the knowledge manager, who will evaluate the information flow to the researcher, who may decide to adopt a specific research design or outlook and, in some cases advises the policymakers, where necessary. This may include the research institutions or governing bodies – private or public. Research is important to provide evidence-based answers to agricultural production questions and problems. Identifying questions and relaying the needs of producers and fellow advisors can be challenging for research scientists and is a role that the trusted advisor can fulfil, as confirmed by Briese (2019). This concept is also confirmed by various stakeholders involved in agricultural research and knowledge management in South Africa (M. Binedell, personal communication, March 04, 2022; B. Flett, personal communication, February 15, 2022; G. Keun, personal communication, July 22, 2021; L. Pistorius, personal communication, July 23, 2021; C. Prinsloo, personal communication, May, 18, 2021; A. Van Schalkwyk, personal communication, March 08, 2021).

2.3.4. Summary

Effective dissemination of knowledge and management is the basis of agricultural progress. Progress involves the modification of existing systems that may have developed over centuries. These modifications require expertise in the science of crop production and how it applies under local conditions (Del Corso *et al*., 2015; Kansiime *et al*., 2018). Together with change

comes the risk of change. Assessments of risks and the probabality of these risks associated with change must be communicated to the farmer and done in every way possible. Data, discussions and implementation form part of the knowledge and application chains discussed by Janssen *et al*. (2017). In addition to traditional knowledge, agriculture continues to embrace advancing digital technology, such as satellite and aerial imagery, yield mapping and plant stress indicators, such as infrared and near-infrared sensing (Erickson *et al*., 2018). It is in the farmers' best interests to employ good management strategies that protect the biological processes and resources they use to produce a crop (Briese, 2019). The concept of the trusted advisor is one such "good management practice" and should be encouraged.

2.4. SOME ADVISORY SERVICES INVOLVED IN KNOWLEDGE TRANSFER IN SOUTH AFRICA

Most sectors of agriculture, agri-business, agri-finance and many more relay information of some sort to the producer. Financing institutions and commercial banks may employ financial experts and risk managers, and even suppliers of machinery and implements may use skilled engineers to disseminate important information regarding the responsible application of their products. For this study, however, the focus is on the advisor or extension specialist responsible for informing the producers about scientific research results and the application thereof.

Although institutions, individuals and companies conduct agricultural research and disseminate these results, the dissemination chain of true science is far more complex for several reasons: not all the latest and most relevant information is generated by local researchers. International institutions and their researchers develop a great deal, and a well-established communication network must exist amongst researchers in their respective fields of knowledge, as shown in a study by Kristjanson *et al*. (2008). In this study, which extended from institutions in Kenya to various universities from the United States, an innovation network was applied to research development for sustainable livestock in Asia and Africa. It was found that projects developed over continents and between different institutions tend to close gaps in knowledge transfer and learning. Furthermore, not all the information from local researchers reaches the target population (J. Dreyer, personal communication, August 17, 2022). Therefore, advisors need to network with fellow advisors locally and internationally. The importance of international networking between researchers and advisors or extension personnel is increasing with the changing face of a rapidly developing agricultural scene. Several works address the issue of networking and proximity in the knowledge creation and the effects of collaboration within and between regions on knowledge productivity (De Noni *et al.,* 2017).

Advisory services combine an entire set of organisations and individuals that support and facilitate agricultural production, solve problems and obtain information, skills, and technologies to improve the livelihoods and well-being of those involved in food production. (Mahlangu, 2019).

2.4.1. Agricultural Advisory Services

2.4.1.1. Private Consultants

In South Africa, numerous examples of such agencies provide research, extension, information sharing and economic development support to their paying members (Liebenberg, 2015). Abdu-Raheem & Worth (2012) identified private sector consultants as individuals, associations and companies. The scope of their services is diverse, ranging from input supply to agricultural and rural development support. The list is probably not exhaustive, and depending on the incentives provided, many more could develop relatively quickly, making it challenging to identify good expert support and a certain level of excellence. Nevertheless, it could serve as a rich source of partnerships available for extension services (Liebenberg, 2015). Increasingly, private advisors are filling the role of information specialists and delivering science directly to farmers (Prokopy *et al*., 2019), refer to advisors who are not equally qualified as extension specialists.

It is important to note that this study viewed advisors and extension specialists as duly qualified specialists. In the South African context and specifically in the crop protection field, the representative of a chemical supply company is often referred to as a "crop advisor" and should not be confused with the advisor for this study. Prokopy *et al*. (2019) further state that advisors often go to extension specialists to provide this information to their clients. More recently, extension is viewing crop advisors as force multipliers to assist in delivering the message. Not only can crop advisers increase the amount of science delivery to farmers, but they also have the skills to tailor this information to meet the specific needs of individual farming systems (Bernacchi & Wulfhorst, 2017).

Private consulting faces a major challenge. Producers worldwide have not yet grasped the importance of independent and objective agricultural advice. They are reluctant to pay for these services, especially farmers new to the agricultural scene (Nettle *et al*., 2018). Most of these consultants are thus forced to offer some technical service or a "product" that accompanies their advice, which may put a question mark behind their objectivity. Private consultants usually approach researchers when the need for results arises (B. Flett, personal communication, March 01, 2021; C. Burger, personal communication, May 19, 2021).

The professional advisor is responsible for the profession, the producer, and the environment. This responsibility is emphasised by the results of the study done by Bruwer in 2021, where it was found that there was a notable difference in preference for advice generated with input from a qualified agronomist (Figure 2.5).

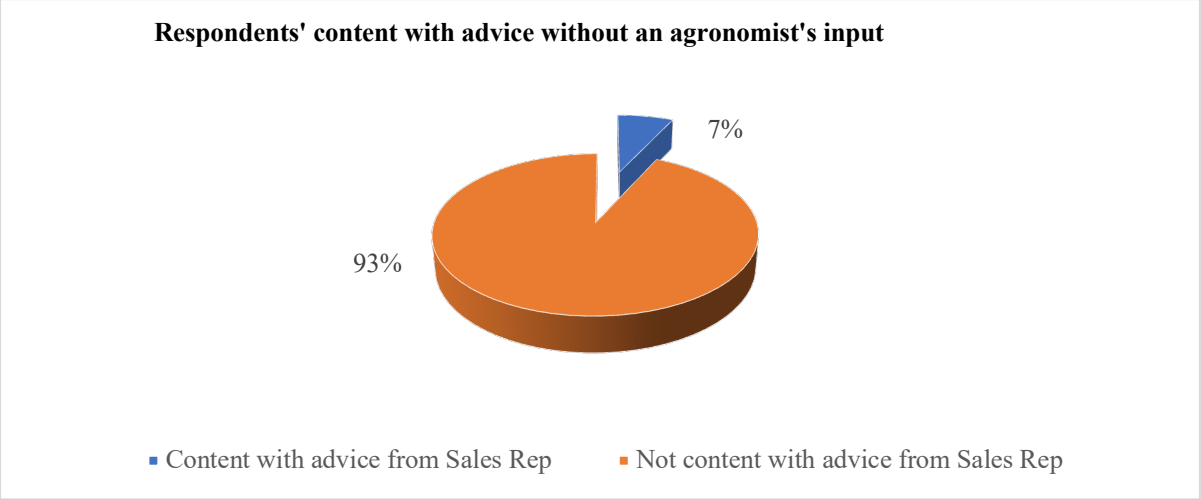

Figure 2.5: Respondents Preference Towards Unqualified Advice From Sales Representatives

2.4.1.2. Agri-Business

An agricultural consultant or advisor may be a business or a technical specialist, and his/her work varies depending on the employing organisation or company (Gradireland, 2020). Another source of support to farmers is agri-business industries. The agribusiness sector provides technical support services to commercial farmers with supply contracts in the interest of securing produce of the appropriate quality and, in so doing, serves as another source of technical support available to farmers, albeit to more skilled farmers, but in many cases not exclusively so (Liebenberg, 2015). Agribusinesses may include product supply companies such as suppliers of chemicals, fertilisers, agri-lime, and seeds, amongst many other products. These individuals are good marketers of their products and are often backed by qualified advisors or extension specialists (Darbas & Lawrence, 2011). Some agricultural supply companies in South Africa employ highly qualified, highly skilled, and knowledgeable advisors, some of whom are world-class experts in their fields (M. Farina, personal communication, July 21, 2020). Once again, the preliminary research of this study showed some concerns about advisors' objectivity as soon as monetary or sales-driven motivation is involved.

2.4.2. Agricultural Researchers: Institutions, Organisations and Individuals as Generators of Knowledge

2.4.2.1. Introduction

There are several institutions, organisations and many individuals involved in agricultural research. Research is a complex and meticulous process and should be managed in the same way to ensure the correct results reach the intended target audience (Gradireland, 2023). Most researchers will probably agree that determining research priorities should take preference. The order of priorities has the largest impact on the pace of progression and resilience of agriculture in modern times (Lamichhane *et al*., 2023).

Once the research topic is identified, the process will usually follow a structured path determined by policies and funding, among other factors. Other stakeholders in this chain of events are the research institutions, the funders or sponsors, the involvement of farmers, advisors and, in some cases, supply companies. This is called participatory research. (J. Dreyer, personal communication, August 17, 2022).

2.4.2.2. Identification and Prioritising of Research Topics

The mere concepts of progress, prosperity and sustainability are the direct results of research and development based on science (B. Flett, personal communication, February 15, 2022); therefore, a quantitative understanding of factors driving yield increases of major food crops is essential for effective prioritisation of research and development (Rizzo *et al*., 2022). Identifying and prioritizing research topics can be controversial and should be done through a process that involves all or most stakeholders of that particular industry. Inputs and contributions from industry, advisors, producers, processors, consumers and researchers are needed to identify the areas of research and, more importantly, determine the priority of the research.

Lamichhane *et al*. (2023) emphasise the importance of research priorities and note that it should be an ongoing process. Because of their fields of expertise, researchers and advisors may not always be objective towards research topics and their priorities. Most research projects have substantial financial implications, and it is therefore of the utmost importance that an independent body, inclusive of all stakeholders, determine the priorities of research and extension of these results (M. Binedell, personal communication, March 4, 2022; G. Keun, personal communication, July 22, 2021). This study has attempted to determine the different processes applied by the stakeholders involved at research institutions or commodity organisations that conduct research.

2.4.2.3. Involvement of the Crop Producer as Researcher (Participatory Research)

This study will also investigate the perceptions of researchers and advisors on the importance of including the producer in research. It is called participatory research, where the field-trials results are tested practically, mainly on the producer's farm. The FARMSCAPE (Farmers, Advisers, Researchers, Monitoring, Simulation, Communication and Performance Evaluation) is a well-known and proven program of participatory research with the farming community of Northeast Australia (Carberry *et al*., 2002). This program regards the involvement of the advisors and producers as crucial to its success. Several studies have found, and opinions are shared, that producers are keen to participate in research in any way that could make a practical contribution (L. Pistorius, personal communication, July, 23, 2021; C. Prinsloo, personal communication, May 18, 2015; Kline & Rosenburg, 1986). This is called the participatory approach. This concept has merits in that it incorporates a bottom-up approach, and thus the farmers' problems can be solved within their specific context. It is the opposite of the top-down approach; the top-down approach is where communication of research results flows from the researcher down to the producer, often without regard for their specific needs. These results are sometimes presented in a way that makes it difficult for producers to understand and may result in a low percentage of adoption by producers. Farmers are sometimes given technologies unsuited to their specific context of production (Van Niekerk, 2012). Most new ideas do not come from research but from practice (Kline & Rosenburg, 1986), as some farmers are keen experimenters and researchers.

To date, Sumberg *et al.* (2002) believe that little empirical evidence exists to support the assumption that bringing formal and farmers' research closer together will result in synergy and, as such, will result in significant additional benefits for producers. It contrasts with the opinions of other knowledge managers, advisors and researchers but highlights an important objective of this study. This objective is to determine the importance and role of the extension specialist or advisor in coordinating the application of research results on the farm. Sumberg *et al*. (2002) further state that farmers' research is probably best seen as a partial substitute for the adaptive end of the formal research spectrum, having particular value in the final specification - or adaptation - of technologies to the diversity of local conditions. The participatory approach in research remains a crucial part of "bringing practice and theory together" and more importantly, it plays an important role as one of the KPIs when measuring the effectivity of a dissemination model (J. Dreyer, personal communication, August 17, 2022).

2.4.2.4. Involvement of the Qualified Advisor or Extension Specialist in Participatory Research

The research sector needs an extension organisation to effectively communicate research results to farmers, even though it may not always need it for its primary research function. In turn, extension organisations or individual advisors need the research sector to generate new knowledge and techniques so that it has something to develop and communicate. Therefore, the development and advisory service is rather more dependent on the research service than *vice versa* (Smith & Rockett, 1983). Although this is true to a certain extent, it is a debatable opinion. J. Dreyer (personal communication, August 17, 2022) states that the producer needs both the researcher and the advisor to optimise production and, most importantly, sustainably. Through their contribution towards sustainability, the extensionist and advisor serve their most important function. Farmers lack the available time, interest and often, the skills to design statistically significant trials. In a study by Orlando *et al*. (2019) in North Italy on the interaction between rice and the organic component of paddies, the researchers emphasised the importance of a "multi-actor network" and farm-led research of which the advisor is an integral part. When it comes to the improvement and experimentation of agronomic practices, the collection of data, and relaying this information back to the researcher in participatory research, the advisor's involvement is unmissable. With the rapid development of technology and the sophisticated knowledge needed to get credible results, the stakeholders became more aware of the need for expert advice and guidance. This led to a shift towards wanting to use trusted agronomists or consultants, extensionists and advisors who knew the crops, the soils, the producers and could drive these models (Carberry *et al*., 2002). Participatory research and development will increasingly rely on the involvement of qualified and knowledgeable extension specialists and advisors. Bruwer (2021) found that most crop producers in the Eastern Highveld of South Africa preferred research results generated with the active involvement of a qualified agronomist. G. Keun (Personal communication, July 22, 2021) states that producers are keen to get involved in research but appreciate the involvement of a qualified advisor or agronomist for assistance.

2.4.3. Universities and Other Tertiary Institutions as Researchers and Generators of Knowledge

This study also focused on several institutions conducting research and extension services. The preliminary research for this study found that within most sectors of the crop production industry, there was a need for increased involvement from universities not only for their

research capacity but also because they offer true scientific education to agriculture students. Universities are considered hubs for knowledge production based on research conducted and their role as educational institutions (Gurmu *et al*., 2010). A short discussion of universities and their potential as generators of research-based agricultural knowledge is therefor considered necessary.

Several universities in South Africa offer Bachelors and post-graduate degrees in Agricultural Extension. The University of the Free State, the University of Pretoria, the University of Mpumalanga, and the Central University of Technology are a few examples. However, in South Africa, tertiary institutions that offer education to agricultural science students have traditionally not been much involved in the practical dissemination of the research generated by the same institutions. Liebenberg (2015) also explains that "the 'traditional' home of agricultural experts has been in higher education institutions and the government". Unfortunately, individuals have increasingly left these institutions to set up private consulting and/or service-providing businesses. However, in South Africa and many countries worldwide, there are still strong links between universities and extension. One such example is the University of California Cooperative Extension (UCCE). This publicly funded research and extension system has offices across counties within California (Chatterjee *et al*., 2018). It provides knowledge in more sectors than agriculture - a well-established system. The United States Department of Agriculture (USDA), through its National Institute of Food and Agriculture (NIFA), emphasises taking knowledge gained through research and education and bringing it directly to the people to create positive changes.

Although most universities in America engage in research and teaching, the more than 100 land-grant colleges and universities have a third critical mission - extension. Through extension, land-grant colleges and universities bring vital, practical information to agricultural producers, small business owners, consumers, families, and young people. NIFA supports both universities and local offices of the Cooperative Extension System (CES) to provide research-based information to a range of audiences. In South Africa, there is a much-needed initiative driven by some crop commodity organisations for greater involvement of tertiary institutions (M. Human, personal communication, June 01, 2023; G. Keun, personal communication, July 22, 2022). This drive seems to be supported by the crop commodity organisations and the universities and is encouraging (M. Human, personal communication, June 01, 2023; G. Keun, personal communication, July 22, 2021). Tertiary institutions and universities, in particular, are the primary producers of professional advisors and extension specialists. Over the past two

decades, several curricula have been adapted to provide for formal qualifications in extension services (University of the Free State, 2023).

The very important contributions of universities and other tertiary institutions to agricultural research should not be overlooked. These institutions have not been directly involved in extension and advisory services until recently. It is important to note that the shift of focus from the ARC could have been one of the main drivers for these institutions to intensify their research capabilities and, more importantly, design certain curricula towards more formal and specialised qualifications in agricultural extension. Today, most universities that offer these qualifications produce young, knowledgeable people with a special ability to address extension in the commercial and small-scale agricultural sectors.

The role of tertiary institutions will become exponentially more important to keep up with the rapid development of technology in Agriculture. The findings of a study by Van Niekerk and Conradie (2023) confirmed the benefits to farmers who use private advisors and public extension specialists. This study found that extension services could also close agriculture's management and technology gaps. The two services, public and private extension, were complementary in some respects and competing. Still, farmers who used both public and private extension services were the most productive.

2.4.4. Crop Commodity Organisation Researchers and Generators of Knowledge

Oxford Languages (n.d.) defines commodities as “a raw material or primary agricultural product that can be bought or sold, such as maize or coffee”. Commodity organisations are groupings that bring together a broad spectrum of interested groups related to a particular commodity or sector (such as sugar) in a particular country. Although the original aim of these organisations may have been to assist producers in several aspects, such as marketing and promoting the commodity, these organisations made a noteworthy difference in establishing private and semi-private research, development and extension.

The existence of crop commodity organisations also seems to be generally appreciated by their governments (Shepherd *et al*., 2009). Abdu-Raheem & Worth (2012) state that one of the implicit behaviours among farmers is that when they reach a state of what can be termed self-reliance or a state where their knowledge and skills in their particular field outstrip those available from the State, they are willing to fund research and extension specific to their primary production focus. This behaviour manifests itself collectively, and commodity-based agricultural support organisations are created. Initially, these services included producer representation, industry promotion, information sharing, quality assurance, industry

transformation, research, extension, production support, industry development and institutional capacity building (Liebenberg, 2015). A shift of focus towards research, development and extension (RD&E) was inevitable as public RD&E for the commercial agricultural crop production sector came under pressure.

The shift towards private research, private extension and commodity extension in South Africa has been slower than in the rest of the world but gradually gained momentum soon after the general election in 1994 (Bruwer, 2021; Liebenberg, 2015; Van Niekerk, 2012). Since then, these organisations have established farmer support and development programs. Most of these development programs were aimed at new entrants to farming, and many of these commodity organisations have also become preferred service providers to departmental farmer settlement programs. These organisations, however, confirmed their commitment to the commercial or large-scale crop production sector. With sufficient funding, many private-sector firms can organise, manage and deliver extension services more efficiently than government agencies (Swanson, 2008).

There are several crop commodity organisations across the world and in South Africa. Each agricultural commodity in SA has one or several Commodity/Producer Organisations representing their industry. Examples of these commodity/producer organisations include Grain South Africa (Grain SA), Oil and Protein Seeds Development Trust and Oilseed Advisory Committee (OPDT/OAC) and the South African Sugar Association (SASA), to list a few. During the preliminary research, it became evident that this study had to focus on some of the major commodity organizations conducting research and their dissemination models. Peritumagri (2023) states that producer organisations go hand in hand with the increasing attention placed on the value chains (or supply chains) that connect farmers with consumers. Such value chains demonstrate farm product production, transportation, processing and marketing interrelatedness. Improving the coordination of activities of different actors (such as firms) in the chain can reduce transaction costs, help guarantee product quality and safety, and enhance the design of marketing strategies. Producer organisations are considered instrumental in increasing the value generated throughout the chain by ensuring that the quality of products is in line with the standard demanded (Peritumagri, 2023).

Producer organisations are increasingly becoming more involved in conducting and coordinating crop-specific research and disseminating the generated data (M. Binedell, personal communication, March 04, 2022; M. Du Preez, personal communication, March 07, 2021; B. Flett, personal communication, March 01, 2021; B. Flett, personal communication,

February 15, 2022; G. Keun, personal communication, July 22, 2021; S. Links, personal communication, March 08, 2022).

The World Development Report, Agriculture for Development (WDR, 2008) makes the case for producer organisations as key actors in agricultural development who can assist producers in the following:

- Information to farmers about customers' quality requirements.
- Implementing quality control systems.
- Marketing functions.
- Research, Development & Extension (RD&E).

2.4.5. Grain South Africa (Grain SA)

Grain SA was established in June 1999 and was formed out of NAMPO (maize), NOPO (soybeans, sunflower and groundnuts), the WPO (wheat, barley and oats) and the SPO (grain sorghum). This organisation represents the interests of the following grain sectors:

Maize, soybeans, sunflower, canola, sorghum, groundnuts, wheat and barley.

The following outlines the vision, mission, culture and values of Grain SA:

- Vision: To influence the macro and micro economic environments to enable sustainable and profitable local grain production and development.
- Mission: Ensure and grow a credible, sustainable, voluntary and inclusive grain producers' organisation that drives the mandated strategic actions, including meaningful stakeholder partnerships and relationships.
- Culture and Values: Build trust and relationships through respectful interaction and open, honest and efficient communication. Valuing consistent, authentic and legitimate teamwork that delivers consistent and impactful results.

2.4.5.1. Summary of the Core Strategic Objectives

- Influence economic sustainability
- Grow and support developing grain producers in becoming commercially sustainable.
- Increase the involvement of younger producer members.
- Grow a broader membership base.
- Grow and maintain key value chain relationships.
- Efficient and effective communication.

Research at Grain SA (as copied from their website) is explained as such:

Grain SA has restructured internally, and two units in line with our ever-expanding mandate were established, namely Grain Economy and Grain Research and Policy Centre. Central to this was the need to escalate Grain SA's active role in coordinating need-driven grain research. The agreed-upon approach was establishing consortia and multi-stakeholder partnerships, preferably with universities and other appropriate public-private partners. Partnerships and stakeholders were also identified to work with the Grain SA team for a food-secure future. Funding is a crucial element, and a concerted effort was made to prioritise funding for the different research needs identified by producers. Grain SA's critical role is ensuring funding is directed to new, prioritised focus areas. These priority focus areas are crop improvement, crop protection and climate change. The next steps were developing joint research programmes for each focus area, linking them with various technology-driven initiatives, and ensuring that appropriate technologies reached the producers.

The grain research and policy centre guides, coordinates, and facilitates grain and oilseed research and policy matters. The unit aims:

- To create a link between key stakeholders such as producers, policymakers and research communities.
- To create a platform for interaction and communication on relevant issues.
- To play an active role in ensuring the roll-out, implementation, monitoring, evaluation and impact assessment of policies, programmes and projects.

These priorities include crop improvement, crop protection, climate change, and conservation agriculture. "Through this, we ensure long-term productivity and sustainability by accessing the latest information and R&D technology" (Grain SA, 2023).

2.4.6. Oil and Protein Seeds Development Trust, Oilseed Advisory Committee (OPDT/OAC) and the Protein Research Foundation (PRF)

These organisations represent the interests of the soybean, sunflower, canola, and groundnut production sectors and the oilseeds and protein value chain.

2.4.6.1. Oil & Protein Seeds Development Trust (OPDT)

The main objectives of the Oil & Protein Seeds Development Trust (OPDT) are the promotion and development of the Oilseeds Industry in South Africa by:

- The financing of research projects with regard to the improvement, production, hoarding, processing or marketing of Oilseeds.

- The financing for the provision of information and advisory services to the Oilseeds Industry about the production of Oilseeds and marketing conditions.
- The investment and conservation of the Assets of the Trust.
- The productive utilisation of the Assets of the Trust from time to time in such a manner that the real value thereof is maintained or increased as far as possible.
- The financing of market access or any further conduct in the interest of the Oilseeds Industry provided that it is in accordance with the objects and purposes of the Act.

2.4.6.2. Oilseeds Advisory Committee (OAC)

The main objectives of the Oilseeds Advisory Committee (OAC) are:

- Rendering of advice to the trustees of the Oilseeds Trust with respect to the application of its funds for the benefit of the oilseeds industry.
- Making recommendations to all interested parties in the oilseeds industry.
- The appointment of trustees to the Oilseeds Trust and any other institutions that the Committee deems necessary to investigate, promote, and report on matters relating to the Oilseeds Industry referred to it.
- Research: An extensive research database in the form of an archive currently supports 29 projects listed for 2023/24.

2.4.6.3. Protein Research Foundation (PRF)

Certain objectives of the Protein Research Foundation (PRF) and its predecessors, including funding of research to achieve specific objectives, date back to 1973. Before 1990, certain other objectives had to be achieved using particular funds, but those were terminated in 1989 to make way for a pure research function and related matters. Those were determined formally in 1990, with the establishment of a research trust now known as the Protein Research Foundation (PRF). This organisation represent the interests of the protein (protein feeds and protein crop production sector)

In the early seventies, the fishmeal industry sold a significant quantity of fishmeal on the international markets. Still, fishmeal was classified as a strategic product, and local requirements had to be met before any fishmeal exports could be considered. The Fishmeal Association was particularly critical of animal feed producers because of the high quantities of fishmeal included in animal feed.

A levy started the so-called fishmeal levy fund, a voluntary fund set aside as a separate research fund, namely the Protein Research Fund. The research funds were to be used to promote the production of protein material for animal feed, with particular emphasis on the increased production of soybeans and soya cakes. As such, it was the origin of the current PRF and its research assignment, which dates to 1973.

Several commodity trusts, like the Maize Trust and the Oil and Protein Seed Development Trust (OPDT), were also established in terms of the provisions of the Marketing Act. Later, the PRF changed its name from the Protein Research Trust (PNT) to the Protein Research Foundation (PRF) to avoid confusion with the newly established commodity trusts.

Mission: The PRF contributes to the realisation of the vision for the provision and utilisation of protein using the pro-active stimulation and funding of applicable purposeful research, as well as the promotion and implementation of such research results through technology transfer to fulfil the increasing demand for protein as well as its optimal utilisation in the Republic of South Africa for animal nutrition.

Vision: The Protein Research Foundation (PRF) strives to make a significant contribution to the promotion of local production of protein on a sustainable basis to satisfy the growing demand for protein for animal production purposes as well as the optimal utilisation thereof, which will lead to an increase in the standard of living of all people in the Republic of South Africa.

Research: An extensive research database in the form of an archive currently supports five projects listed for 2023/24.

2.4.7. South African Sugar Association (SASA)

The South African sugar industry is one of the world's leading cost-competitive producers of high-quality sugar. It makes an important contribution to employment, particularly in rural areas, to sustainable development and the national economy. It is a diverse industry combining the agricultural activities of sugarcane cultivation with the manufacture of raw and refined sugar, syrups, specialised sugars and a range of by-products.

The cane growing sector comprises 23,000 registered sugarcane growers farming in KwaZulu-Natal and Mpumalanga. Sugar is manufactured by six milling companies, with 12 sugar mills operating in various cane-growing regions. The industry produces an estimated 2.2 million tons

of sugar per season. About 60% of this sugar is marketed in the Southern African Customs Union (SACU). The remainder is exported to Africa, Asia and the Middle East markets.

The multi-billion South African sugar industry is cost-competitive, consistently ranking in the top 15 of approximately 120 sugar-producing countries worldwide. Stretching across two provinces of South Africa, namely Mpumalanga and KwaZulu-Natal, the sugar industry makes a positive difference in the lives of more than a million people. It is a catalyst to economic growth and development. The South African sugar industry is a significant contributor to the national fiscus and operates in rural areas of the country. The economic impact of the industry has proven over decades to be so significant that entire towns, for example, Tongaat in KwaZulu-Natal and Malelane in Mpumalanga, among many other rural towns and regional centres, have been established based on the business of growing sugarcane and supplying sugar. The sugar industry employs people in job-starved regions, often in deep rural areas with little other economic activity or employment opportunities. The industry provides education and training, contributes to excellence in research, science and technology, supports enterprises, and ensures the sustainable use of natural resources (South African Sugar Association, 2023).

2.4.7.1. SASRI as a Private Research and Dissemination Institution of the South African Sugar Association (SASA)

- ***History of SASRI***

In 1925, leaders of the SA sugar industry were prompted to establish their own Experiment Station. The main reason for doing so was the need to introduce and select more productive and disease-resistant varieties for the industry. At the time, the sugarcane disease, Sugarcane Mosaic Virus, posed a serious threat to the industry, as many promising varieties under test proved to be susceptible to the disease.

Dr WE Cross, Director of the Tucuman Research Station in Argentina, advised the SA industry not to rely on the inadequate number of government-employed agricultural scientists working on several different crops but to employ its own scientists in different disciplines to concentrate exclusively on sugarcane. This formed the foundation for SASRI as an independent and extremely successful research institute with a highly effective knowledge management and dissemination model by their in-house extension specialists (M. Binedell, personal communication, March 4, 2023).

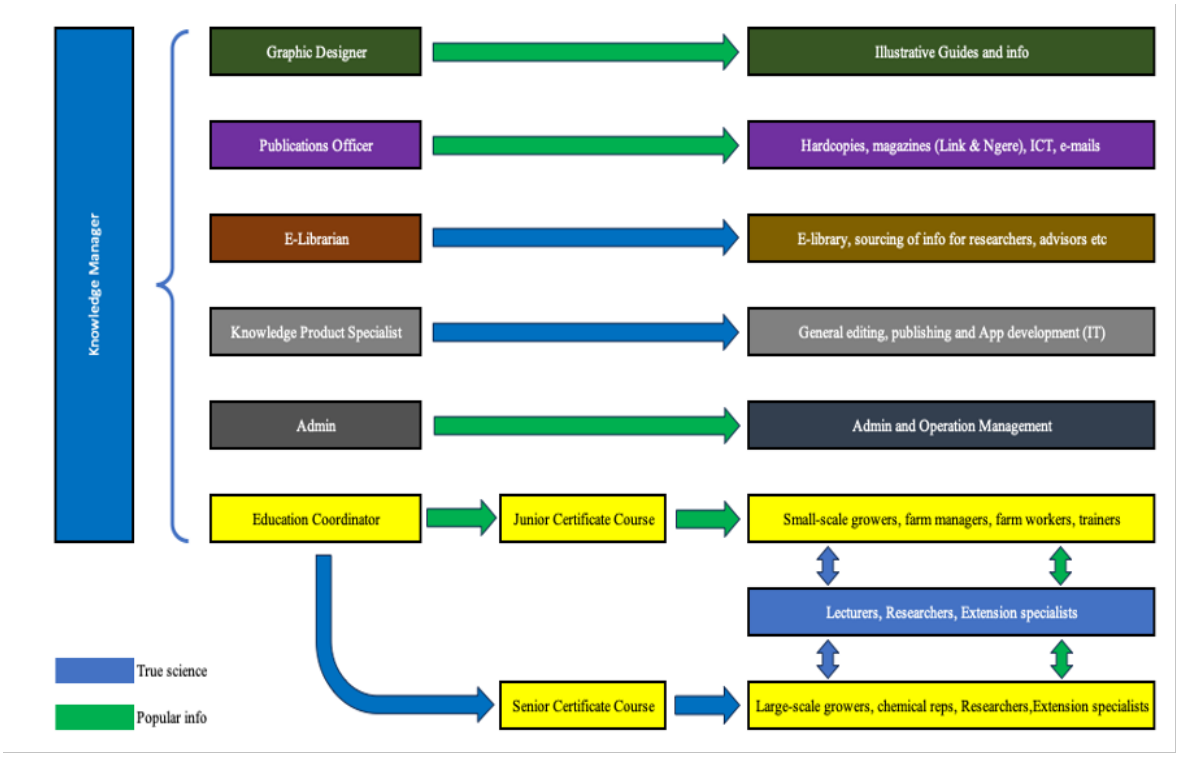

Figure 2.6: SASRI Structure of the Knowledge Management Team

The South African Sugarcane Research Institute (SASRI) serves the industry by providing for all the agricultural research requirements related to the growing and production of sugarcane. This is accomplished through a rigorous research, development, and technology exchange programme that responds to industry sustainability and profitability needs and is cognisant of global developments in sugarcane research. The South African Sugarcane Research Institute (SASRI) is a world-renowned agricultural research institute delivering relevant technology and facilitating the implementation of innovative solutions for a sustainable industry (Figure 2.6).

- ***Research and Research Culture***

SASRI values a climate of creativity, innovation, and national and international cooperation. SASRI embraces a research ethos that includes honesty and integrity in all interactions. Research at SASRI is clustered within four multidisciplinary programmes: variety improvement, crop protection, crop performance, management and systems design and optimisation.

SASRI conducts research and delivers services in the following disciplines:

- Varieties: Developing and delivering new sugarcane varieties provides increased economic returns.

- Research: Conduct research to advance sugarcane nutritional, agronomic and engineering technology.
- Services: Provide services to support sugarcane farming best management practices.
- Product development: Transform research outputs into practical knowledge and technology products.
- Technology adoption: Facilitate the adoption of technology and best management practices that encourage responsible, sustainable and profitable land use.
- Innovation: Generate new ideas to enlarge the scope of sugarcane agriculture and sustain the industry into the future.
- Extension service: An extension service provides the essential link between researchers and sugarcane farmers. SASRI also offers various services, including fertiliser advice, disease diagnoses and education courses (The South African Sugarcane Research Institute, 2023). As a result of continued contact with farmers and because research and extension are combined rather than separated, communication problems are reduced, and the time lag between defining problems and adopting technology is minimised (Hoffmann *et al*., 2009).

2.5. MONITORING AND EVALUATION OF DISSEMINATION: KEY PERFORMANCE INDICATORS (KPIs)

Dissemination makes information available and usable to target audiences through various channels or formats. A channel is a communication route such as a news conference, publications or posters. A format refers to the actual layout for communicating the information. Information can be communicated orally and in writing (Centres for Disease Control and Prevention, 2018). The effectivity of these formats should be monitored using different indicators that apply to the specific industry. Indicators describe the extent to which the target audiences have been reached (Centres for Disease Control and Prevention, 2018). In the case of agricultural research results, those can include producers, advisors, students, processors and consumers.

The two most important key performance indicators (KPIs) used in most industry sectors worldwide are the adoption rate of research results and feedback from the whole spectrum of the original target audience (Danso-Abbeam, 2022). Different circumstances in agriculture may determine the importance and effectivity of either one or both. It must be emphasised that

these KPIs must be an integral part of the dissemination model and constantly monitored, as shown in Figure 2.7 (Taylor & Bhasme, 2018).

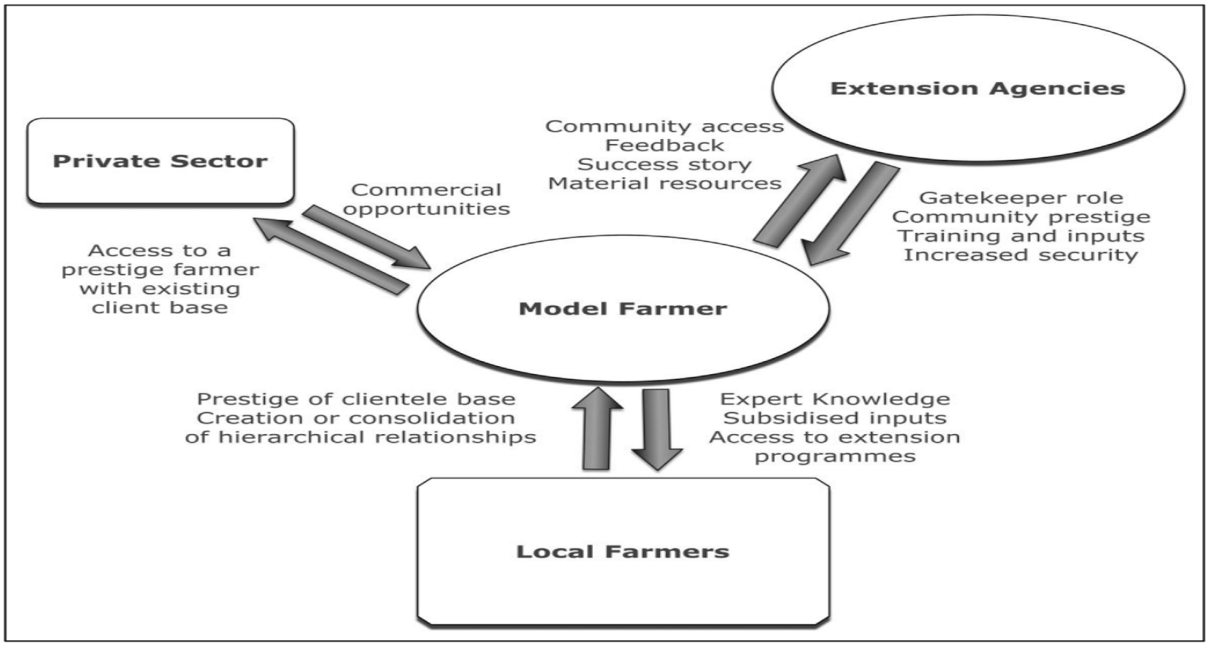

Figure 2.7: Key relationships in a model farmer network (Source: Taylor & Bhasme, 2018)

2.5.1. Adoption Rate of Research Results

Oxford Languages (n.d.) defines adoption as "the action or fact of choosing to take up, follow, or use something". Such as "the widespread adoption of agricultural technology". There are different ways in which the researcher can collect data when applying this KPI, such as questionnaires, interviews and online surveys. However, the target population's response to these surveys may not always be favourable. In agriculture, a very effective way involves the advisor or the bodies responsible for knowledge management and transfer. They are usually in direct contact with producers. They should have first-hand knowledge of the rate at which these research results have been adopted and implemented in practice (M. Binedell, personal communication, March 04, 2022).

Farmer experimentation with conservation agriculture began in the 1960s and has continued to this day, where around 80% - 90% of Australia's 23.5 million hectares of winter crops are now grown using conservation agriculture principles. This remarkable achievement results from sustained investments in agricultural research and development, dissemination and farmer innovation. Australian economic settings and science policies have encouraged and facilitated

farmer participation in the conservation agricultural innovation system (Bellotti & Rochecouste, 2014).

Using a particular or combination of communication channels relates to the stage in which a farmer is adopting to achieve the desired effect. This process refers to decisions and actions that an individual must take and adopt innovation as recommended to him, adapts it to suit his situation or rejects it altogether (Israel & Wilson, 2006). Therefore, different channels are important at different adoption and innovation decision-making stages (Israel & Wilson, 2006). The difficulty arises because changing production practices involves risk, capital investment, experimentation and the precise application of science. Local knowledge of soils, weather, nutrient cycling, and crop adaptation is critical for successful agricultural production. The ability to obtain and process traditional and precision management information and assist farmers in applying scientifically sound site-specific solutions to solve problems is paramount in implementing on-farm change (Briese, 2019). Taylor and Bhasme (2018) introduced the concept of "model farmers" in the developing world (Figure 2.1). Extension agencies use model farmers to serve as in-community representatives for new agricultural inputs or cultivation techniques. They often play a dual role by providing an entry point in a community for applying new farming practices or technology and providing an observable field "demonstration" that serves as a practical example that can inspire confidence in fellow farmers. Although Taylor and Bhasme (2018) refer to the developing world, this may also be true for the commercial farming sector in developed countries. The advisor's involvement in these processes may provide the other stakeholders in the information model with first-hand knowledge regarding the adoption rate amongst producers. The results of a study done in Northern Ghana, where the adoption rate of soil-water-conservation (SWC) practices was measured, indicated that contact with extension services positively and significantly increased the adoption of all the SWC practices under study. Thus, farmers who receive SWC extension messages from extension agents are more likely to apply the SWC practices on their farm plots than those who do not interact with extension agents (Danso-Abbeam, 2022).

2.5.2. Feedback

Advisors: Analysing their perceptions and measures applied to ensure that they stay informed of and updated on, the latest scientific research results on an ongoing basis and what are the key factors or distinguishing features of an effective communicator (Du Plooy-Cilliers *et al*., 2014) - the advisor's opinion of pseudo-science and its influence on sustainability.

It remains a challenge to design measurable indicators to capture the quality and effectivity of dissemination (Prager *et al*., 2016). Feedback should come from all the stakeholders in the dissemination chain, which is, without doubt, the quickest and most effective way of monitoring the success of dissemination. Although there is no need for a formal system, it is important to establish well-structured channels through which feedback can be supplied (Wang & Chen, 2009). Again, communication lies at the heart of this process, and this study will prove that effective communication equals effective dissemination, improved feedback and quicker adoption of scientific results.

2.5.2.1. Feedback Loops

Human nature can sometimes lead to a reluctance for change, and information can get stuck in a rut, going from point A to point B. Gardner (2022) suggests that information must flow from the fork to the farm, sharing consumer preferences, analysis and insights with farmers in record time. This will help guide producers, businesses and policymakers in their decision-making and inform research into nutrition and sustainability. This is true for all the stakeholders in the dissemination chain. Prompt and timely feedback between all the role players is vital when information flows in multiple directions between food, agribusinesses, producers, researchers and advisors, as Gardner (2022) suggested.

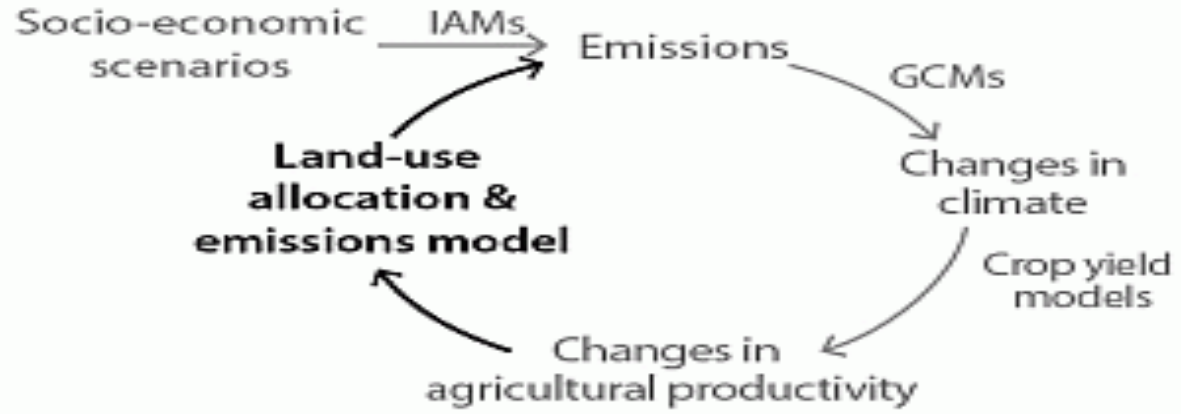

Figure 2.8: Graphical Abstract of a Feedback Loop (Source: Bajzelj & Richards, 2014)

Bajzelj and Richards (2014) used the feedback loop concept to demonstrate the interaction between agriculture and climate change (Figure 2.8). This principle may be applied to general agricultural dissemination to simulate the interaction between researcher, advisor and producer.

2.6. INFORMATION OVERLOAD AND THE CURRENT INFORMATION ENVIRONMENT

A concept that has been increasingly gaining prominence in the context of fake-science is that of "information overload". Perhaps the best example of information overload and the utter confusion it creates can be demonstrated by the prevalence of health misinformation on social media and how it has effected peoples' behaviour, caused a global sense of panic and increased the threats to public health during the period of COVID-19 (Wu & Pei, 2022). Hotez (2020) reports that much of fake-science and disinformation may even be linked to "Anti-science extremism. A study by Hotez (2020) has found a sharp rise in the anti-science rhetoric in the United States, especially in the public health sector. While it is not sure if this extremism could also be linked to agriculture, pseudo-science is a global problem in most sectors of industry and even more so on all levels of social interaction. Müller-Wille and Charmantier (2012) say that the many technologies designed to contain information fuelled its further production, partly by providing platforms for more efficient data accumulation and partly by bringing new structural relations and patterns within the material collected. Müller-Wille and Charmantier (2012) are further of the opinion that in many cases, the very people who suffer from information overload tend to be the same people who created it. The dangers of information overload are a serious problem and a genuine concern for true scientists. Briggs (2017) warns that fake science due to information overload poses a threat, such as risking public health and undermining public trust in research. This is also the case in agriculture. Information overload occurs when the nature of the information is uncertain, ambiguous, complex, or intense. Specifically, information overload in consumer decisions can be caused by the number of alternatives or product attributes (Hu & Krishen, 2019). One of the characteristics of the online environment is the sense of control and autonomy for decision-makers; prior research suggests that the Internet environment enables consumer empowerment and can lead to consumers' positive assessments of products or services. The study also found that the negative effect of information overload on decision satisfaction is minor for consumers with high product knowledge (Hu & Krishen, 2019). This is exactly where the problem lies: many consumers, in this case, producers, do not know about complex products such as chemicals, medicine, plant nutrition and many other scientific concepts and are exposed to exploitation by pseudo-science advocates.

2.7. PSEUDO-SCIENCE OR FAKE SCIENCE IN AGRICULTURE

As elsewhere in the world, the South African agricultural sector is also affected by pseudo-science, and this study has attempted to find reasons why pseudo-science seems to have pushed true science aside and taken its place as the information that reaches the producers or growers. The definition of pseudo-science or fake science is a system of theories, assumptions, and methods erroneously regarded as scientific (Merriam-Webster, n.d.). This study also attempted to prove that the importance of true scientific information cannot be overemphasised.

When farmers do not have access to formal extension services, they use other sources of information, sometimes using technologies such as mobile phones and internet options (Mahlangu, 2019). The internet and social media platforms such as Facebook, YouTube, and similar platforms are usually where an information overload is generated – a situation conducive to pseudo-science. Information created under these circumstances to confuse and blur the otherwise definite line between science and fake science is called professional jargon. If nothing else, the professional jargon of different disciplines can sometimes close the door on effective communication and open the door to pseudo-science (Esslinger & McCorkle, 1986). Scientists are also not completely absolved from all responsibility regarding information overload and fake science, as stated by Oakley (2023). Scientists must publish to succeed, and this pressure to publish in an increasingly competitive environment has led to more publications annually. Still, it has also led to more rampant research misconduct and lower-quality science being published in predatory journals. Through their publishers, such journals feed on a continuing trend in science, where researchers' assessment is often based on the number instead of the quality of their scientific publications. In 2010, the number of papers published in predatory journals reached 53,000; however, by 2014, 420,000 were estimated to have been published (Grzybowski, Patryn & Sak, 2017). These journals were most rampant in the fields of medicine but have also penetrated the agricultural research publications scene.

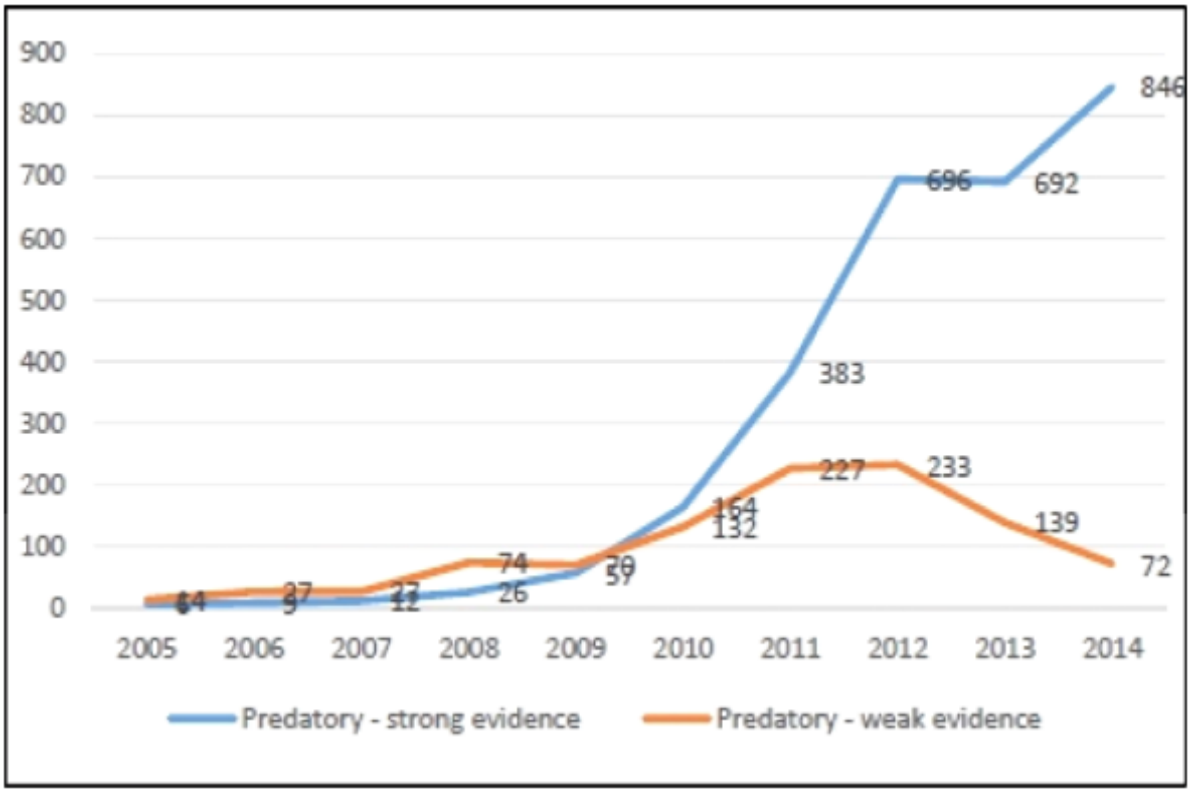

Figure 2.9: Increase in Number of Papers Published by South African Authors in Predatory Journals from 2005 to 2014 (Source: Mouton & Valentine, 2017).

From their study, Mouton and Valentine (2017) found that a sharp increase occurred from 2011, raising concerns about the undermining effect these publications have on true science (Figure 2.9).

The future of agriculture and food production depends not only on the discovery of scientific knowledge but more so on the application of it. Briese (2019) pleads with all agronomy and related agricultural sciences practitioners to become trusted advisors, elevate their practice to a new level, and approach the challenges of agriculture from a systems point of view. They also need to create actionable strategies to protect crop yields and the soil, the environment, the ecosystem, and the well-being of the farmers and consumers (Briese, 2019).

In developed countries, narrow profit margins mean farmers do not have much room for failure (Del Corso *et al*., 2015). Thus, narrow margins encourage farmers to stick with proven practices with more predictable risks rather than try new practices with unknown yields and economic risks (Del Corso *et al*., 2015). The line between true science and pseudo-science is sometimes rather feint, and advocates of fake science have mastered the art of capitalising on it. There is a saying, “a half-truth is worse than a lie”. Briese (2019) explains this concept best

by the example of two completely different concepts, namely weather and climate, where the distinction between weather and climate for many ordinary citizens is blurred. Despite the high degree of agreement among scientists (~97%) on most scientific data, also in agriculture, non-scientists continue to debate these conclusions (Tyson, 2014; Benegal & Scruggs, 2018). The ongoing application of pseudo-science in agriculture is hazardous; it wastes science resources, results in misleading advice to farmers, undermines farmer's confidence and costs millions of dollars in lost productivity (Edmeades, 2011).

2.8. FUNDING OF AGRICULTURAL RESEARCH

Funding of research and the sources thereof is an important part of the process. The source and forms of funding for general research influence several factors. The same situation transpires in research for agriculture, and to understand the current situation regarding funding in South Africa, it is important to study the comprehensive work done by Liebenberg (2013). He reports that the source and form of funding influence not only the amount of research conducted but also the types of research undertaken, including the balance between strategic (or longer-term R&D) versus more applied (shorter-term research), between crops and livestock or between particular crops or even other specific problems confronting agriculture.

2.8.1. Short Historical Overview of Research Funding in South Africa

Until 1992, research by the Department of Agriculture relied heavily on block grant funding from the national government. The commodity-oriented Control Boards (such as the Wheat Board, Tobacco Board, Maize Board, and so on, which operated under the statutory marketing structures for agricultural that existed under various guises from 1937 to 1992, were an additional source of support. Allocations to agricultural research were made from levy income generated from the marketing schemes promulgated under the Marketing Act as amended in 1968 (Act 59 of 1968). In 1992, Agricultural Research Council (ARC) institutes began to diversify their funding sources, and the reported share of government core funding for ARC dropped from 89.8% in 1992 to 1993 to 76.2% from 1995 to 1996. From 2001 to 2002, the share of ARC funding from the government in the form of block grants fell to 53% of total revenue. The crop-related institutes (specifically, the grain crops, industrial crops, and small grains institutes) have sourced a large share of their non-core income from the provision of research services (Liebenberg, 2013).

2.8.2. Non-Government Sources of Support

The policy governing the activities of Science Councils in South Africa classifies all sources of funding other than the parliamentary grant as private and is commonly referred to as external funding. Liebenberg (2013) defines private funding from non-government sources, including commodity trust funds, levies from producer organisations, and research funding from private firms. The year 1997 was an important transition year with significant implications for industry support for ARC research. In that year, the commodity Control Boards overseeing managed marketing schemes ceased to exist, as did the producer levy schemes that underwrote the commodity stabilisation funds and other costs incurred by these Control Boards. It took several years before a new set of statutory levy schemes was in place under the legislative authority of the Marketing of Agricultural Products Act of 1996 (Act 47). In 1998, just seven industries agreed to a levy scheme; by 2007, the number had grown to 11 industries. Levy income provides collective goods to farmers in each industry, including promotional services for local and export markets, product development, quality control, sectoral transformation activities, plant improvement and research overseen by The National Agricultural Marketing Council (NAMC). For the ARC, another significant source of industry support comes from the commodity trust funds that developed as a redeployment of the closing balances of the pre-1997 commodity stabilisation reserves that are now overseen by their respective boards of trustees, including industry and ministerially appointed representatives.

The share of levy income directed to agricultural R&D varies markedly across industries and over the years. Notably, the share of statutory levy income earmarked for agricultural research projects has declined over the past three years.

Another concern is that even if funding from the commodity trusts to the ARC was increased, all the levy income collected was allocated to research, representing only 23% of the total ARC external income. Moreover, if all the revenue generated through research services was assumed to come from private clients, only two-thirds of the crop institutes would be deemed to be earning more than half their external (non-core) income from private sources (Liebenberg, 2013). These services are largely funded through membership fees, trust funds, trust fund proceeds, and levy income (Liebenberg, 2015).

2.9. INFORMATION COMMUNICATION TECHNOLOGY (ICT) AND SOCIAL MEDIA-LIKE MEANS OF DISSEMINATION

Millions of people across countries are constantly sharing a wide range of irrelevant and important content all at once through ICT, which is a broader term for Information Technology

(IT). It refers to all communication technologies, including the internet, wireless networks, cell phones, computers, software, middleware, video-conferencing, social networking, and other media applications and services enabling users to access, retrieve, store, transmit, and manipulate information in a digital form (Food and Agricultural Organisation, 2023). Scientists also use these channels to communicate their research fast and efficiently to every corner of the world. Apart from a few exceptions, the range of social media platforms scientists use is relatively vast and dependent on discipline and sentiment. The ability to communicate to the masses via social media is critical to distributing scientific information among professionals in the field and to the general population (Van Eperen & Marincola, 2011). To ensure effective communication and continuous improvement (Esslinger & McCorkle, 1986) suggested that the scientist considers quality, frequency, intensity and various channels.

In an interesting study by Alotibi and Dabiah (2021), they investigated the soil-plant relationship by looking at the knowledge levels of social media users, the relationship between the users' characteristics, and their knowledge of the soil-plant relationship. The results of an online survey showed most of the participants (68.8%) were moderately dependent on social media to acquire knowledge on soil-plant relationships and indicated "Twitter" as the most highly utilised platform, followed by "*YouTube*". Meanwhile, 48.8% of the participants indicated that social media greatly impacted on their knowledge-based information on soil-plant relationship and agricultural contents. Inferential analysis showed there was a significant positive relationship ($p < 0.01$) between independent variables: *Twitter, YouTube, Instagram, and Snapchat*, the degree of trust on these platforms, and the level of knowledge of the soil-plant relationship (dependent variable). Only 13% of the variance accounted for the impact of social media on participants' agricultural knowledge base can be predicted from the combination of participants' reliance on a set of social media platforms (*Twitter, Instagram, YouTube,* and *Snapchat*). The study revealed the trust and confidence of the users using social media on agricultural information and soil-plant relationships had a medium effect on social and educational research (Alotibi & Dabiah, 2021). However, using social media as a tool for agricultural information dissemination may have issues with content structure, information quality, stakeholders' participation and transformation of knowledge (Barau & Afrad, 2017).

Interestingly, from the study by Alotibi and Dabiah (2021), the order of preference for these platforms to access agricultural information was *Twitter* followed by *YouTube*. Participants indicated that they sometimes use other social media platforms such as *WhatsApp*, *Instagram* and *Snapchat.* However, the results show that *Facebook* is the least used platform for the participants to get agricultural information (Alotibi & Dabiah, 2021).

Tateosian *et al*. (2023) found that ecological researchers have even codified Web media as a source of indirect citizen science-like observations as "iEcology". This is new terminology, and their study also found that *Tweets* can be an effective proxy for observations, especially in monitoring agricultural diseases or trends. Trends must not be confused with scientific information, and it is unclear if research results, on a continuous and large-scale, will always reach the target audience. Nevertheless, the uniform and information-dense format of *Twitter* posts *("Tweets"),* proximity to first-hand observations, and the service's Application Programming Interface (API) access to raw data make it a likely data source for understanding both global and local trends (Tateosian *et al*., 2023).

Oakley (2023) confirms this trend of scientists and social media or Academic Social Networks (ASNs). The use and number of social media platforms have increased dramatically in the last decade. Latest statistics show there are more than 3.78 billion social media users worldwide, and that number steadily increases year after year. Scientists can use social media to communicate with other scientists inside or outside of their field or with the public. The perception of social media is often mixed, with many dissenting opinions on whether it is beneficial or detrimental. The panel discussion focused on the benefits: social media is a way to boost a professional profile, give and receive support, promote openness and sharing of information, act as a public voice for science, facilitate collaboration and career advancement, or engage in a fun conversation with scientists and non-scientists outside the local work environment (Oakley, 2023). Studies show it is worth developing relevant training programs that focus on integrating social media into research activities and their use in disseminating research findings. Ollerer (2015) confirms the recent movement of scientists to interact more directly with people via internet blogs and social media such as *Facebook, Twitter*, and *YouTube* to deliver science to the end user. It is, however, a minority of scientists and is not yet a significant channel for citizens to obtain scientific information.

2.10. ACCREDITATION OF AGRICULTURAL ADVISORS AND EXTENSION SPECIALISTS

Most stakeholders in the agricultural dissemination chain have a positive attitude towards accreditation with either regulatory bodies that may require compulsory registration or voluntary accreditation with institutions that offer advanced training and qualification.

In South Africa, the accreditation of extension service provision has been demanded by end users (in this case, small-scale farmers) because it builds trust and credibility (Shemfe & Oladele, 2018). This study also investigated whether the researcher, large-scale advisor, and

extension specialist share this opinion. Shemfe and Oladele's (2018) study has found that extension officers generally have a high knowledge of and favourable attitude towards the accreditation of service providers. They also pointed out a need to adopt accreditation procedures for extension service providers. They further determined that the most prominent impact of accreditation on extension service delivery was that it improved the confidence and accountability of extension agents. However, the main constraint was that accreditation does not guarantee a certain level of individual competence.

In North America, the Certified Crop Adviser program (CCA) is one way for advisors to distinguish themselves as reputable purveyors of science. The Agronomy Society of America (ASA) administers this voluntary certification program. To become certified, the applicant must pass two agronomic knowledge tests (international and local), gain experience in the field providing advice to producers, and agree to and sign a code of ethics. Signing a code of ethics is a crucial foundation of the CCA's accreditation and something the accreditation authorities or bodies in South Africa should note. Furthermore, for the CCA accreditation, the required experience only includes time spent assessing crops and providing advice to farmers and ranges from two to four years, depending on the level of education obtained by the applicant. Once certified, crop advisers must complete 40 hours of pre-approved continuous education every two years to maintain certification. As of November 2018, there were over 13,000 CCA's in North America (ASA, 2018). Government agricultural agencies in the US and Canada also recognise the CCA program as experts in managing on-farm agricultural challenges. Some federal programs that provide funding for farmers to implement environmentally friendly management practices require the services of technical service providers. CCA certification is one of the necessary credentials to become a technical service provider. One example is comprehensive nutrient management plans. These plans are designed to reduce nutrient losses from agricultural fields and protect the environment from nutrient runoff by using soil tests, knowledge of plant physiology and weather observations to detail when, how and how much manure and other fertilisers are applied to the crop. Nutrient management plans are required for manure applications in sensitive regions such as the Chesapeake Bay. This process helps to ensure that the farmers receive and apply sound science to improve on-farm and environmental outcomes (Briese, 2019).

Advisers in Turkey need to pass examinations and earn certificates to practice. All advisers are registered service providers, and most continue to attend training and educational programs to further their knowledge and education (Ates & Sendundar, 2013). They interact with the remaining extension and research scientists to obtain new information and practices.

In South Africa, advisors in the crop production sector may apply for accreditation with one or more of the following: the South African Council for Natural and Agricultural Science Professions (SACNASP), the South African Society of Agricultural Extensionists (SASAE), CropLife South Africa and the Fertiliser Association of South Africa (FERTASA), amongst others. Some of these accreditations may be compulsory for an advisor in a specific field of advisory service – maintaining these regulations seems questionable (C. Burger, personal communication, May 19, 2021; C. Prinsloo, personal communication, May 18, 2021).

Some individuals question whether accreditation and qualification make a difference and if experience (often it comes with age) is a sufficient substitute for accreditation. Sha (2010) conducted a study in "public relations" and compared concepts such as accreditation, age, experience, licensing and competency, to name a few. The study refuted the argument that age and professional experience were sufficient substitutes for qualification and accreditation in public relations. It is uncertain if the same result can be applied to agriculture, but arguably, it is highly probable.

2.11. CONCLUSION

From the literature review, it can be concluded that communication between the agricultural researcher and the target audience is crucial to promoting sustainable practices and utilisation of resources. Continuous research and subsequent results are important drivers in this process. Timeous and effective dissemination of results to maximise adoption and implementation are equally important, emphasising the linkage of the researcher to the end-user.

CHAPTER 3: METHODOLOGY

3.1. INTRODUCTION

Research is a dynamic process, and during the preliminary research phase, this study initially started as an exploratory design, as not much has been published about perceptions on dissemination in the large-scale crop production sector of South Africa. This study used a comparative approach, but it has also crossed borders with evaluative research assessing the effectiveness of existing methods, paradigms and models (Bouchrika, 2021), as well as descriptive research. The last mentioned is defined as "to draw comparisons" (Du Plooy-Cilliers *et al*., 2014). A descriptive research design usually aims to describe some group of people or other entities and their perceptions and opinions (Creswell *et al*., 2019). The aim would be to investigate, compare and describe the different dissemination models used by different organisations, the perceptions of selected stakeholders and participants in such a model and the actual measurements (where applicable) of success for this process. The participants' perceptions of the constraints of the current system and suggestions for improvements will also be collected, analysed, compared and described.

Swanson (1971) believes that thinking without comparison is unthinkable and, in the absence of comparison, so is all scientific thought and scientific research. Comparative study analyses compare two or more objects or ideas. This comparison often focuses on a few specific characteristics and sharpens the power of description. Comparative study is also used in testing hypotheses, and it can contribute to the inductive discovery of new hypotheses and theory building. The comparative study explains what the relation is between the two subjects (Shahrokh & Miri, 2019) and explains that the two main styles are:

- *Descriptive Comparison*: Descriptive comparison aims to describe and perhaps also explain the invariance of the objects. It does not aim to generate changes in the objects; on the contrary, it usually tries to avoid them.
- *Normative Comparison:* A special style of comparative study is needed when the aim is not just to detect and explain but also to improve the present state of the object or to help improve or develop a similar object in the future. This is the technique of normative comparison. This study used a combination of the abovementioned methods of comparison. Bukhari (2011) says that although the comparative approach has always existed mostly in the social sciences, the changes now are opening up a new dimension for even the natural sciences.

Comparative research focuses on unit similarities and differences (Holt & Turner, 1970). However, the decisions that lead to its final configuration are rarely all made at the outset. More often, new insights emerging during the research process yield reconsiderations and revisions of preliminary decisions (Shahrokh & Miri, 2019). A similar situation transpired through this study when it was later decided that research institutions' knowledge managers and research coordinators had to be included as participants.

It can be the method for testing hypotheses and causal analyses that aim at a more nuanced description of the respective item (Shahrokh & Miri, 2019).

3.1.1. Descriptive Comparisons

The most basic research questions are often descriptive and seek to describe certain phenomena and how these occurrences vary between cases (Strömbäck & Van Aelst, 2010). In this study, the cases being compared are three different models of dissemination and the perceptions of some stakeholders involved. Some of the analyses are descriptive, and as such, they include comparisons regarding the perceptions of researchers, advisors and knowledge managers.

Statistically, the descriptive comparison of two (or more) groups of participants is not too difficult, and comparisons of means (e.g., t-tests) and analyses of variance (e.g., ANOVAs) are often sufficient (Esser & Vliegenhart, 2017). In addition to descriptive statistics, inferential statistics was applied to complete the analysis.

3.1.2. Basic Explanatory Analysis

The second type of research question addressed in comparative research is a basic explanatory one to determine whether certain variables at the unit level impact other variables measured at the same level (Holtz-Bacha & Norris, 2001). In such instances, multivariate analyses, such as regression analysis, can be applied. However, the limited number of cases is an issue for many of the studies. A considerable number of cases are required to conduct multivariate statistical techniques, and in many instances, data for a sufficient number of cases is unavailable.

3.1.3. Comparison of Relation

A third type of research question is the comparison of relation, which involves investigating in different contexts the relationship between an independent participant, SASRI in this case, and a dependent variable, the summer grains crop sector. The comparison of contexts is a robustness check to determine whether a relationship holds in various situations (Holtz-Bacha & Norris, 2001).

3.1.4. Comparative Explanatory

The final type of question is labelled comparative explanatory.

Walk (1998) weights A (crop sector) and B (SASRI) equally BUT regards B as the norm to understand A better and names five principles of a comparative study when writing a paper: Frame of reference, grounds for comparison, thesis (compare-and-contrast), organisational scheme, text-by-text, point-by-point, as described by Visvis and Plotnick (2023).

- Juxtaposing is to place two concepts or objects following or near to each other, thereby highlighting their innate differences and similarities. Oxford Languages (n.d.) lists similar words as "compare and contrast".
- Linking A and B is important, as is the relative weight of similarities and differences (Visvis & Plotnick, 2023). The data which applies to this study should be described on this basis.

Once the similarities and differences are listed and described, it can be decided whether they outweigh the differences or *vice versa* to create a thesis statement reflecting their relative weights. A more complex thesis must include similarities and differences (Azadi & Filson, 2009).

A mixed methods approach allows the researcher to integrate qualitative research with quantitative data and could be a useful method for analysis of perceptions obtained from interviews. This study combined the methods mentioned above to compile the conclusions and recommendations. Juxtaposing emphasised the differences between the different dissemination models while linking the models' similarities obtained from the stakeholders' perceptions, providing a picture of the current situation.

3.2. RESEARCH DESIGN AND APPROACH

3.2.1. Materials and Methods

This study will be conducted in the large-scale (commercial) summer grain crop sector (maize and oil seeds) and the sugarcane production sector. A preliminary research and pilot-test study was conducted in 2021 to collect background data to find a better understanding of and points of view from experienced stakeholders in these sectors and to identify potential participants and respondents. It was an important part of this study to determine the focus and approach as Du Plooy-Cilliers *et al*. (2014) suggested. Data and information collected during this phase will not necessarily be used in the actual findings but rather to find and correct any mistakes in the research instruments and materials and identify limitations for this study.

From the pre-research study done, it appeared that there were three prominent opinions expressed by individuals involved in different research and extension models in the abovementioned agriculture sectors:

- The “confident-yes model”

  This is where a senior spokesperson of a research institution, an individual researcher or a crop commodity organisation involved in research was asked whether they were sure that all their research results reached the target audience as defined by themselves. The target audience may include producers, advisors, trainers and others, and the answer to the question was confident: “yes!”
- The “confident-no model”

  This is where a senior spokesperson of a research institution, an individual researcher or a commodity-based organisation involved in research was asked whether they were sure that all their research results reached the target audience. The answer was confident: “no!”
- The “confident we-are-not-sure model”.

  This is where a senior spokesperson of a research institution, an individual researcher or a commodity-based organisation involved in research was asked whether they were sure that all their research results reached the target audience. The answer was confident: “we are not sure!”

From the information gathered, it was encouraging to find that most of the institutions investigated, individuals and crop commodity organisations were conducting a fair variety of research projects despite difficult circumstances and monetary constraints. South African agricultural researchers are highly regarded and respected locally and internationally (G. Keun, personal communication, July 22, 2021).

The information provided also indicated that ethical researchers apply true scientific principles throughout the whole process of research and publishing the results. From the moment the results were ready to be shared, different approaches became apparent:

- The “confident-yes model” uses advisors and trainers to disseminate the information to their target audience. The “own advisors and trainers” can be individuals permanently employed by the institution or on a contractual basis as a consultant or private advisor. It was assumed that these advisors and trainers were properly qualified – a fact that needed to be researched. This model also uses all the conventional ways of communicating results, such as publications online, printed media and personal contact. This model seems to have

certain key performance indicators in place, enabling the institution to measure the effectivity of knowledge transfer.

- The "confident no-model" does not have its advisors and trainers employed to disseminate the information to its intended target audience but relies on supply companies' advisors and private advisors. However, this model employs trainers to disseminate information to the small-scale sector but not the large-scale sector. It also makes use of conventional printed and online publications and information sessions. This model does not seem to have any key performance indicators to measure effectivity.
- The "confident we-are-not-sure model" where most of the above-mentioned information was unknown. They were unsure of the outcome of dissemination and what role advisors had in the transfer of knowledge, and although they also used conventional printed and online publications and information sessions, the rate at which these publications reached the target audience could not be measured accurately and does not seem to have any key performance indicators in place.

It was decided that the perceptions of the main stakeholders, through the entire process, must be the focus of this study. A list of possible participants and respondents was compiled. Each group consisted of a larger or smaller number of participants involved in knowledge transfer. Still, the key role players of this process were the institutions and individuals who generated the information, namely the researcher, the institutions or individuals responsible for converting this information from science into practice, namely the extension specialist or advisors and thirdly, the grouping or individuals accountable for coordinating the research and dissemination process namely the research coordinators or knowledge managers. The following areas of the process were targeted to formulate the research questions and objectives:

- The entity responsible for establishing research priorities includes boards of directors, CEOs, and research committees.
- Sponsors and funding from different sources such as levies, trust funds, governmental grants, and private funding.
- Entity or body responsible for choosing researcher or institution such as research committees, coordinators, and consultants.
- Target audiences may include advisors, trainers, lecturers, consultants, producers, other specialists, and technical staff.
- Key Performance Indicators (KPIs). These are ways to determine if the information reached the target audience.

- Feedback to researcher, institution and commodity-based organisation followed by appropriate action. This would complete the cycle of scientific dissemination.

3.3. TARGET POPULATION AND SAMPLING

Purposive sampling, also called judgmental sampling was used to determine the respondents. Govindan (2014) describes it as "based on the belief that researcher's knowledge about the population can be used to hand-pick sample members". Certain sectors of the summer grains industry and the sugarcane industry in South Africa were targeted. The researcher is familiar with many researchers and advisors in these sectors which made purposive sampling ideal for the identification of respondents. When just a small number of people exhibit the characteristic that a researcher is interested in, judgmental sampling is the most beneficial.

3.3.1. Commodity Producer Organisation: South African Sugarcane Research Institute (SASRI)

The South African Sugarcane Research Institute (SASRI) conducts in-house research and employs a successful dissemination model. The South African sugarcane industry is rated among the top 15 of the 120 sugar-producing countries worldwide (M. Binedell, personal communication, March 04, 2022; South African Sugar Association, 2023). Preliminary research was done on the research and dissemination model applied by SASRI to understand better the profile and number of stakeholders involved. The aim was to determine the representation of respondents and participants. The following information was supplied (M. Binedell, personal communication, March 04, 2022) but may not be exact numbers:

Management team: 16 positions, of which 14 are currently filled, and eight members were holders of a PhD (South African Sugarcane Research Institute, 2022). Research coordinators: Research, Development & Extension (RD & E) committee. SASRI employed a total of 36 senior and junior researchers. They collaborate closely with more than one academic institution and sometimes sub-contract those research institutions and their researchers. SASRI may also research on behalf of these educational institutions.

Advisors employed by SASRI: 19 extension specialists and cooperation with an unknown number of private advisors, especially from the agri-chemical industry. Many sugarcane growers also use private agronomists and advisors, but the precise number is unknown.

Number of large-scale sugarcane growers in South Africa: 1 126 large-scale farmers (South African Sugar Association, 2022).

Research funding was mainly the result of a levy contribution by growers and millers.

SASRI is based in Mount Edgecombe, Kwa-Zulu Natal, South Africa.

3.3.2. Crop Commodity Development Trust, Advisory Committee and Research Foundation - referred to as Crop Commodity Organisation 1 (CC1)

Preliminary research was done on the research and dissemination model applied by the abovementioned institution to understand better the profile and number of stakeholders involved. The aim was to determine the representation of respondents and participants. The following information was supplied (M. Du Preez, personal communication, March 07, 2022) but may not be exact numbers:

Management team: Eight positions are currently filled, two of whom were holders of a PhD.

Coordinating research on soybeans: this Research Foundation's research committee and technical committee. Currently, the Advisory Committee funds almost three times as many research projects as the Research Foundation. No researchers were employed. Collaboration and sub-contract of research: 19 researchers, three independent research contractors, four academic institutions (UP, US, NWU and UFS), ARC, Western Cape Department of Agriculture (WCDA) and National Marketing Council (NAMC). No advisors were employed, and an unknown number of private advisors were also involved in the seed- and agri-chemical industry. Many oilseeds farmers use private agronomists and advisors, but the precise number is unknown.

Information sessions: limited, but research contractors disseminate results through information sessions of the Agricultural Research Council (ARC), seed supply companies and agri-chemical supply companies

Number of large-scale soybean producers and farmers in South Africa: estimated at 1,000 large-scale farmers.

Funding for research was mainly from the commodity Development Trust and the research foundations.

This institution is based in Johannesburg, South Africa.

3.3.3. Crop Commodity Producer Organisation 2 - referred to as Crop Commodity Organisation 2 (CC2)

Preliminary research was done on this commodity organisation's research and dissemination model to understand better the profile and number of stakeholders involved. The aim was to determine the representation of respondents and participants and the number of stakeholders involved. The following information was supplied (S. Links, personal communication, March 08, 2022) but may not be exact numbers:

Management team: 16 positions, of which 14 were currently filled—research coordinating on summer grains through the research coordinators. No researchers were employed. Collaboration and sub-contract of research: 21 researchers, five independent research contractors, four academic institutions (UP, US, NWU and UFS), Agricultural Research Council (ARC), Western Cape Department of Agriculture (WCDA) and National Marketing Council (NAMC). No advisors are employed. Private advisors involved: unknown number but mainly in the seed- and agri-chemical industry. Many summer grain farmers use private agronomists and advisors, but the number is unknown.

Information sessions are limited, but research contractors disseminate results through information sessions of the Agricultural Research Council (ARC), seed supply companies, and chemical supply companies.

Number of large-scale maize producers and farmers in South Africa: estimated at 2,000 large-scale farmers. The precise number of summer grains producers would be difficult to determine as it may vary from year to year due to practices such as crop rotation and crop preference, which, in turn, is determined by the selling price and cost of inputs; in other words, the profitability of a crop.

Funding for the research was mainly from the Department of Science and Innovation (DSI), the Maize Trust, private companies, and voluntary contributions from producers.

This Commodity Organisation is based in Pretoria, South Africa.

3.4. OVERALL RESEARCH SAMPLING SIZE

- Five researchers from the summer grains production sector. These researchers were widespread over South Africa (Figure 3.1).
- Five summer grains crop production advisors, including agronomists, soil scientists and crop protection advisors. These respondents were widespread over South Africa (Figure 3.1).

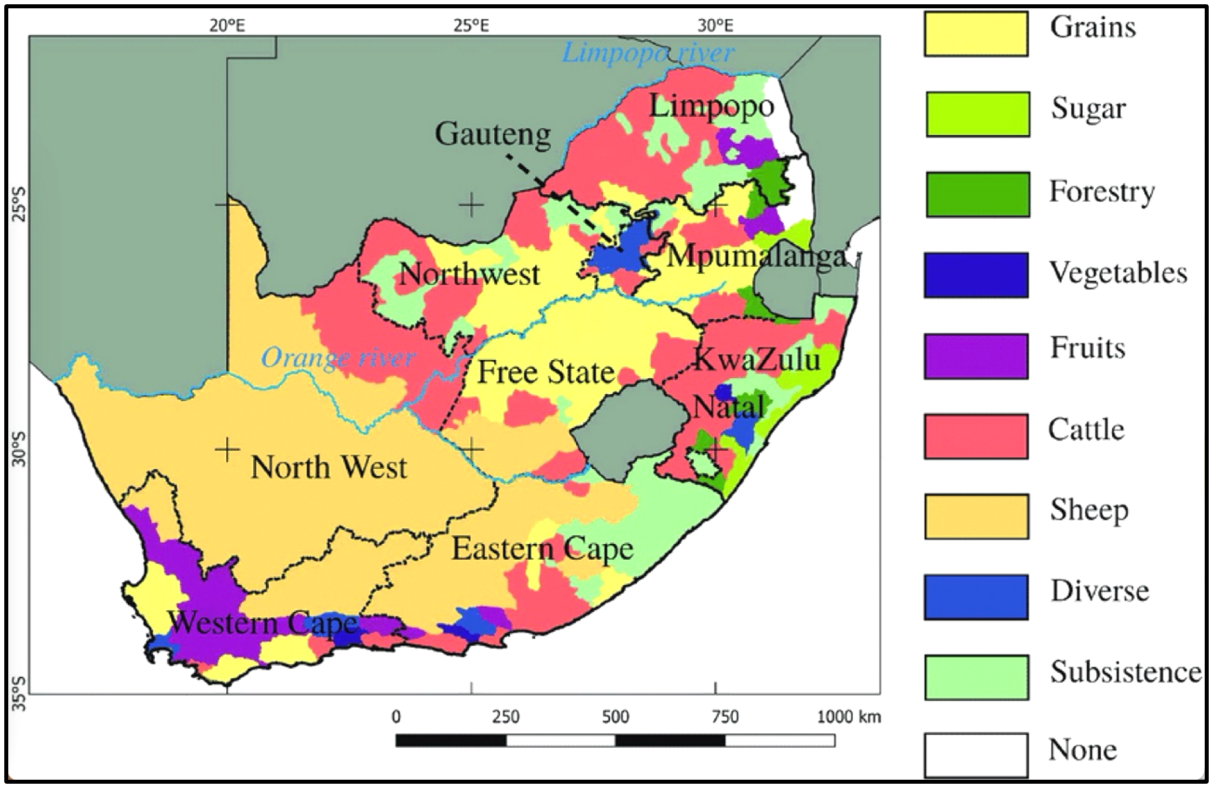

Figure 3.1: Location of the Summer Grains Crop Production Sector, Researchers, Advisors and Research Coordinators (Source: Waldner *et al*., 2017)

- Five researchers from the sugarcane production sector. These researchers were located at SASRI, Mount Edgecombe, Durban, South Africa (Figure 3.2).
- Five sugarcane production extension specialists, including agronomists, soil scientists and crop protection advisors. These extension specialists were in the Lowveld of Mpumalanga and Kwa-Zulu Natal (Figure 3.2).

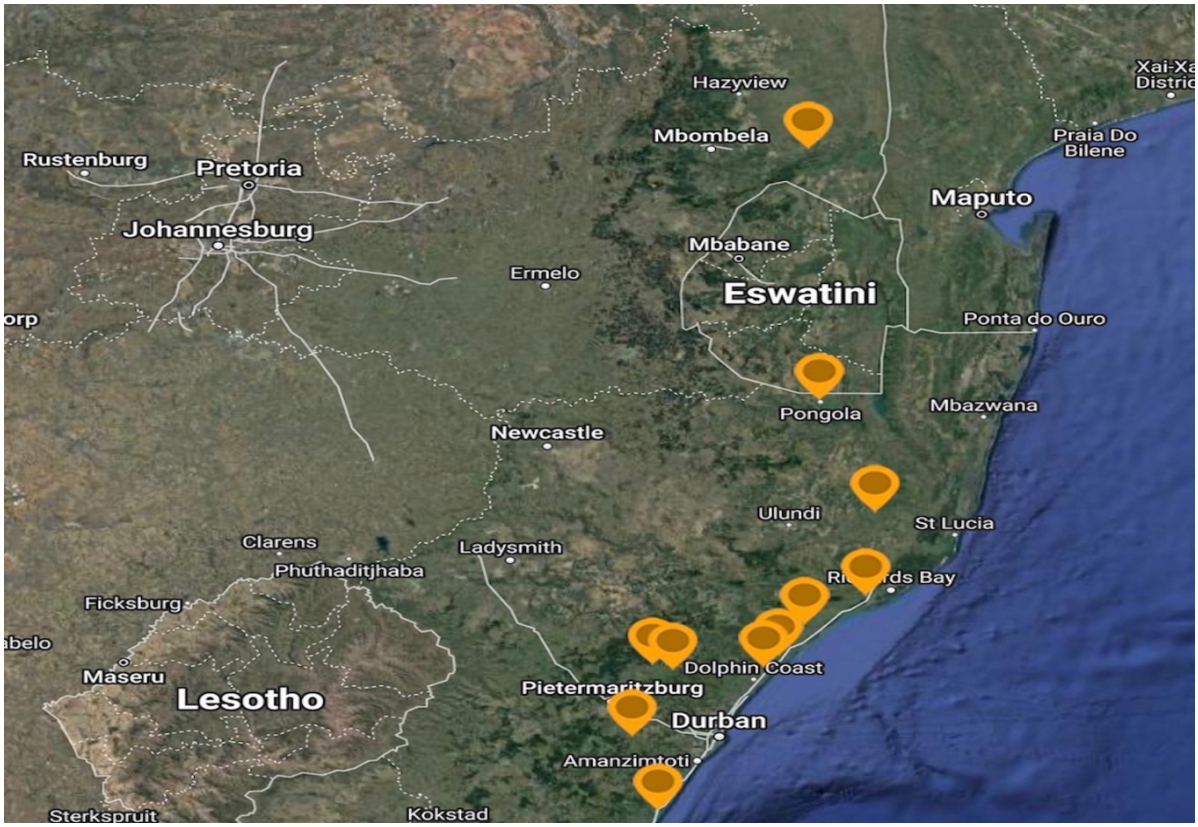

Figure 3.2: Location of the Sugarcane Production Areas, the Researchers and the Extension Specialists (Source: SASA, 2023)

- The research coordinators from Crop Commodity Organisation 1 (CC1). This grouping indicated that they were responsible or partly responsible for coordinating research and disseminating scientific results generated. They were located in Johannesburg, South Africa.
- The research coordinators from Crop Commodity Organisation 2 (CC2). This grouping indicated that they were responsible or partly responsible for coordinating research and disseminating scientific results generated. They were located in Pretoria, South Africa.
- The knowledge manager and team of the South African Sugarcane Research Institution (SASRI) who indicated that they were responsible for coordinating research and disseminating scientific results generated. This participant was located at SASRI, Mount Edgecombe, Durban, South Africa.

3.5. DATA COLLECTION AND RESEARCH INSTRUMENTS

The employers (where applicable) of the participants were approached for permission to participate on behalf of their employees, and permission was obtained (see Appendix G). All participants and respondents were then contacted in person, the study was explained to them,

and they were asked to participate voluntarily. Data was collected using a questionnaire and complemented by a semi-structured interview schedule. The data collection methods/techniques applied were in-depth (face-to-face) and focus group interviews, preferably in the participant's natural environment (field research), as described by Du Plooy-Cilliers *et al*. (2014). A structured questionnaire was designed based on the specific research objectives regarding the quantitative research data collection instruments. The usual closed-ended questions regarding age, gender, demography, location, and type of farming/research/advice were used. Questionnaires to respondents consisted of general questions, matrix, multiple-choice, pared-comparison and scale questions. The quantitative part of the study consisted of a cross-sectional survey design to create an overall picture of the nature of the dissemination model and some preferences from the stakeholders and respondents involved. Quantitative data collection methods tend to rely on random sampling since one of the aims of quantitative research is to generalise results to a broader population (Du Plooy-Cilliers *et al*., 2014). Research institutions, commodity organisations and their researchers, management, academic institutions with their researchers, extension specialists, and advisors were interviewed and asked to complete the questionnaires. Interviews were recorded and stored using the *Otter.ai* mobile application and transcribed by a professional data analyst. Several ways and services of transcribing interviews conducted for research with different options were researched, such as verbatim (transcribe word-for-word) or non-verbatim (Top Transcriptions, 2022). Verbatim transcribing was used for this study. A list of valuable suggestions for increased reliability and ethics was found online (Mondada, 2007), and many of them were applied during the data collection process.

The following subjects were covered and formulated as questions and discussions during semi-interviews with participants:

- Institutions: the current systems and channels of communication between researchers, advisors, producers and all other stakeholders and role players of that specific agricultural environment. Such as the summer grain industry or the sugarcane sector.
- The nature, function, policy, and dissemination model of the research institution or the organisation that conducts research. Public facilities such as the Agricultural Research Council (ARC), academic facilities such as universities, private institutions such as the South African Sugarcane Research Institute (SASRI), crop commodity organisations such as the Oilseeds and Protein Development Trust, the Oilseeds Advisory Committee

(OPDT/OAC), the Protein Research Foundation (PRF) and Grain Producers of South Africa (Grain SA).

- Scientific researchers generate research results and disseminate information for these commodities. These participants may or may not be connected to the crop commodity organisations. Evaluating their qualifications, experience, perceptions of research and dissemination, interaction with researchers and advisors, commitment to communication, methods to measure effectivity and success, constraints, and suggestions towards sustainable communication (see Appendix B).
- Advisors, extension specialists, and the summer grains crop production sector are involved in disseminating information generated by researchers in these sectors. These participants may or may not be connected to the crop commodity organisations. Evaluating their qualifications, experience, perceptions of research and dissemination, interaction with researchers and advisors, commitment to communication, methods to measure effectiveness and success, constraints, and suggestions towards sustainable communication (see Appendix C).
- Knowledge managers and research coordinators from the different crop commodities are involved in conducting and coordinating research and subsequent dissemination of the generated information. Evaluating their qualifications, experience, perceptions of research and dissemination, interaction with researchers and advisors, commitment to communication, methods to measure effectiveness and success, constraints, and suggestions towards sustainable communication (see Appendix A).

Findings will be presented in a combination of data summarised in a graph, tabular and calculations. Data was interpreted through grouping in terms of objectives and text "converted" to numbers and coded, where necessary.

3.6. STUDY AREA/ LOCATION/ GEOGRAPHICAL AREA OF WORK

The demographics of the participants' locations and their areas of work determined that the study concentrated on two regions of South Africa, namely specific sugarcane crop-producing provinces of Kwa-Zulu Natal and Mpumalanga and most of the summer grains crop-producing area of South Africa (Figure 3.1 & Figure 3.2).

3.7. DATA ANALYSIS

A mixed method approach was chosen, consisting of quantitative questionnaires analysed using Statistical Package for Social Sciences (SPSS) version 29. The quantitative part of the study used a cross-sectional survey design to create an overall picture of the nature of the dissemination model and the stakeholders and respondents involved. Frequency tables were produced for all categorical data (choice-like questions) and discussed through descriptive statistics, defined as the collective name for several statistical methods to organise and summarise data meaningfully (Creswell *et al*., 2019).

Qualitative data: interviews were transcribed, and themes were analysed manually. The qualitative part of the study consisted of interview schedules of the participants' perceptions. The qualitative data generated was subjected to content analysis. The data will represent a sample of a group in a population and institution and be described in graphical and numerical ways, depending on the number of variables.

The qualitative data was analysed and described through a comparative study using descriptive and inferential statistics. Comparative research or analysis is a broad term including quantitative and qualitative comparison (Mills *et al.,* 2006).

3.7.1. Descriptive Statistics

Descriptive statistics are solely concerned with the properties of the observed data, and it does not rest on the assumption that the data come from a larger population (Cuemath, 2023). Frost (2018) suggests the most common tools of descriptive statistics are:

Central tendency: Use the mean or the median to locate the centre of the dataset. This measure indicates where most values fall.

Dispersion: The range or standard deviation can be used to measure the dispersion. A low dispersion indicates that the values cluster more tightly around the centre. Higher dispersion signifies data points falling further from the centre (Frost, 2018).

Skewness: The measure indicates whether the distribution of values is symmetric or skewed.

Although descriptive statistics describes a sample, there may be a percentage of uncertainty because it represents only the sample that has been measured (Frost, 2018).

The five-number summary provides this information using various descriptive statistics. These are all order statistics - each describes where a particular value falls in the distribution. The five statistics in this summary are the following, from highest to lowest data values, namely, the highest value in the dataset, third quartile (Q3) - greater than 75% of the values in the dataset,

the median or second quartile (Q2) - splits the dataset in half, first quartile (Q1) - greater than 25% of the values and the lowest value in the dataset (Frost, 2018).

3.7.2. Inferential Statistics

Statistical inference is the process of using data analysis to infer properties of an underlying probability distribution. Inferential statistical analysis infers properties of a population, for example, by testing hypotheses and deriving estimates. The observed data set is assumed to be sampled from a larger population. Inferential statistics can be defined as a field of statistics that uses analytical tools to conclude a larger population by examining random samples (Cuemath, 2023).

Inferential statistics can be contrasted with descriptive statistics (Cuemath, 2023). There are two main types of inferential statistics - hypothesis testing and regression analysis (Cuemath, 2023). SPSS version 29 was used for inferential analysis, and the chi-square test of association was applied.

Assumption testing is important and done before any inferential statistics to make sure the data is sufficient to interpret results, the importance confirmed by Shatz (2023). Statistical significance was accepted at $p \leq 0,05$.

Effect size is a measurement that tells one how much of an effect the "significant result" actually has (range between 0 and 1). For example, to determine a statistically significant difference between taking a pill and living longer, a small effect size will mean a longer life by a day or two (not a large effect). In contrast, a large/ strong effect size will mean a person lives many years longer (larger effect) (Shatz, 2023).

Chi-square test of association. a chi-square (X^2) test of independence is a non-parametric hypothesis test. It can be used to test whether two categorical variables are related to each other. The chi-square test of independence is an inferential statistical test, meaning that it allows one to draw conclusions about a population based on a sample. More specifically, it will enable one to conclude whether two variables are related to the population (Turney, 2022).

Fisher's exact test: used to determine whether or not there is a significant association between two categorical variables. It is typically used as an alternative to the Chi-Square Test of Independence when one or more cell counts in a 2 x 2 contingency table are less than 5 (Zach, 2020; Kim, 2017).

3.8. ETHICAL CONSIDERATIONS

This study intended to adhere to the ethical considerations of research and data collection. After the preliminary research, the participants were identified without preference for race or gender. An application for ethical clearance was submitted to the Research Ethics Committee of the UFS, and approval was granted (see Appendix E). The employers (where applicable) of the participants were approached for permission to participate on behalf of their employees, and permission was obtained (see Appendix G). All participants and respondents were then contacted in person, the study was explained to them, and they were asked to participate voluntarily. It was presented to the participants, and all measures were taken to ensure that the data collected, including the results, were accessible to the researcher and analysts only and that anonymity and confidentiality were guaranteed. The names of participants were not part of the study, and numbers were allocated for analysis (see Appendix F). The expected duration of possible inconvenience was discussed.

A letter of introduction with details of the study was presented to the participant, and a consent form was attached to be signed by the researcher and the participant (see Appendix D). The researcher ensured questionnaires were sent or handed out at convenient and pre-arranged times that suited the participant. The same applied to the interviews conducted in the participant's natural environment, where preferred. The interviews were done to accommodate the participants with regular breaks. It was also explained that the participant had the right to withdraw from the process at any time and that no reason for withdrawal had to be given. The researcher collected the data and did not discuss it with a third party to ensure confidentiality. The researcher supplied the details of the UFS and the supervisor in case respondents had any concerns. The expected duration of the study was given, and contact details were supplied if a respondent needed access to the findings.

The researcher travelled to various locations to conduct the interviews and did not expect any respondents to drive or travel for this research to minimise the risk of injury or harm.

CHAPTER 4: PERCEPTIONS OF RESEARCHERS IN THE DISSEMINATION OF RESEARCH INFORMATION

4.1. INTRODUCTION

The inquisitive mind of the researcher and the urge to investigate are some of the world's most precious treasures and have been the key to modern mankind's survival and social development. Lambertini (2018) confirms the importance of research and science by saying that hunting for new, smarter ways to support mankind's development has always been a critical driver of technological advancement. However, Briese (2019) states that one of the problems researchers face is identifying which problems apply to a broader audience versus those that apply to a vocal minority. This is also true for the agricultural sector. It may be that researchers do not always have the necessary experience in the practical applications of scientific results. It is, therefore, of great importance to study the perceptions and opinions of the agricultural researcher in an attempt to find more effective ways of disseminating research results to the target audience.

4.2. DEFINITION OF THE AGRICULTURAL RESEARCHER

Oxford Learner's Dictionary (n.d.) defines a researcher as a person who studies something carefully and tries to discover new facts about it. Merriam-Webster (n.d.) offers a more descriptive definition by saying it is "a person who conducts studious inquiry or examination and especially, investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws, the collecting of information about a particular subject and careful or diligent search". To summarise, research can be described as, "to search or investigate exhaustively" (Merriam-Webster, n.d.). Agriculture, like many other industries in the world, is depended on continuous research and seen against the background of the information overload "pandemic" the impact of reliable results generated by true scientific researchers and the integrity of research papers has never been more important than now.

4.3. DUTIES AND RESPONSIBILITIES OF THE AGRICULTURAL RESEARCHER

Although it would seem impossible to define every role of the researcher, it is important to look at certain functions that apply to this study. Information compiled from Indeed for Employers (2023) provides a relevant summary:

- Determine areas of research to increase knowledge in a particular field.

- Identify sources of funding, prepare research proposals and submit funding applications.
- Plan and perform experiments and surveys.
- Collect, record and analyse data.
- Interpret data analysis results and draw inferences and conclusions.
- Present research results to relevant committees and authorities.
- Use research results to write reports, papers and reviews and present findings in journals and conferences.
- Collaborate with research teams, industry stakeholders and government agencies.
- Assist regulators and institutions in formulating policies and regulations relevant to the industrial sector, such as agriculture.
- Communicating the research information to the target audience is critically important for sustainability.

To summarise the responsibilities of the agricultural researcher: performing all the above-mentioned tasks ethically and scientifically to ensure that the results contribute towards sustainable agricultural practices and responsible utilisation of global natural resources.

4.4. IMPORTANCE OF SCIENTIFIC AGRICULTURAL INFORMATION

4.4.1. Introduction

The South African agricultural sector is overwhelmed by pseudo-science, and this study has attempted to improve communication between qualified researchers and producers to shut the door on fake science. The importance of true scientific information cannot be overemphasised.

4.4.2. Pseudo-Science and Predatory Journals Versus Scientific Information

Predatory journals - also called fraudulent, deceptive, or pseudo-journals - are publications that claim to be legitimate scholarly journals but misrepresent their publishing practices. Some common predatory publishing practices include falsely claiming to provide peer reviews, hiding information about Article Processing Charges (APCs), misrepresenting journal editorial board members, and other violations of copyright or scholarly ethics (Elmore & Weston, 2020). Fake science or pseudo-science is a global problem throughout most sectors of industry, science, health and human behavioural studies, to name a few. It is also a growing concern in agriculture. Ritchie (2018) reports that worldwide investigations have highlighted the problem of predatory journals and fake science. In 2018, a British newspaper and a German broadcaster reported that 175,000 scientific articles published by the top five predatory journals in England

bypassed basic checks and balances for scientific research. They further reported that over the preceding five years, more than 10,000 scientists from British and German universities have published articles in predatory journals. It is estimated that more than 500,000 researchers have been targeted worldwide by these unscrupulous journals. These unsettling statistics are confirmed by Briggs (2017), who explains that requests by the BBC under Freedom of Information rules show that at least 300 allegations were reported at 96% of a specific research-intensive group of universities between 2011 and 2016 among staff and research students, resulting in the retraction of more than 30 research papers.

In South Africa, the National Research Foundation (NRF) has issued a statement of warning called the Statement on Ethical Research and Scholarly Publishing Practices, regarding these predatory journals (National Research Foundation, 2019) and Ritchie (2018) reports that the South African Department of Higher Education, who also funds academic research, is reviewing its accreditation processes after a study the previous year showed that publications supported by the department have appeared on a list of predatory journals. Ritchie (2018) further notes that in 2018 it was estimated that up to R300 million rands may have been spent on publications in predatory journals.

This chapter will present the data generated by questionnaires and interviews to collect the perceptions of agricultural researchers.

4.5. RESEARCHERS DEMOGRAPHIC INFORMATION

4.5.1. Gender

The researchers in the sample group from the crop production sector were primarily females, with only one male researcher. However, in the case of the South African Sugarcane Research Institute (SASRI) researchers, three were male, and two were female, as reflected in Table 4.1.

4.5.2. Age and Years of Experience

The age of the crop production respondents varied between 30 years and more than 60 years, whereas the SASRI researchers were slightly older, from 36 years to more than 60 years. Table 4.1 also shows that all the crop researchers were very experienced in their respective fields, with only one participant with slightly less than 10 years in her field of expertise, leaving the rest with more than 20 years. Most SASRI researchers had between 10 and 20 years of expertise, making them, as a group of participants, less experienced than the crop researchers. Both groups of researchers were eager to share their knowledge and experience for the study and were convinced of its importance.

4.5.3. Racial Groups

All the respondents from the crop researchers were Caucasian/White, and in the sample group from SASRI, 80% were Caucasian/White, and 20% were African/Black. The black researchers were the younger respondents in the groups, which was a refreshing perspective.

4.5.4. Highest Qualification

Research is a wide-open concept and can be conducted by anyone interested in a research topic. There are no official guidelines or minimum requirements to be classified as a researcher. Still, in the world of science, a Bachelor of Science degree is generally accepted as the basic requirement. Environmental Sciences (2021) says that agricultural scientists need a minimum Bachelor's degree from a land-grant college to obtain entry-level positions. However, many go on to get their master's or doctorate degrees. Typically, the bachelor's degree must be in agricultural science, biology, chemistry, or other related fields (Environmental Sciences, 2021). However, most scientific researchers have a Master in Science degree or go on to obtain a PhD in their field of expertise. In both groups of crop researchers and SASRI researchers, most possessed a PhD, and the minimum qualification was a Master of Science (Table 4.1).

Table 4.1: Gender, Age, Racial Group, Qualification and Experience

Other crops			SASRI		
Gender	**Frequency**	**Percent**	**Gender**	**Frequency**	**Percent**
Male	1	0	Male	3	60
Female	4	80	Female	2	40
Researchers' age	**Frequency**	**Percent**	**Researchers' age**	**Frequency**	**Percent**
20 - 35	1	20	20 - 35	1	20
36 - 45	1	20	36 - 45	1	20
46 - 60	2	40	46 - 60	2	40
60+	1	20	60+	1	20
Racial groups	**Frequency**	**Percent**	**Racial groups**	**Frequency**	**Percent**
African/Black	0	0	African/Black	1	20
Caucasian/White	5	100	Caucasian/White	4	80
Highest Qualification	**Frequency**	**Percent**	**Highest Qualification**	**Frequency**	**Percent**
PhD	4	80	PhD	3	60
Master's degree	1	20	Master's degree	2	40
Honours degree	0	0	Honours degree	0	0
Bachelor's degree	0	0	Bachelor's degree	0	0
Years' experience	**Frequency**	**Percent**	**Years' experience**	**Frequency**	**Percent**
>5 years but <10 years	1	20	>5 years but <10 years	0	0
>10 years but <20 years	0	0	>10 years but <20 years	3	60
>20 years	4	80	>20 years	2	40

4.5.5. Researchers Own Perception of a Qualified Agricultural Researcher

All the participants from both groups of researchers felt that a qualified researcher should have an academic background, such as a post-graduate degree and experience in the relevant fields of expertise.

"Somebody that's at least got a Master's or PhD … and obviously experience that comes with it, experience is very important, you can't take away experience. I'd say at least 10, 12 years, maybe 15 years."

They also believed that a researcher should understand the trial layout and interpretation well and be a respected researcher through peer-reviewed publications.

"Someone with suitable training and education to undertake robust scientific research."

4.5.6. Crop Advisors' and Extension Specialists' Perception of a Qualified Agricultural Researcher

Advisors mentioned that a qualified and accredited researcher should have the relevant credentials, including an academic and scientific background and experience.

"They must definitely have a relevant degree, must be registered with SACNASP and must have experience, practical experience." (translated from Afrikaans)

One SASRI advisor stated: 'To be accredited, you have to be qualified'. Fellow SASRI advisors agreed that a good academic background is required, preferably in agriculture. Good research skills that come with experience were also a necessity. Lastly, good people skills are required to interact with different producers.

The knowledge managers from the summer grains sector defined a researcher as qualified and experienced, with peer-reviewed publications and a strong bond with industry partners.

It is clear that advisors, researchers and knowledge managers regard an academic background, a post-graduate degree and experience as the minimum requirements of an agricultural researcher. The importance of this perspective and its contribution to the fight against pseudo-science will be discussed later.

4.5.7. Fields of Expertise

All researchers indicated that the PRF, ARC and Grain SA conducted research applicable to their fields. Four advisors also mentioned the OPDT/OAC as an institution doing research in their field of expertise. It is the main reason for selecting this sample of crop production researchers as they all indicated that the five institutions decided on conducting research during the preliminary research in their respective fields of expertise and dissemination. All the SASRI advisors indicated that SASRI does research in their respective fields of expertise and dissemination.

All the crop researchers indicated that they had been involved in disseminating the abovementioned institutions' research results in the past decade and that most of the

information disseminated was scientific and field-trial-based. The reasoning behind this and the importance of both science and field-trials regarding pseudo-science will be discussed in the section. SASRI advisors have only been involved in disseminating SASRI's results and sugarcane production-orientated information.

As discussed, all the researchers were experienced and individually in more than one field of expertise. The crop researchers had experience in several subjects, including plant pathology, mycotoxins, plant diseases, epidemiology, grain varieties and genetics, weed science, and ethology and soil science. The SASRI group had research experience in applied plant pathology, sugarcane quality management and plant breeding, crop science, soil, soil health and irrigation. It is safe to say that from both groups, their knowledge matches their years of experience. All the researchers were regarded as knowledgeable in their respective fields.

4.5.8. Current Employment and Research Conducted

All the researchers were currently employed. Interestingly, four crop researchers were employed by the government and one by an academic institution. This confirms that "some of the best researchers in this country are still employed by governmental or academic institutions" (Bruwer, 2021). All the SASRI researchers were employed by SASRI and indicated that they have only conducted research on behalf of SASRI in the past ten years. In contrast, the crop researchers showed that all the crop commodity organisations mentioned in this study conduct research applicable to their fields of expertise.

Most researchers stated that their research was based on scientific (laboratory-generated) and field-trial-based research. This is a crucial perspective, and the significance of both laboratory work and the practical field-trials of these results becomes important when formulating the definition of pseudo-science *versus* true science.

4.6. PERCEPTION OF RESEARCH, FUNDING AND CURRENT DISSEMINATION MODEL

This study aims to determine the current ways of disseminating research results to the target audience or end-user, in this case, primarily the producer. It was therefore considered necessary to investigate the entire research process and how this process was initiated. How does the researcher find the information, researcher topic or need, and how are the results eventually channelled to the relevant target audience? Also, to study the perceptions of researchers regarding prioritising research topics and who was considered responsible for funding such a

project. The researchers were asked for their perceptions on these matters using various questions and interviews.

4.6.1. Identification of Research Topics as Seen by Researchers

Research topics typically originate from the stakeholders in a particular sector. For this study, a list of possible sources was determined during the preliminary research phase and presented to participants. The amended list included production sector needs identified by the researcher, producers or growers, advisors or extension specialists, relevant crop commodity organisations, agricultural supply companies and the government.

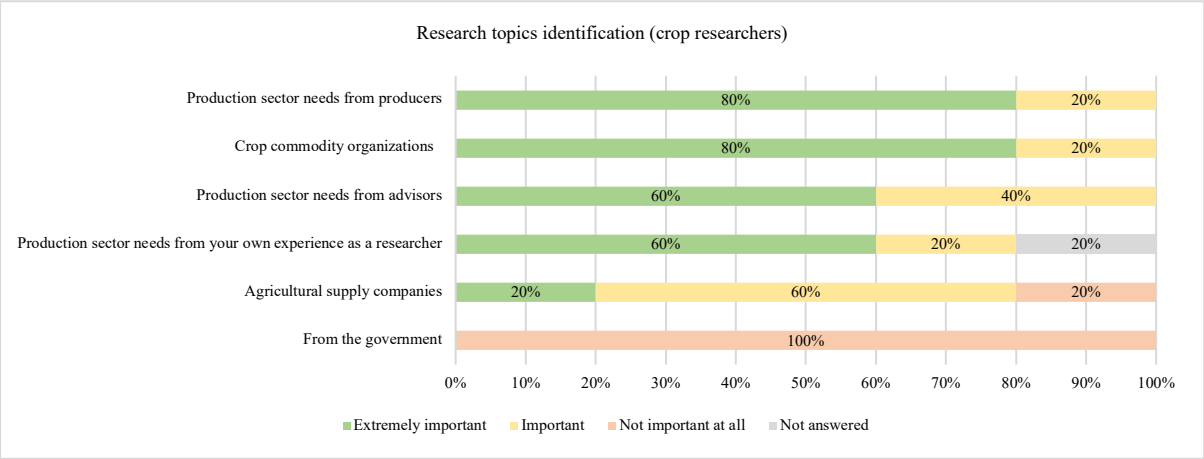

Figure 4.1: Sources of Research Topics as Seen by Crop Researchers

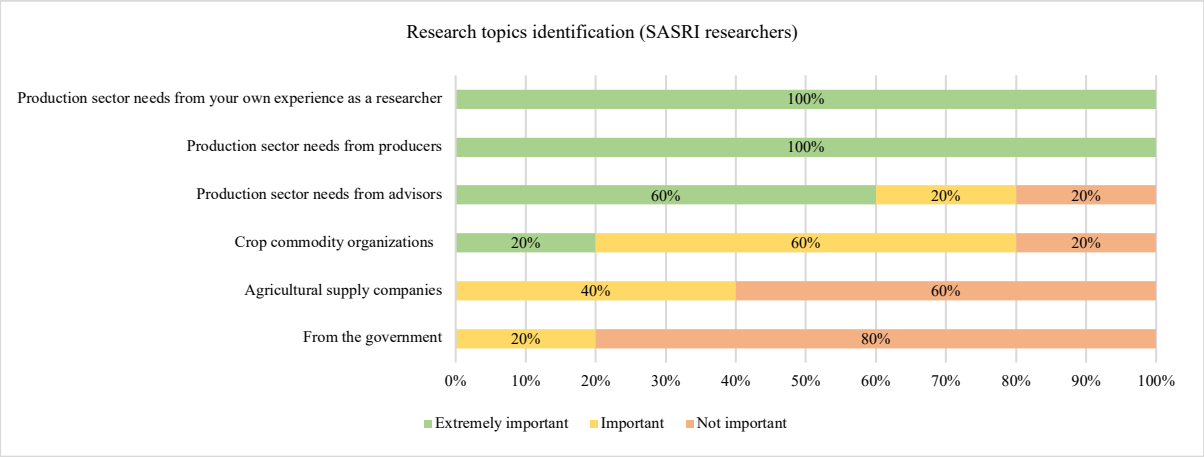

Figure 4.2: Sources of Research Topics as seen by SASRI Researchers

As seen in Figure 4.2 and based on the mean, the production sector needs from producers and crop commodity organisations were rated the most important for identifying research topics in

South Africa by crop researchers (ẋ = 2,80 respectively), with 80% of researchers rating both these as extremely important. In contrast, the government was rated least important (ẋ = 1,00). The researchers were of a different opinion than the crop advisors, who don't regard the crop commodity as an important source of research topics. The fact that crop commodity organisations, or similar crop commodity trust-funds, are largely responsible for research funding may play a role in this perception, as indicated by the crop researchers.

In the case of the SASRI researchers and comparison, based on the mean, production sector needs from producers and researchers own experience was rated the most important for identifying research topics in South Africa by SASRI researchers (ẋ = 3,00 respectively), with all of SASRI researchers rating both these as extremely important. In contrast, the government was rated least important (ẋ = 1,20), as shown in Figure 4.2.

It is significant to note that the government, as a source of research topics, was also rated least important for crop advisors and extension specialists.

4.6.2. Funding of Research

Crop researchers believe that funding appears to come from many avenues. All researchers mentioned that funding comes from industry and/or crop commodity organisations or agricultural supply companies. Most researchers also noted government and government-related organisations as sources of funding. In addition, two researchers mentioned that research funding comes from private companies, and one researcher mentioned the National Research Foundation (NRF).

> *"Up until recently it (funding) came from commodity organisations and private companies, but I think from next year, if all goes well, it will also come from government" - crop researcher. (translated from Afrikaans). Some researchers seem to be optimistic towards the government as a source of funding. That could be a positive indication that government has re-prioritized funding for agricultural research.*

In the case of SASRI, most funding is obtained through a levy-based system, in which sugarcane growers contribute two-thirds and sugar millers the remaining third. Some funding is obtained through the National Research foundation (NRF) but to a limited extent and often a once-off financing only. If research is done on behalf of a supply company, that company funds the research. It is important to note this type of research is normally for products to be tested, and SASRI does not promote any of these products and is unbiased towards the project's outcome.

4.6.3. The Process of Determining Research Priorities

In the crop production sector, the needs identified by producers or other stakeholders become a research priority. Some researchers say that weather conditions play an important role in prioritising research projects. This is why communication with producers, advisors and organisations is so important. A project based on applied research that quickly impacts the industry is normally prioritised above developmental-type research. One researcher stated that financial gain has recently become a priority, which is a big concern. This researcher calls this phenomenon "research prostitution" implying that some institutions and their researchers may sometimes not have any other choice than to accept projects funded by private companies to be financially sustainable. The outcome of such projects may be questionable. It is not a situation unique to agriculture, as demonstrated in a recent study by Barnor, Caton and Miljkovic (2022). Their research objective was to determine the factors that influenced the outcomes of previous scientific research, in this case, on the potential adverse effects of glyphosate-based herbicides (GBHs) on human and animal health and the environment. The study attempted to understand better why science on a subject has not always been conclusive and, thus, not the main driver of "science-based" policies about a specific topic.

> "*In my experience, research becomes a priority. Just working and speaking with producers and requests from private companies" – crop researcher.*

In contrast to the abovementioned, the SASRI researchers work according to specific guidelines and research policies developed by the knowledge management centre. For example, grower concerns are raised at annual Research, Development & Extension (RD&E) workshops. Advisors forward these concerns to SASRI researchers. The SASRI researchers evaluated all the concerns and separated completed projects from new projects. The results of completed research projects are then disseminated by the KM Centre, leaving the others to be prioritised. The researcher compiles a short proposal of the prioritised topic and sends it to the research managers/committee, where it is discussed and either accepted or rejected. Those accepted projects require an in-depth proposal, including a dissemination plan, the target audience and budgets, to name a few. Once all resources have been approved, it goes to the South African Sugar Association (SASA) for consideration. However, growers are not the only source of research topics as some participants mentioned that researchers can also initiate research projects themselves.

4.6.4. Dissemination to Target Audience

The definition of a target audience is "the group of people you hope to influence with your message" (Goemans, 2017). This study attempts to research certain linkages between the researchers, advisors, producers or growers, trainers and technical personnel.

On the one hand, all the crop researchers regarded the producers as their most important target audience, then advisors, and third, most important, researchers. Interaction and communication with fellow researchers were regarded as slightly less important at 40%, which may indicate a medium to low level of cooperation amongst researchers. An average of 40% viewed other researchers as part of the target audience.

On the other hand, the SASRI researchers regarded the growers, advisors and trainers as the target audience, in the same order of importance. All the participants stated that growers were the primary target audience. SASRI is interested in small-scale sugarcane growers, and trainers are extensively used in that particular dissemination model. That may explain the researchers' perception of the trainers' importance in communication.

4.6.5. Steps Taken by Researchers to Ensure Target Audience Received Information

A list of current ways of transferring knowledge as presented to the participants to determine their preferences and objections towards these methods. A shortlist of methods was compiled after preliminary research was done to determine the most commonly used and thus perceived as conventional. ICT-based dissemination (Information and Communication Technology) was added to complete the list. The information was grouped into publications, communications, virtual, social media and e-mail. The selected methods were integrated with the steps taken by the researchers to ensure their target audience received the information. Although there may be many other ways of transferring agricultural knowledge, the results showed a noticeable trend in the South African commercial agricultural sector. The definition of Information and Communication Technology (ICT) is a broader term for Information Technology (IT), which refers to all communication technologies, including the internet, wireless networks, cell phones, computers, software, middleware, video-conferencing, social networking, and other media applications and services enabling users to access, retrieve, store, transmit, and manipulate information in a digital format (FAO, 2023).

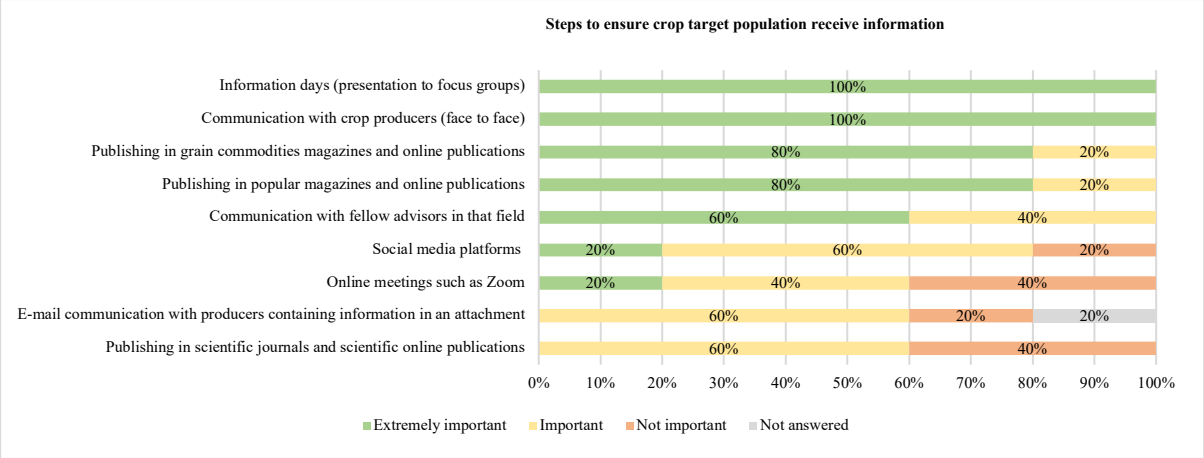

Figure 4.3: Steps to Ensure Crop Target Audience Received Information

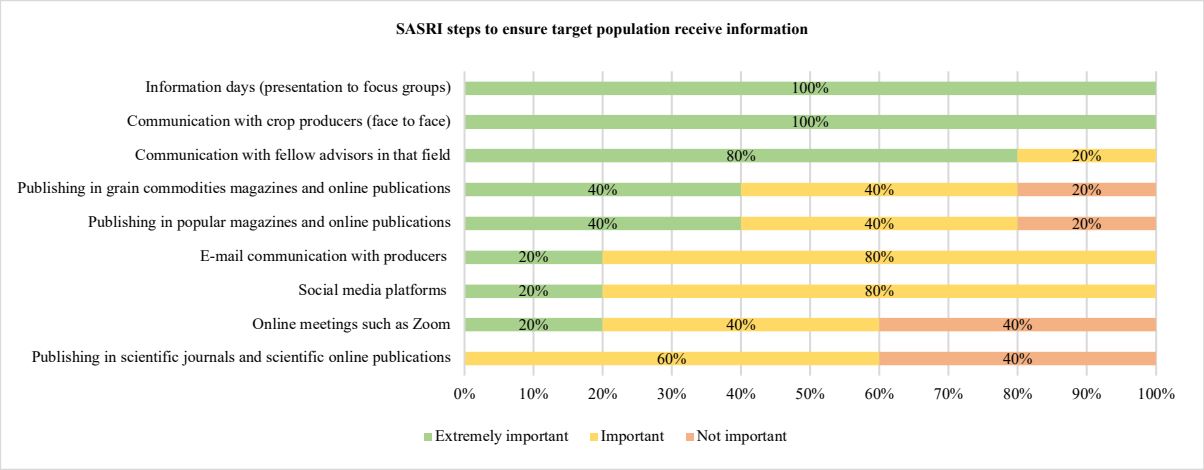

Figure 4.4: Steps to Ensure SASRI Target Audience Received Information

From Figure 4.4 and the crop researchers' perceptions and based on the mean, the most important step they took to ensure that the target population received information was direct communication with producers in that field. That is communication with crop producers (face-to-face) and information days (presentation to focus groups) ($\dot{x}$ = 3,0 respectively), with all researchers rating these as extremely important and publishing in scientific journals and online publications ($\dot{x}$ = 1,6) as least important, with 40% of the researchers rating it as unimportant. Publishing is an important part of a researcher's career and the initial reaction is to be surprised by this perception. However, it may be because researchers understand the difference in "communication languages" between scientific publications and the "language" used in dissemination. Researchers were aware that producers and growers were unlikely to read academic publications. Similar results were produced by Oakley (2023), who found that online tools improve research efficiency and scientific metrics and enhance professional networking but are more meaningful to early career scientists for promoting name and research.

A very similar opinion can be formed from the data presented in Figure 4.4 and also based on the mean, the SASRI researcher's most important measures taken to ensure that their growers receive information is communication with crop producers (face-to-face) and information days (presentation to focus groups) ($\dot{x}$ = 3,0 respectively), with all SASRI researchers rating these as extremely important. The least important step was scientific publications ($\dot{x}$ = 1,6), with all SASRI researchers rating it unimportant.

4.6.6. Researchers' Perception of the Standard of Local Agricultural Research and Advisory Services

The historical dynamics of Agricultural Research, Development and Extension in South Africa have been studied and debated many times (Bruwer, 2021; Liebenberg, 2013; Liebenberg, 2015). Looking at the current state of affairs, most crop researchers feel that the standard of agricultural research in South Africa is still *on par* with other major crop-producing countries worldwide. They also thought that they were in regular contact with their international peers. It is important to note that governmental institutions employed 80% of the crop researchers and that most researchers were very concerned about the future of these institutions and their ability to maintain the internationally accepted standard of research. They were also concerned about the lack of funding and infrastructure. An interesting added perception from one researcher was that it's a case of "all seems fine from the outside" but only because two of the major crops produced, maize and soybeans, are doing very well. This is not the case for the other less-produced crops, for which the research situation is in dire straits.

> *"I can see that the work we're doing is relevant to our community, but also to the scientific community at large" – crop researcher.*
>
> *"You can't compare internationally, you can't. Funding is one of our major challenges… And, you need, of course, good equipment, which we don't have" – crop researcher.*

About the advisory services, most crop researchers felt many government advisors were not up to international standards. They furthermore felt that private advisors are much better qualified and more experienced, but 80% of them had reservations about whether the private advisors were disseminating objective advice without a monetary interest.

> *"If I look at government advisors, definitely not, non-existing. If I look at uhm, the private sector, well, I will say we might be around about 70, 80% there" – crop researcher.*

About research in South Africa: Most SASRI researchers (80%) said that research in South Africa was *on par* with other sugarcane-producing countries worldwide, adding that SASRI researchers had a good local and international standing regarding sugarcane research. One

researcher mentioned that the integrated research-extension environment is a major contributor. Another important fact indicates the success of the SASRI model.

> *"Definitely, we are one of the leaders-it's us, Australia and America, probably the leaders in agricultural research in the world, on sugarcane, it stands out everywhere – it's emphasised in our presence on international committees and the like, so yes, for sure, we are the leaders" – SASRI researcher (translated from Afrikaans).*

About the advisory services in South Africa: Most SASRI researchers felt their advisors were world-class. It speaks of confidence in the SASRI model and system of generating scientific advice. One researcher mentioned that advisors tend to be very good in their field but may lack experience in other areas of knowledge.

4.6.7. Researchers' Self-Evaluation of Effectivity and their Perception of the Ideal and Most Effective Dissemination Model

Researchers from the crop production sector seem unsure of the percentage of the research results that eventually reach their target audiences. Most researchers (60%) were of the opinion that only 21 – 50% of the results they generated reached their target audiences. They also agreed that the best model of disseminating information would be for the researcher to publish the results and then initiate contact with the target audience.

In contrast, all the SASRI researchers were confident that most of the information reached the target audience. None doubted this, with 20% claiming that only 51 – 80% of results reach the target and 60% of respondents claiming a success rate of between 81% and 100%. As opposed to the crop researchers, the SASRI researchers are part of a successful and measurable dissemination model. They also believed that the best model of disseminating information would be for the researcher to publish the results and then initiate contact with the target audience.

4.7. OBJECTIVITY OF RESEARCHERS TOWARDS RESEARCH RESULTS AND SUBSEQUENT DISSEMINATION THEREOF

4.7.1. Researchers' Perception of the Influence of Funding Sources for Research and the Objectivity of Results Generated

Lower public support for agricultural research and a shift towards more funding from the private sector have become important sources of agricultural research initiatives (Ziegler & Mohanty, 2010). It is also reported by Heisey and Fuglie (2018) that in recent years, public agricultural research and development (R&D) investment in high-income countries has grown

considerably more slowly than public agricultural R&D in developing countries. They also claim that this applies to private R&D for agricultural inputs.

The same situation may apply to agricultural research in South Africa. However, much research is still funded by the government (ARC, 2023), and other research projects in the crop production sector are financed by either crop commodity organisations, trust funds, private- or supply companies (Grain SA, 2020; OPOT/OAC, 2023). Prioritising projects and funding sources with subsequent expected research outcomes may influence the objectivity of many stakeholders, including the researcher. This study also attempted to determine the researchers' perceptions, and participants were asked if they thought this might be the case.

From the crop production sector, the majority of researchers (60%) felt that the source of funding could influence the researcher and generate biased results that are directed towards a certain goal, but 40% of researchers felt that ethics played an important role; thus, funding should not have any influence at all. Two researchers, however, claimed that they had witnessed the results of privately funded projects being manipulated. This is a disturbing perception, indeed.

> *"You need to find someone that's not going to, that's ultimately trying to pursue the good of everyone and not just themselves" – crop researcher.*

The SASRI researchers admitted that possible manipulation of priorities and results may be a problem but stated that it was not a problem within the SASRI system and model. All the participants kept referring to the SASRI knowledge management centre and its effectiveness.

> *"I think those influences come in, but I mean, there's so many committees that look at these things. I think they have to try and actually filter out and sort of say, that's a personal agenda, this is a common agenda" – SASRI researcher.*

4.7.2. Timely Advice and Objectivity of Researchers

True objectivity in science is a controversial matter and must always be seen in the context of the research problem and objectives. Finding an expected outcome often creates new questions requiring even more research. The validity of original results may also change over time as circumstances change and more information becomes available, as Barnor *et al*. (2022) show. Sometimes, researchers' objectivity is questioned. Still, results are often generated "with what we had and what was known at the time" (B. Flett, personal communication, February 15, 2022). Speculation in the media often precedes updated results. With a target audience that includes advisors and producers, this situation and the shift of focus towards small-scale

farmers can create the perception that the large-scale crop producer is neglected regarding timely advisory services.

Most crop researchers agreed with this perception. In contrast, all the SASRI researchers disagreed and were confident that their growers were not neglected regarding timely advice and advisory services.

Regarding researchers' objectivity, the participants from both groups agreed that independent researchers seem to be more objective, while financial and company objectives influence supply company researchers. Although objectivity differs, one researcher mentioned that if the right question has been asked and measured correctly, it can be considered objective despite a possible connection to a supply company.

> *"Researchers employed by supply companies might be less objective. They are nearly, I don't want to say 'forced' but, to keep his job, he needs to show their product is OK" – crop researcher (translated from Afrikaans).*

Most SASRI researchers confirmed that supply company researchers are generally less objective due to marketing aspects. Independent researchers tend to be more objective and sell 'best practices' rather than products.

> *"Immediately when, when funding becomes an issue in your work, like, your work might become subjective, like some of the things that you do" – SASRI researcher.*

4.7.3. Pseudo-Science, the Researcher, and Their Concerns

The definition of pseudo-science is "a collection of beliefs or practices mistakenly regarded as being based on scientific methods" (Oxford Languages, n.d.) and Merriam-Webster (n.d.) defines it as "a system of theories, assumptions, and methods erroneously regarded as scientific".

Table 4.2: Percentage of Researchers Concerned About Pseudo-Science Towards Sustainable Crop Production Practices

	Crop researchers	SASRI researchers
Researchers concerned about pseudo-science towards sustainable crop production	100%	60%

As seen from Table 4.2, the crop researchers had a much stronger opinion and were more concerned about pseudo-science than their counterparts in the sugarcane sector. All the crop

researchers thought fake science was a serious problem because producers are desperate for information and take what they can get, regardless of the source. Pseudo-science results are not based on scientifically laid out trials with proper controls and statistics; this causes a false sense of security and results in on-farm losses. They also confirmed that they had first-hand knowledge of the mentioned on-farm losses by producers.

"There's so many variables and outside factors that can have an effect on it, you need, you, you definitely need some form of scientific backing" – crop researcher.

Table 4.2 shows that 60% of SASRI researchers were concerned about pseudo-science in agriculture and mentioned that products were promoted without proper testing and selling due to good marketing strategies instead of proper science. However, they confirmed that pseudo-science was not a concern in the sugarcane industry *per se* due to the advisor presence and systems installed by SASRI and its knowledge management centre.

"It does pop up, but like we said previously, there are mechanisms in place to prevent it, for example the farmer knows that his first step should be to consult his advisor" – SASRI researcher (translated from Afrikaans).

Regarding financial losses attributed to pseudo-science, the SASRI researchers agreed that it is possible but could not confirm first-hand experience or knowledge about it.

4.7.4. The Researcher and Terms Sometimes Associated with Pseudo-Science

The move towards sustainable agriculture practices has put research under pressure. Scientists find it difficult to generate results in a timely manner to keep up with the rate at which newer trends and "buzzwords" are thrown at all crop production levels. Giller *et al*. (2021) state that the clarion call for Regenerative Agriculture swells against crisis narratives such as "agriculture is in crisis, soil health is collapsing, biodiversity faces the sixth mass extinction, and crop yields are plateauing".

Crop researchers confirmed that they are experiencing an exponential increase of so-called expert opinions accompanied by products that claim to contribute towards practices such as soil health, regenerative farming, organically produced bio-stimulants and bio-fertigation and their potential negative effects on sustainability. They further felt that because many of these buzzwords and pseudo-science lack a scientific basis, they threaten the farmers as they are easily convinced and fall prey to deceiving advice and products.

"Farmers are easily convinced because they do not always have the scientific background to make an informed decision" – crop researcher.

SASRI researchers shared most of their fellow researcher's views; they were also concerned about the effect on the sustainability of production. They reported many requests from the industry for products to be tested and endorsed, although few of these products have scientific backing. SASRI has a Specialist Advisory committee in place to work through these requests. Fake science is a major concern, and SASRI has successfully combatted it in the sugarcane industry through the workings of this special Advisory Committee.

4.7.5. The Researcher's Perception on the Importance of Fields of Research

To combat the effect of fake science, obtaining opinions from researchers about the importance of certain fields of research and the effective and continuous dissemination of the results was necessary to close the door to pseudo-science.

The question is what the researcher perceives as important areas of research and the critical regions of disseminating those results. Based on the preliminary research, eight areas of study and dissemination were identified: soil management, plant nutrition, crop protection and pest control, regenerative farming, organic farming, bio-stimulants, foliar feeds and technology hardware and software.

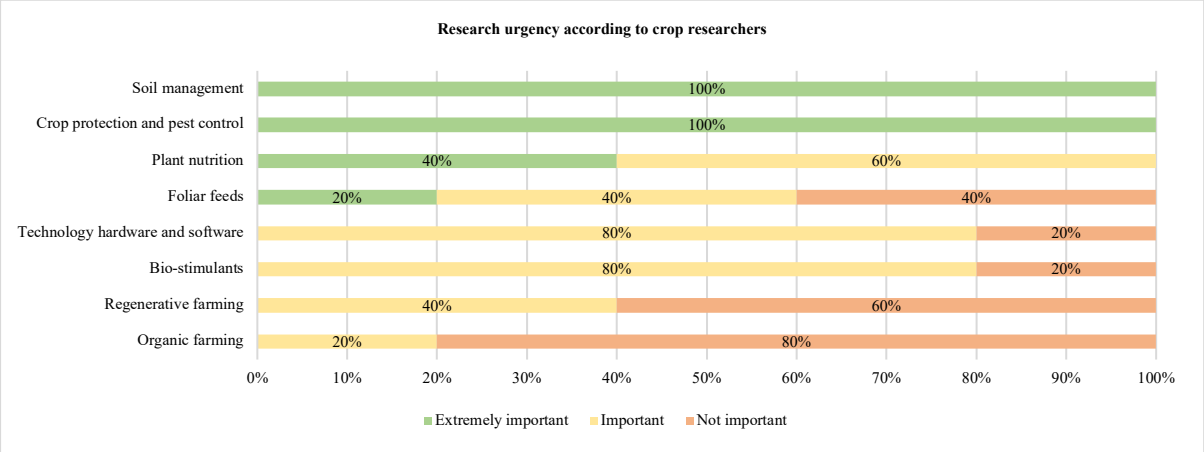

Figure 4.5: Crop Researcher's Perceptions of Areas that Require Urgent Research

Based on the mean, researchers felt that the most urgent research was needed in soil management and crop protection and pest control ($\dot{x} = 3{,}00$ respectively), with all researchers rating both these as extremely important (Figure 4.5). In contrast, research in organic farming was rated least important ($\dot{x} = 1{,}20$).

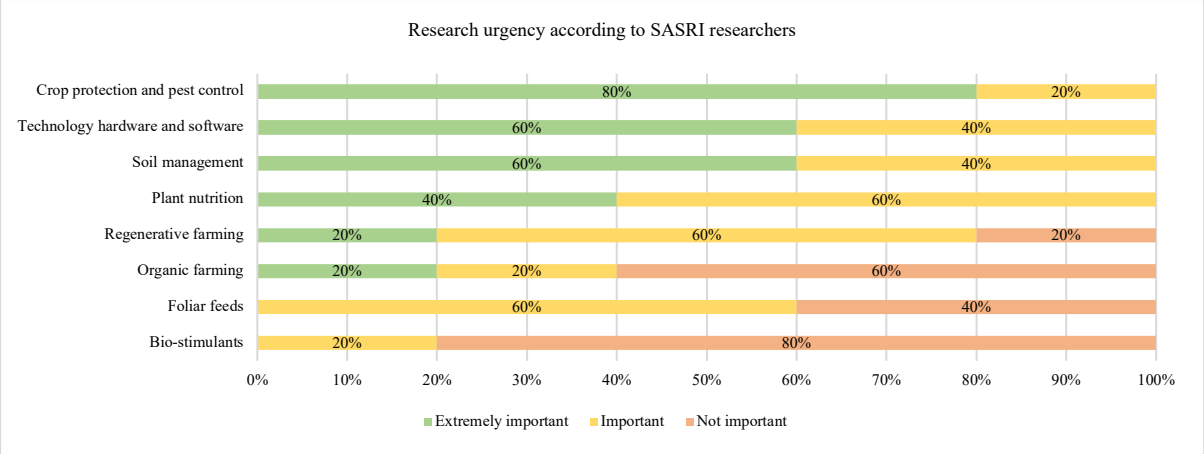

Figure 4.6: SASRI Researcher's Perceptions of Areas that Require Urgent Research

As shown in Figure 4.6 and based on the mean, SASRI researchers felt that the most urgent research was needed in crop protection and pest control ($\dot{x} = 2,80$), with most researchers rating it extremely important. In contrast, bio-stimulant research was rated least important ($\dot{x} = 1,20$).

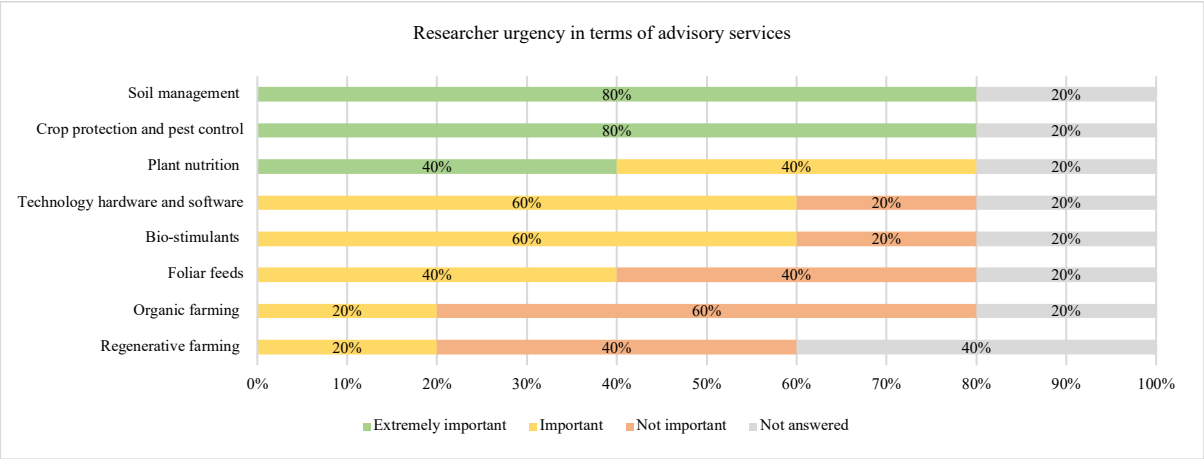

Figure 4.7: Crop Researcher's Perceptions of Areas that Require Urgent Dissemination

Based on the mean (Figure 4.7), researchers felt that the most urgent field of agriculture regarding advisory services was needed in soil management and crop protection and pest control ($\dot{x} = 3,00$ respectively), with most researchers rating both as extremely important. In contrast, advisory services in organic farming were rated least important ($\dot{x} = 1,25$).

Researchers from both groups had strong opinions about researching, disseminating and promoting proven scientific principles of sustainable crop production.

4.8. PROBLEMS AND CONSTRAINTS OF THE CURRENT MODEL

This part of the study discusses different perceptions and the importance of communication between advisors, researchers, and producers, as well as the importance of feedback and measurement of the effectiveness of respective researchers.

Researchers are the first step in information dissemination, where communication (including linking activities) is crucial for effective dissemination, and the extension specialist and advisor play a critical role (Modirwa & Oladele, 2017). This study attempts to establish effective communication, thus highlighting the importance of the researchers' perceptions.

Only two (40%) crop researchers were confident that all, or most of, the results generated reached the intended audience. In contrast, most of the SASRI researchers (80%) were confident that all their information reached the growers.

Crop researchers who weren't confident their results reached their target population mentioned a shortage of advisors to act as mediators between researchers and their target population. Alternatively, those who were confident their results reached their target population said that they saw this during feedback at meetings and continual funding of their projects.

> *"This institution does not have a technology transfer section as such, doesn't have advisors, it doesn't have people that are permanently in the field and yet… they still keep funding the project after 40 years" – crop researcher.*

Most SASRI researchers felt that their research results reached their target population because of the constant flow of information between researcher, advisor and grower. There was also an inclination towards using different ways of dissemination (instead of focusing on one method) to reach as much of the target population as possible (face-to-face, farmer days, online articles, commodity magazines). One researcher's concern was that the same information was continually being disseminated on grower days, which they felt meant the farmers were somehow not getting the correct message.

> *"I see it in my research-extension-grower partnerships, you've got a chain" – SASRI researcher (translated from Afrikaans)*
>
> *Some individuals were slightly less confident. "I'm sceptical about how much information gets out there. The fact that I'm doing so many back-to-basic talks tells me something's gone amiss" – SASRI researcher.*

Although researchers from both groups regarded the producers and growers as their primary target audience, it is clear that they, as researchers, don't have the desired contact with the producers. The successful model of SASRI relies on their advisors to act as "messengers"

between those two parties. From the crop researchers' perception, it is clear that the flow of information is compromised in the absence of advisors.

4.8.1. Researchers' Perception of Communication and Feedback Towards and from Advisors and Producers

It was important to study the perception of researchers on existing channels of communication between themselves and their target audience. Initially, most of them believed that good communication channels existed; however, when the "feedback to and from" narrative was used, it changed their perceptions significantly (Table 4-3).

Table 4.3: Researchers Perception of Communication Towards and from Advisors and Producers

	Crop researchers		SASRI researchers	
	Yes	No	Yes	No
Feedback from producers or growers	60%	40%	100%	0%
Feedback from advisors	20%	80%	100%	0%

Most crop researchers said they receive producer feedback through personal communication or reports on information days. Disturbingly, only 20% of researchers felt they received any feedback from advisors. It was previously established that effective dissemination was compromised in the absence of advisors; therefore, this proves poor communication between researchers and producers in the crop production sector.

In comparison, Table 4.3 shows that all SASRI researchers have excellent communication and feedback with and from their extension specialists and, thus, the growers. Most SASRI researchers again mentioned the constant knowledge exchange between the researcher, advisor and producer. Exchange is through formal feedback channels, including Research, Development & Extension (RD&E) workshops, updated quarterly programs and progress reports. Most SASRI researchers mentioned that feedback was through the extension officer. All the researchers also preferred it this way. If contacted directly by a producer, the extension officer is always kept informed to ensure all stakeholders in the chain of dissemination are aware of any issues. One SASRI researcher also mentioned that they get feedback during personal farm visits.

4.8.2. Researchers Most Likely Means to Monitor Effectivity of Dissemination

During the preliminary research, it was noted that some researchers felt that measuring a dissemination model was the advisor's responsibility or that of the institution and not the researcher. To test this theory, researchers were asked to voice their opinion on this issue. Also, during the preliminary research, a range of possible means of measurement of effectivity was identified. Some of these methods are sometimes used for surveys and opinions. Researchers were asked to indicate the preferred means of evaluating their effectiveness in relaying information.

On the one hand, based on the mean, the crop researchers rated feedback on information days and at regional and national conferences as extremely important for monitoring dissemination efficiency (ẋ = 3,00, respectively). Researchers rated most surveys (except *WhatsApp*) as least important, as well as relevant post-graduate students and webinar information sessions, as shown in Figure 4.8.

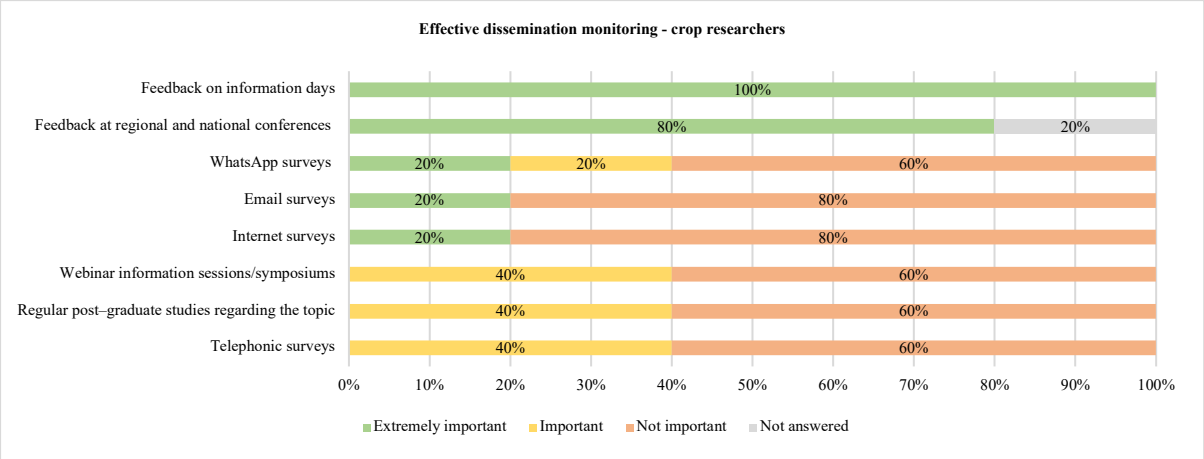

Figure 4.8: Crop Researchers Most Likely Means of Measuring Effectivity of Dissemination

The SASRI researchers, on the other hand, and based on the mean, rated feedback on information days as extremely important for monitoring dissemination efficiency (ẋ = 3,00) and relevant post-graduate students as least important (ẋ = 1,00), shown in Figure 4.9.

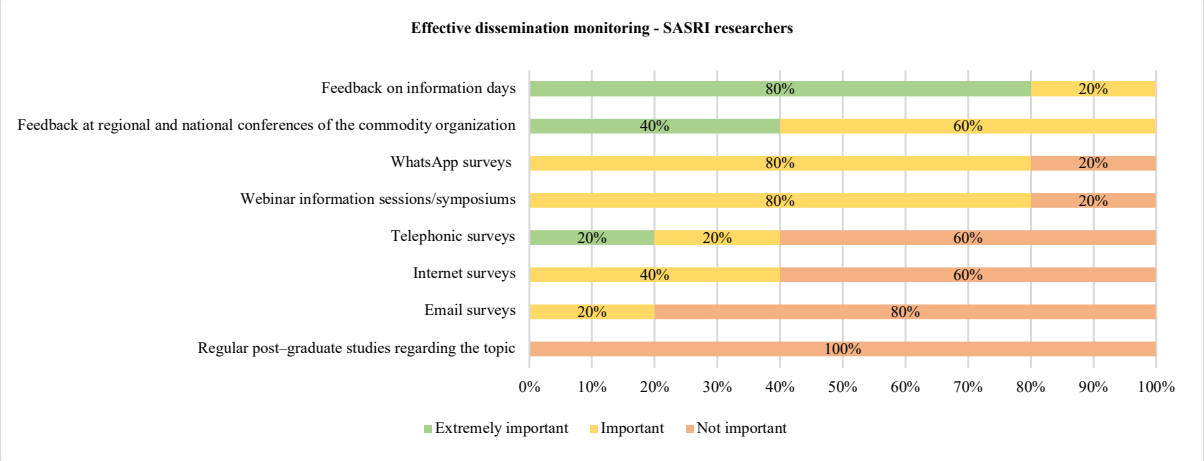

Figure 4.9: SASRI Researchers Most Likely Means of Measuring Effectivity of Dissemination

4.8.3. Researchers' Main Constraints Regarding Dissemination and Suggestions

The crop researchers reported three major constraints in their current model.

- Time and time management
- Insufficient finances, funding and resources
- Shortage of qualified advisors to link producers and researchers

The SASRI researchers reported the following major constraints in their current model.

- Time for one-on-one visits
- Lack of grower interest in information researched and disseminated
- Capacity constraints – most researchers were eager to increase interaction with advisors and growers.

4.8.4. Researchers' Recommendations on Effective Dissemination

Crop researchers were unanimous with the following suggestions:

- Institutions and individuals conducting research must provide a link between the researcher and the target audience.
- Platforms where research results can be discussed and debated must be created.
- Increased interaction at information days.
- More personal interaction (face-to-face) with the target audience.
- Researchers must be careful not to prioritise scientific articles above other means of dissemination merely because it may be a possible requirement for promotion.

- The younger generation needs to be informed about the opportunities in agriculture.

SASRI researchers agreed on the following suggestions:

- The adoption rate (growers' application of research results) must be monitored more accurately. However, this does not necessarily indicate the model's success, as many growers might have received the information but decided against adopting the practice.
- The flow of information must be through the advisor and extension specialist. Without the involvement of this link, any model has little chance of success.
- Visibility in the area through interaction

  "You need to be visible in the areas…I don't go anywhere without wearing my SASRI shirt. I'm passionate about branding" – SASRI researcher (translated form Afrikaans).

4.9. COMMITMENT TO EFFECTIVE COMMUNICATION AND THE RELATIONSHIP WITH RESEARCHERS AND PRODUCERS

This study attempted to determine if there is a breakdown in communication between researcher and producer, the reasons for this breakdown, and to find ways to repair existing communication channels or suggest alternatives.

4.9.1. Researchers' Perception of a Possible Breakdown of Communication Between Agricultural Researcher and Producer

The crop researchers agreed that there is a definite communication breakdown between the researcher and the producer. In contrast, most SASRI advisors (80%) confidently disagreed with this statement. It shows the effectiveness of the SASRI communication model (Table 4.4).

Table 4.4: Communication Between Researcher and Producer

There is a breakdown in communication between researcher and crop producer	**Crop researchers**	**SASRI researchers**
	100% Agree	80% Disagree

4.9.2. Researchers Preferred Directions of Communication with Target Audience

As previously discussed, Van der Ban (1987) proposed three directional models of communication:

- Top-to-bottom is where communication originates from the researcher to the advisor to the producer or grower.

- Bottom-to-top is where communication originates from the producer and grower to the advisor and researcher.
- Bi-lateral is where communication starts with any stakeholders in either direction, and the advisors are pivotal in facilitating this communication.

Both groups of researchers reported that they preferred bi-lateral research communication and mentioned the importance of a facilitator between the producer and researcher.

Most crop researchers (60%) had an existing channel with producers but admitted that communication was minimal. The rest of the respondents had no contact with producers despite claiming they were the primary target audience.

"There is communication, but it is too little" – crop researcher.

Most SASRI advisors also preferred the bilateral communication model with advisors in the middle. They felt that although the growers had an open line to them, they would always request that the grower report an issue through the extension specialist to keep everybody informed. They further emphasised the importance of the formal communication channels created by SASRI and the knowledge management team, as discussed earlier. One SASRI researcher noted that bottom-to-top is also important to keep the growers involved.

For communicating research results, both groups of researchers indicated that they used face-to-face interaction, information days, and crop commodity magazines, both printed and online, to relay information in that order of preference.

4.9.3. Involvement of Producers and Advisors When Collecting Data Through Participatory Research

The definition of this type of research is where designs, methods and frameworks use systematic inquiry in direct collaboration with those affected by an issue being studied for action or change (Vaughn & Jacquez, 2020). Academics have recognised for some time that agricultural extension needs to be reinvented (Trauger *et al*., 2008). Kloppenburg (1991) argues that the agricultural science and education system requires an alternative science that includes farmers' and extension specialists' experiences and local knowledge. Most crop researchers reported that they seldom do any research on a producer's farm but felt that if the need arises, the involvement of a qualified advisor is crucial to the scientific validity of the results. Researchers mentioned that although advisors were sometimes included in collecting data, it depended on the type of research being done. It was also noted that scientific journal

publications drive many researchers because this is what academic institutions recognise; therefore, they aren't involved in too much on-field research and don't involve advisors.

"Not often, but it's not as if they're totally not there" – crop researcher (translated from Afrikaans).

Researchers mentioned that producers are sometimes involved in data collection, and many enjoyed this approach however, some researchers said that it was important to monitor the process as some producers might not prioritise the trials, and important information could be lost. This is a genuine concern in the crop production sector.

"We also found in a lot of cases, our trials don't get priority, you know. You invest, and then the cows are accidentally lost, or the farmer harvests all the things together and leaves the yield bag for you" – crop researcher.

SASRI advisors, in comparison, were very eager to involve growers in research on the grower's farm. It is required that the extension specialist be involved in this research as per guidelines provided by SASRI. They reported that it was a regular occurrence.

4.9.4. Commitment of Researchers to Share Knowledge

A disturbing statistic was found regarding the frequency with which the crop researchers were invited as knowledgeable persons and how often the relevant research institution initiated such an event. Although some 60% of the researchers reported that they were invited between two and four times a year to address a target audience, most participants stated that the research institution rarely or never initiated an information event.

On the contrary, the SASRI researchers were often invited to address groups of growers, study groups and advisors.

Both groups of researchers expressed a willingness to share their knowledge in such a manner on a more regular basis.

4.10. SUGGESTED SOLUTIONS FROM THE RESEARCHERS

4.10.1. Sustainability, Dissemination Models and Measures of Effectivity (KPIs)

Researchers from both groups agreed that a measurable dissemination model is crucial for sustainable agriculture and that most scientific information must be driven and motivated strongly and often repeatedly before producers adopt certain principles. They also agreed that an awareness campaign should be launched and driven to make stakeholders aware of the importance of effective communication between researchers and producers, not only for effective dissemination but also to shut the door on pseudo-science and address the problem of

information overload. Most researchers felt that the qualified and accredited advisors would be the most probable link between the producer and the researcher. Crop researchers felt that such a campaign should focus on effective communication that includes producers, advisors, researchers, and consumers. The way consumers perceive agriculture should also be considered. Ways to make communication more effective could include providing a platform to discuss research (making producers more aware of reliable information sources) and moving towards more modern communication. The roles of different organisations need to be defined more clearly and streamlined so that information flows easier. It was also mentioned that such a campaign should include revising agricultural curricula, especially at tertiary education institutions.

Furthermore, the SASRI researchers felt that continuous dissemination was crucial. Ensuring the correct information is shared, the soil and environment are taken care of, and pseudo-science can be eliminated.

SASRI researchers also felt it was important to get their research to the grower, not just stop the process at the publication of results. One researcher suggested incorporating some Research, Development and Extension (RD&E) feedback into information days so that growers are more informed regarding the research, resulting in effective communication. This can identify and steer away from pseudo-science.

4.11. CONCLUSION

Agricultural researchers were found to be ethical, experienced and well-qualified. Ethics in research is non-negotiable and, fortunately, an issue that enjoys much attention, as Thompson (2015) described. In a comparative study of research ethics in the past and present, he also found researchers to be ethical. The SASRI model of determining research topics, priorities and especially the emphasis placed on the dissemination plan distinguishes itself from the process in the crop production sector. The crop researchers confirmed less effective communication with advisors and admitted that it was an important problem that needed to be addressed. Both researchers were aware of the dangers of pseudo-science, although the SASRI participants weren't concerned about it. They also believed that funding for research was managed correctly and were not concerned about possible manipulation of priorities or results. The crop researchers, however, felt that funding was a problem, and some even reported instances where the funding source influenced the results generated. All the researchers acknowledged the problem of information overload. They agreed that qualified advisors and

extension specialists would be the most suitable individuals to filter through this mass of information.

CHAPTER 5: PERCEPTIONS OF ADVISORS AND EXTENSION SPECIALISTS IN THE DISSEMINATION OF RESEARCH INFORMATION

5.1. INTRODUCTION

Most of what exists around all people in the world is either a direct result of nature, research or a combination thereof, whether through ancient experience or faster, ground-breaking scientific research. Like in most other sectors of the world, in agriculture, what eventually becomes an everyday practice depends on the adoption rate of research results by the target audience. Still, producers often feel disconnected from researchers because there is little or no formal interaction between the two. Also, in agriculture, personality traits and differences between producers and researchers play an important role in what is often perceived as miscommunication (B. Flett, personal communication, February 15, 2022). It becomes clear that trust in the experience and advice from the adviser becomes essential to implementing research at the farm level, which usually results in change to a larger or lesser extent. Not only can crop advisers increase the amount of science delivered to farmers, but they also have the skills to tailor this information to meet the specific needs of individual farming systems (Bernacchi & Wulfhorst, 2017). Sometimes policymakers and researchers view problems from the top-down (to farm level) to identify research needs and topics. Still, stakeholders and producers viewing problems or topics from the bottom-up (to the researcher level) determine what should be done or what works in practice considering the financial and other risks involved. Power dynamics and cultural, personality and philosophical differences often lead to conflict and distrust between these groups (Briese, 2019). This is also confirmed by Maister, Green & Galford (2021).

The results obtained from the participants and the advisors involved in certain large-scale summer grain and extension specialists in the large-scale sugarcane production sector have been analysed and will be discussed in this chapter. Most results are presented in the order of the questions per the questionnaires and consolidated responses from the interview schedules.

5.2. DEFINITION OF THE AGRICULTURAL ADVISOR AND EXTENSION SPECIALIST

The term “advisory and extension system” or “advisory services” refers to the set of organisations and people that enable farmers to develop farm-level solutions by establishing service relationships to produce knowledge and enhance skills (Birner *et al*., 2009). This study's target audience is the crop producer or sugarcane grower. In the crop production sector, this service is known as advisory services, and the individual is called an advisor, whereas in the

sugarcane production sector, the same function is known as extension services, and the individual is, therefore, an extension specialist. Their functions and objectives remain the same; for this study, both advisor and extension specialist are considered similar in most respects.

However, a third group in agriculture is known as trusted crop advisers or extension specialists, who currently work to help bridge the gap between researchers and stakeholders. The concept of the "Trusted Advisor" in business is well-described by Maister, Green & Galford (2021), and the same principles should apply to the agricultural sector. The broader concept of the crop advisor can best be defined as similar to the definition of agronomy and the agronomist. It needs to be understood that not all crop advisors are agronomists. Still, the average responsibilities of the advisors as participants of this study all had a very similar profile to that of the agronomist. Agronomy (the science of crop production) is defined as the integrated, holistic perspective of agriculture and "agronomists are specialists in crop and soil sciences, as well as ecology" (American Society of Agronomy, 2019). Briese (2019) supports the term "trusted advisor", which most effectively describes effective crop advisers and crop consultants recognised as trusted advisers by farmers, researchers, research institutions and university extension.

5.3. DUTIES AND RESPONSIBILITIES OF THE AGRICULTURAL ADVISOR AND EXTENSION SPECIALIST

AgCareers (2020) lists the agronomist's (crop advisor or extension specialist) responsibilities as follows:

- Obtain scientifically based knowledge or reliable referrals to make recommendations to growers to achieve efficient crop production.
- Sampling of soil in the fields, including sampling at different depths, by geo-reference and multiple site sampling in the event of changes in soil texture.
- Soil classification and mapping, including physical inspection of soil pits with subsequent calculation of potential.
- The agronomist must be able to conduct field trials, have an extensive knowledge of plant physiology and make recommendations on irrigation practices.
- It is especially important to regularly scout customer fields for weeds and insects, diseases, and nutrition issues. An old Japanese proverb in its modern-day form says: "The footsteps of the Farmer are his best fertiliser".

- The agronomist should ensure that all applications, seeding, fertiliser, and chemical programs are executed under ideal conditions.
- Gather, compile, analyse and interpret test results and prepare progress reports.
- Analyse crop claim issues where necessary and act as arbiter in a dispute regarding agricultural matters.
- Interact with the farmers to establish a relationship based on trust and mutual respect.
- Agronomists, crop advisors, and extension specialists must train, supervise, and advise the marketing personnel if involved with a supply company, especially regarding speciality products.
- Crop advisers are also an important source of information for policymakers.

Smith and Rockett (1983) investigated the work of Agricultural Development and Advisory Service (ADAS) Liaison Officers in Wales and England; they noted these individuals' functions and named the following tasks as very important in the context of this study:

- Report on the industry's needs and relate them to new information generated by the research stations.
- Advising researchers on the practical problems of farming and contributing towards guiding the selection of research priorities.
- Linking research with production realities, both in operational problems and research priorities.
- Continuous adviser updating. One of the most important functions is to be the linkage between researcher and producer.

To summarise the responsibilities of the crop advisor and extension specialist: soil management, plant nutrition and crop protection recommendations, conducting field trials, advising on technology, monitoring of crops and producers' or growers' adopting of research results, and advising on other farming-related responsibilities. According to Van Niekerk *et al*. (2011), agricultural extension must fulfil five core activities to help farmers with all these challenges: training, integrated support systems, innovation, improved communication systems and capacity development.

5.4. IMPORTANCE OF SCIENTIFIC AGRICULTURAL INFORMATION

Agricultural research is seen as the fountainhead of technological innovations, and extension delivers this to farmers (Van Niekerk, 2012). Agricultural advisory is not simply the process of solving singular production problems. Scientific research and discovery are essential to

developing sustainable agricultural practices and sustainable utilisation of our resources. Communication is crucial to help producers understand the importance of science and assist researchers in understanding the problems producers and advisors face. Briese (2019) further notes that it is critical to detect, accurately diagnose and prioritise the problems and challenges within agricultural systems. It can't be done by individuals who don't have an agricultural background and a fundamental understanding of farming systems. The qualified and accredited crop advisor and extension specialist is such a person. This is confirmed by Van Niekerk (2012), who says, "the extension worker acts as a link between farmers, subject-matter specialists and researchers".

In a study done from 2005 to 2018 in the Nebraska Valley, United States, it was discovered that second to climate trends, the most important driver for increased maize yields was agronomic practices (39%). This is a testimony of the involvement of knowledgeable and experienced crop advisors who provide producers with reliable, scientific advice to increase yields sustainably. This also means that future crop-yield gains may increasingly rely on improved agronomic practices (Rizzo *et al*., 2022). Stakeholders must trust these advisors and that the advice they disseminate is seen as reliable and scientific, hence the critical role of the trusted adviser. As described by Maister, Green & Galford (2021), "the trusted adviser" is someone with a knowledge, language, and work culture shared with the target audience. In the agricultural sector, they must have access to scientists and fully comprehend and interpret the research. Trusted advisers have the most important role in the dissemination chain, and producers can only adopt and apply research results when advisors convert a "scientific language" into information suitable to individual producer's needs (Smith & Rockett, 1983).

5.5. ADVISOR DEMOGRAPHIC INFORMATION

5.5.1. Gender

The sample size of 10 advisors and extension specialists from both the crop production sector and the South African Sugarcane Research Institute (SASRI) were all male, as reflected in Table 5.1. Although two female advisors were approached, it is unfortunate that interviewing them was impossible. In the South African commercial farming sector, female advisors may be in the minority but perceived as equally knowledgeable and successful as their male counterpart advisors (G. Keun, personal communication, July 22, 2021).

5.5.2. Age and Years' of Experience

The age of the respondents varies between 21 and 61 years. The SGS advisors included individuals younger than 35 years, whereas all of the SASRI extension specialists were older than 35. Table 5.1 also shows that all the advisors were very experienced in their fields, with only one participant with more than five years in his field of expertise and the rest with more than ten years. The older group was marginally more enthusiastic about participating in the study, which was reflected in the comprehensive information shared during the interviews. The reason could be that because of their longer experience in the advisory business of farming, they were eager to share their positive and negative perceptions. The average age of the respondents was between 38 and 50 years.

5.5.3. Racial Groups

In the sample group, 80% were Caucasian/White, and 20% were African/Black. Both black advisors were employed by SASRI, and from the interviews, it is clear that they were knowledgeable and comfortable being extension specialists in the commercial sugarcane sector, often seen as a predominantly white farming sector. This may not be the case in the commercial crop production sector. As with the female respondents, some black extension specialists in the commercial sector were approached, and, unfortunately, none were prepared to participate in the study.

5.5.4. Highest Qualification

Crop production has developed into a true science during the past 50 years. Farmers have embraced agricultural science and adopted and applied almost all the principles of concepts such as satellite technology, soil management, crop protection and the sustainable practices that support these concepts. It is no surprise, then, that farmers are better qualified to deal with new scientific challenges. Bruwer (2021) says, "farming has become more than a lifestyle over the last decades as is notable in the qualifications of commercial farmers". He found that 77% of commercial farmers who participated in his study had a tertiary qualification such as a university degree, college diploma or technical university degree. All the advisors who participated had a tertiary qualification. Interestingly, more than half of the participants possess a post-graduate degree, such as an honours or master's degree. Advisors in both groups were suitably qualified to advise the modern farmer (Table 5.1).

5.5.5. Fields of Expertise

Apart from advising farmers on general crop production issues, the advisors in the crop production sector were specialists in agronomy, agricultural chemical remedies for plants and crops, plant health and diseases, plant nutrition and precision farming. All the sugarcane advisors are extension specialists in sugarcane crop production and, as experts, cover the fields of varieties, crop nutrition, soil management and conservation, pest and disease control, irrigation of sugarcane and plant physiology.

5.5.6. Accreditation

Most advisors indicated that they were accredited with AVCASA and CropLife SA, which means that they met the minimum requirements to be advisors in the fields of agricultural chemical crop protection and pest and disease control. None of the sugarcane advisors passed the FERTASA exams required to be an accredited fertiliser advisor. In contrast, more of the advisors in the crop production sector regarded this accreditation as important. Most of both groups of advisors regarded SACNASP accreditation as very important and SASAE accreditation as less important. Most of the advisors were familiar with all the mentioned regulatory authorities, namely, FERTASA, AVCASA, CropLife SA, SACNASP and SASAE. In Australia, less than half of the advisors who took part in a study by Nettle *et al*. (2018) were members of professional associations. Of this group, only 43% were accredited through these associations.

Table 5.1: Gender, Age, Racial Group, Qualification, Accreditation and Experience

Crop production sector			SASRI		
Gender	**Frequency**	**Percent**	**Gender**	**Frequency**	**Percent**
Male	5	100	Male	5	100
Female	0	0	Female	0	0
Advisor's age	**Frequency**	**Percent**	**Advisor's age**	**Frequency**	**Percent**
20 - 35	2	40	20 - 35	0	0
36 - 45	0	0	36 - 45	2	40
46 - 60	2	40	46 - 60	1	40
60+	1	20	60+	2	20
Racial groups	**Frequency**	**Percent**	**Racial groups**	**Frequency**	**Percent**
African/Black	0	0	African/Black	2	20
Caucasian/White	5	100	Caucasian/White	3	100
Highest Qualification	**Frequency**	**Percent**	**Highest Qualification**	**Frequency**	**Percent**
Master's degree	2	40	Master's degree	1	20
Honours degree	1	20	Honours degree	2	40
Bachelor's degree	2	40	Bachelor's degree	1	20
Tertiary Diploma	0	0	Tertiary Diploma	1	20
Accreditation	**Frequency**	**Percent**	**Accreditation**	**Frequency**	**Percent**
FERTASA	2	40	FERTASA	0	0
AVCASA	2	40	AVCASA	2	40
CropLife SA	2	40	CropLife SA	4	80
SACNASP	3	60	SACNASP	2	40
SASAE	1	20	SASAE	0	0
Years' experience	**Frequency**	**Percent**	**Years' experience**	**Frequency**	**Percent**
>5 years but <10 years	1	20	>5 years but <10 years	2	40
>10 years but <20 years	1	20	>10 years but <20 years	2	40
>20 years	2	40	>20 years	1	20

5.5.7. Current Employment

Interestingly, three of the advisors on the crop production side were employed by an agricultural supply company, a crop commodity organisation employed one, and another advisor was an independent agronomist. In contrast, all the sugarcane extension specialists were full-time employees of SASRI. This difference in employment turned out to be most significant as the study progressed and will be discussed later.

All advisors indicated that GrainSA conducted research applicable to their field. Four advisors also indicated PRF, ARC, OPDT/OAC. This is why this sample of crop

production advisors was selected, as all of them noted that the five institutions decided during the pre-research to do research in their respective fields of expertise and dissemination. All the SASRI advisors indicated that SASRI does research in their respective fields of expertise and dissemination.

All crop advisors indicated that they had been involved in disseminating the abovementioned institution's research results in the past decade and that most of the information disseminated was scientific and field-trial-based. The reasoning behind this and the importance of both science and field trials regarding pseudo-science will be discussed in the section. SASRI advisors have only been involved in disseminating SASRI's results and sugarcane production-orientated information.

5.6. PERCEPTIONS ON RESEARCH, FUNDING AND CURRENT DISSEMINATION MODEL

This study aims to determine the current methods of disseminating research results to the target audience or end-user, in this case, mostly the producer. It was therefore considered necessary to investigate the entire research process from identifying research topics, how specific topics became priorities, who was responsible for the funding of such a project and most importantly, the current ways and means used to ensure that the target audience received these results. The advisors were asked for their perceptions on these matters through various questions and interviews.

5.6.1. Identification of Research Topics as Seen by Advisors

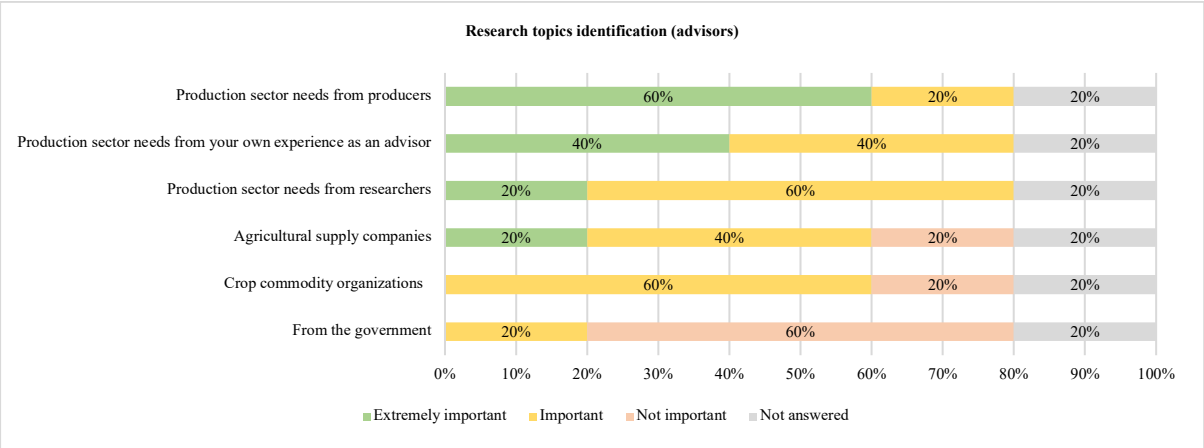

Figure 5.1: Sources of Research Topics as seen by Advisors

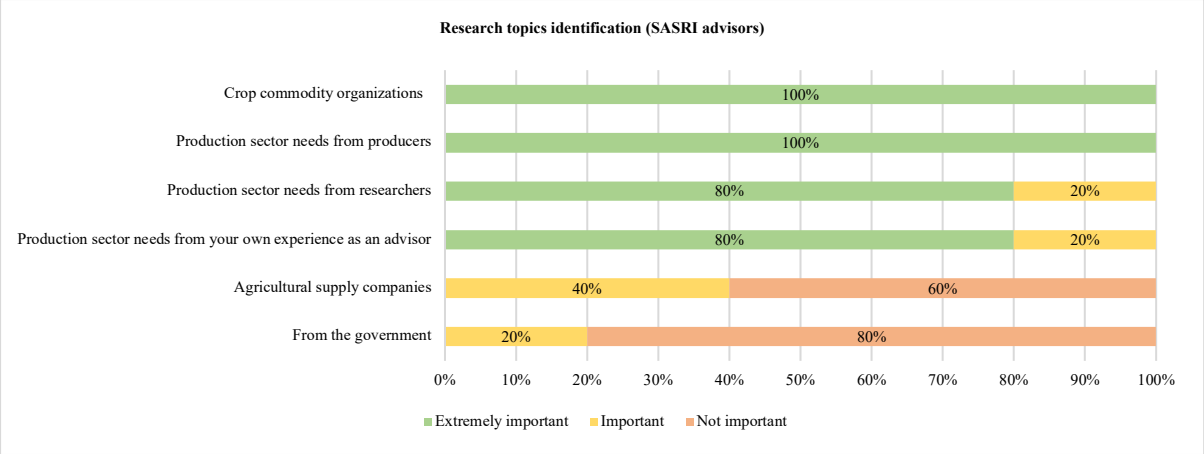

Figure 5.2: Sources of Research Topics as seen by SASRI Advisors

The source of the research topic is of utmost importance, steers and drives research in the right direction, and determines the relevancy of results (A. van Schalkwyk, personal communication, May 05, 2021). As seen in Figures 5.1 and 5.2 and based on the mean, the crop production sector needs from producers was rated the most important for identifying research topics in South Africa by advisors (ẋ = 2,75), with 60% of advisors placing this as extremely important. In contrast, the government was rated least important (ẋ = 1,25). In the case of the SASRI advisors, in comparison and based on the mean, production sector needs from growers was most important. Crop commodity organisations were rated the most important for identifying research topics in South Africa by SASRI advisors (ẋ = 3,00 respectively), with all SASRI advisors rating these as extremely important. In contrast, the government was rated as least important (ẋ = 1,20). The added importance of the crop commodity (SASRI) indicates their well-structured dissemination model.

5.6.2. Funding of Research and the Process of Determining Research Priorities

Not all advisors from the crop production sector were aware of the source of funding; those that did name a source indicated that funding came from crop commodity organisations and trusts such as OPDT, PRF, Grain SA and the Maize Trust. Private institutions and supply companies such as Bayer, BASF, Syngenta and Monsanto were also mentioned. It was also noted that most advisors believed funding should come from the producers. This issue will be discussed further in this paper.

"It must come from the farmers, from the producers, they must, they must supply the funding" – crop advisor.

Also, not all advisors knew how research projects became a priority. However, once a problem or research topic is identified, the appropriate application process, as determined by the different institutions, is followed. Normally, projects with a greater contribution (most often financially) will be prioritised. This state of affairs could affect objectivity towards research priorities.

"You rate it according to what potential damage it can cause that crop, or what is the potential money you can make out of it, and then decide" – crop advisor.

The response from the SASRI advisors regarding funding was unanimous in that most of the research funding comes from growers through levies. The sugarcane mills are also responsible for a portion of funding.

"In terms of our organisation, I think most of it will come-, will be funded by the growers. They get levied for it at the end of the day. So, the producers and the mills are the ones that in the end will actually fund the project" – SASRI extension specialist.

5.6.3. Dissemination to Target Audience (Communication Between Advisor and Producer)

The target audience is "the group of people you hope to influence with your message" (Goemans, 2017). In agricultural terms, there can be different stakeholders. Still, for this study and to investigate certain linkages, the options were narrowed down to researchers, fellow advisors, producers or growers, trainers and technical personnel.

On the one hand, the crop advisors all regarded the producers as their most important target audience; fellow advisors, trainers and technical staff were regarded as much less important, which may indicate a disturbingly low level of cooperation amongst advisors. Only 40% viewed some researchers as part of the target audience, which may indicate a need for communication with researchers.

On the other hand, fewer of the SASRI advisors regarded any researchers as part of their target audience but shared their counterparts' views regarding growers and fellow advisors. All the SASRI advisors were totally committed towards the growers as their target audience.

5.6.4. Knowledge Transfer

A list of current ways of transferring knowledge was presented to the participants to determine their preferences and objections towards these methods used. A shortlist of methods was compiled after preliminary research was done to determine the most commonly used and thus perceived as conventional. A few modern methods (unconventional and using ICTs) of communicating were added to complete the list. Information Communication Technology

(ICT) is a broader term for information technology (IT), which refers to all communication technologies, including the internet, wireless networks, cell phones, computers, software, middleware, video-conferencing, social networking, and other media applications and services enabling users to access, retrieve, store, transmit, and manipulate information in a digital form (Food and Agriculture Organisation, 2023).

The information was grouped into publications, communications, virtual, social media and e-mail. The selected methods were integrated with the steps taken by the advisors to ensure their target audience received the information. There may be many other ways of transferring agricultural knowledge, but the results showed a noticeable trend in the South African commercial agricultural sector.

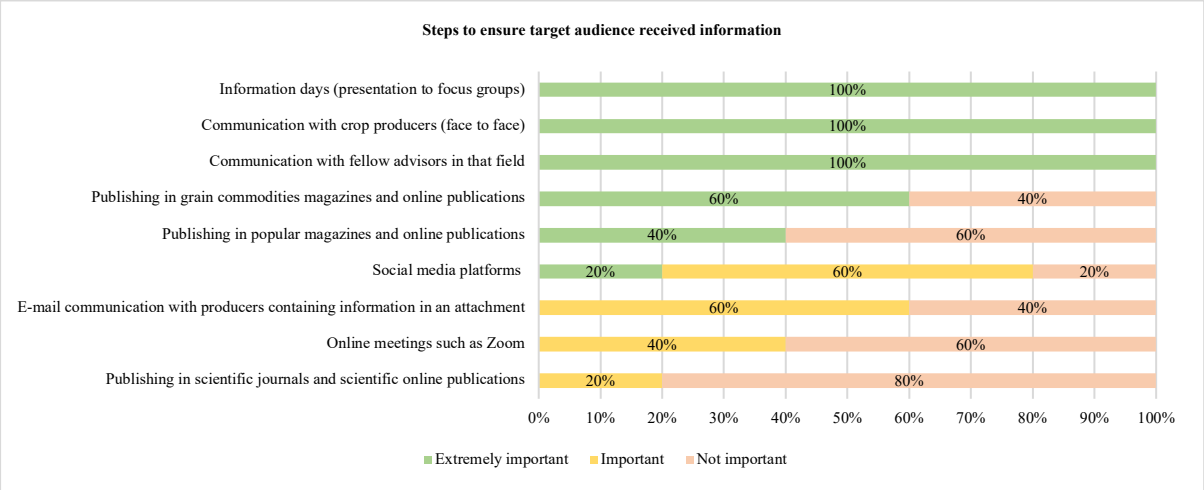

Figure 5.3: Steps to Ensure Target Audience Received Information

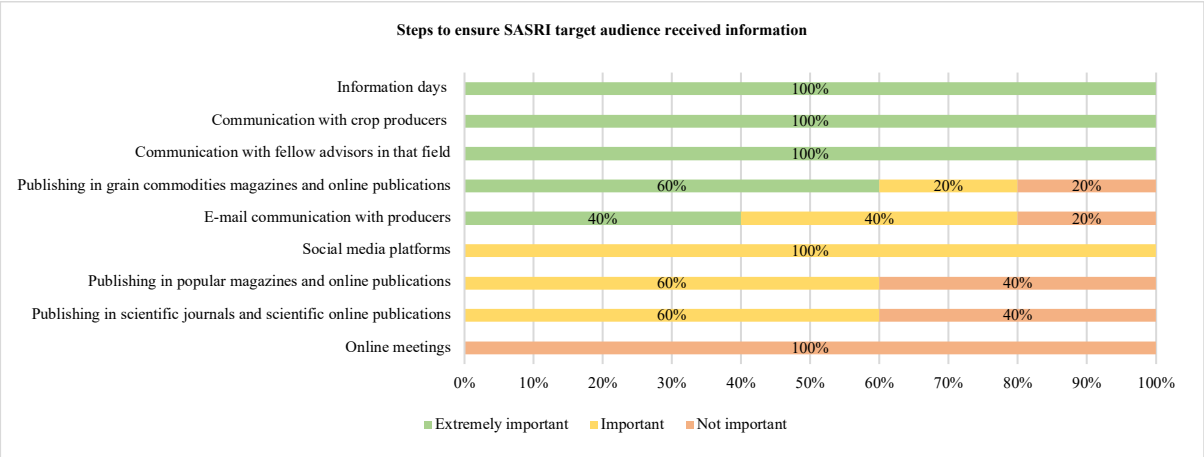

Figure 5.4: Steps to Ensure SASRI Target Audience Received Information

From Figure 5.3, it is clear that the crop advisors' perceptions and based on the mean, the most important steps taken by them to ensure that the target population receives information is communication with fellow advisors in that field, communication with crop producers (face-to-face), and information days (presentation to focus groups) ($\dot{x}$ = 3,0), with all advisors rating these extremely important. The least important step was publishing in scientific journals and online publications ($\dot{x}$ = 1,2), with 80% of the advisors rating it as unimportant.

A similar opinion can be formed from the data presented in Figure 5.4 and also based on the mean, the SASRI advisor's most important measures taken to ensure that their growers receive information is networking with fellow advisors in that field, communication with crop producers (face-to-face), and information days (presentation to focus groups) ($\dot{x}$ = 3,0), with all SASRI advisors rating these extremely important. The least important step was online meetings ($\dot{x}$ = 1,0), with all SASRI advisors rating it as unimportant.

When the interview data is added, a picture can also be formed of the advisor's most preferred ways of communicating their information. Table 5.2 shows a few interesting facts and trends. Producers, growers and farmers in general must spend most of their time outdoors with their crops, animals or other activities linked to production. It is, therefore, understandable that scientific publications would not be a preferred way of transferring knowledge. The same may apply to virtual portals of information and social media to a certain degree. It is, however, becoming more popular but, according to most advisors, more as a marketing platform than a knowledge transfer platform. It is important to note that advisors regard popular magazines as less important than crop commodity magazines. Although the number of readers of commodity magazines may be significantly less, the advisors believe that the crop commodity magazine is a more reliable media for transferring scientific knowledge. It is also interesting to note that some advisors believe that to ensure the producers take note of the information relayed, they have to be sent an e-mail followed by a WhatsApp that serves as a reminder to read the e-mail containing the information. A similar trend was found among advisors in a study by Nettle *et al*. (2018). When prompted about information delivery modes, the following was found: 74% of advisors mentioned one-on-one advice, 64% mentioned farmer groups, and 49% used media and web-based communication. Most respondents preferred a combination of one-on-one and group interactions (Nettle *et al*., 2018).

Table 5.2: Advisors Preferences Towards Ways of Communicating with the Target Audience

	Advisors (SGS)			Advisors (SASRI)		
Publications	**Not important**	**Important**	**Extremely important**	**Not important**	**Important**	**Extremely important**
Scientific Journals (printed & online)	80%	20%	0%	60%	40%	0%
Popular magazines (printed & online)	60%	0%	40%	20%	30%	0%
Crop commodity magazines (printed & online)	40%	0%	60%	20%	20%	60%
Communication						
With fellow advisors	0%	0%	100%	0%	0%	100%
With producers/growers (face to face)	0%	0%	100%	0%	0%	100%
Information days (face to face)	0%	0%	100%	0%	0%	100%
Virtual						
Portals such as Zoom and MS Teams	60%	40%	0%	100%	0%	0%
Social media						
Facebook, Twitter etc	20%	60%	20%	100%	0%	0%
WhatsApp	0%	20%	80%	100%	0%	0%
e-mail	40%	60%	0%	20%	40%	40%

5.6.5. Advisors' Perception of the Standard of Local Agricultural Advisory Services and Research

With the South African focus shifting away from public agricultural extension to other alternatives came the unfortunate demise of previously world-class research, development, and extension institutions such as the ARC (Bruwer, 2021: Liebenberg, 2013). Speculation often arises amongst scientists and other stakeholders involved in research and extension about the standard of these two disciplines in this country.

Regarding advisory services in South Africa, the participants, within different age groups and varying years of experience, were tested on this question, and most advisors felt that there was a lot of expertise in the field, with many individuals having many years of experience. They think that the standard at most tertiary institutions offering a Bachelor's degree in agriculture is still good enough to serve as the basis for a qualified advisor. Although the information is up to standard, there appears to be a gap in disseminating the information.

Regarding research in South Africa, two advisors felt that South African agricultural research was *on par* with other countries concerning some major crops but lacked in different sectors of the agricultural spectrum. An additional two advisors said that South Africa's agricultural research was not *on par* with other countries, one of which stated that too many people were involved and that regulations were not up to standard.

> *"There's just too many guys in the sector, and that together with the lack of correct regulations of what, where, and when"- crop advisor. (translated from Afrikaans)*

Regarding advisory services in South Africa, from the SASRI's advisors' perspective, all but one were very confident that their advisors were comparable with the best in the world. They feel that their well-structured dissemination model helped them stay *on par* with the rest of the world. Open communication between researchers and advisors was a vital aspect of this model. It was also noted that because the growers are involved, the research and advice given are relevant, resulting in a fairly quick adoption and implementation. Furthermore, advisors felt that their fellow advisors were knowledgeable with years of experience and much mutual respect among the advisors and researchers.

Regarding research in South Africa, all SASRI advisors believed that research in the sugarcane industry is *on par* with the rest of the world; two advisors felt they were one of the leaders in sugarcane research. Advisors thought this was because SASRI researchers are highly recognised for their work. One advisor said that having one head office for research helps. This respondent referred to the Knowledge Management Centre located at the head office - another crucial contributory part of their successful model. One advisor was concerned that the current financial situation makes staying *on par* difficult.

> *"What's nice about our model is that if we are unsure about something we phone each other, we have direct access to our researchers" - SASRI extension specialist (translated from Afrikaans).*
>
> *"The guys all have years of experience behind them... All of them are degreed, have studied, and the guys are very knowledgeable on what they're talking about" - SASRI extension specialist.*
>
> *"The expertise are there in terms of having the information. However, the dissemination and the sharing of that information, in our country, is very much driven through an economical sense as for self-economic gain – crop advisor".*
>
> *"Definitely, yes, SASRI has been considered one of the leaders in sugarcane research for decades" - SASRI extension specialist. (translated from Afrikaans).*

5.6.6. Advisors' Self-Evaluation of Effectivity and Their Perception of the Ideal and Most Effective Dissemination Model

Advisors from the crop production sector seem unsure of the percentage of the research results that eventually reach their target audiences. A relatively large proportion of advisors (20%) are uncertain of how much information reaches their audience. In comparison, the balance of this group was equally divided at 51 – 80% and only 21 – 50% (Figure 5.5). This shows a disturbing trend towards the lack of feedback from the producer or follow-up from the advisor and the need for a dissemination model that includes some key performance indicators (KPIs) to measure the success of their extension efforts. Without KPIs, time-consuming and expensive research may never reach its intended goals.

In contrast, all the SASRI advisors were confident that most of the information reached the target audience. None doubted this, with 40% claiming that 51 – 80% of results reach the target and 60% of respondents claiming a success rate of between 81% and 100% (Figure 5.6). As opposed to the crop advisors, the SASRI advisors are part of a successful and measurable dissemination model. From the interviews, it was concluded that they had reliable KPIs in place to measure their affectivity.

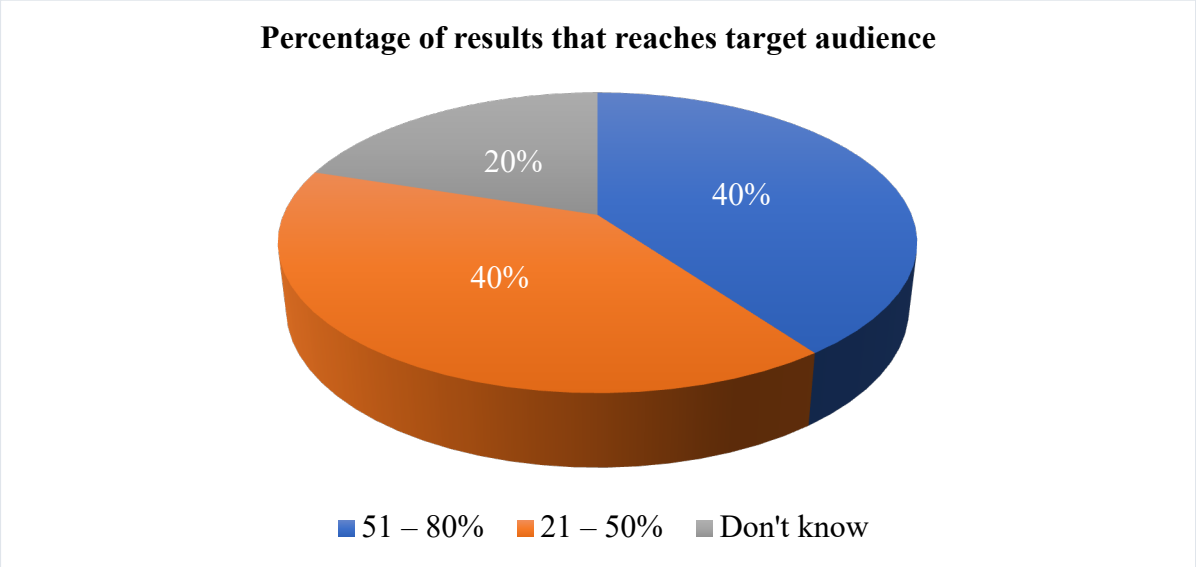

Figure 5.5: Percentage of Results that Reaches the Target Audience

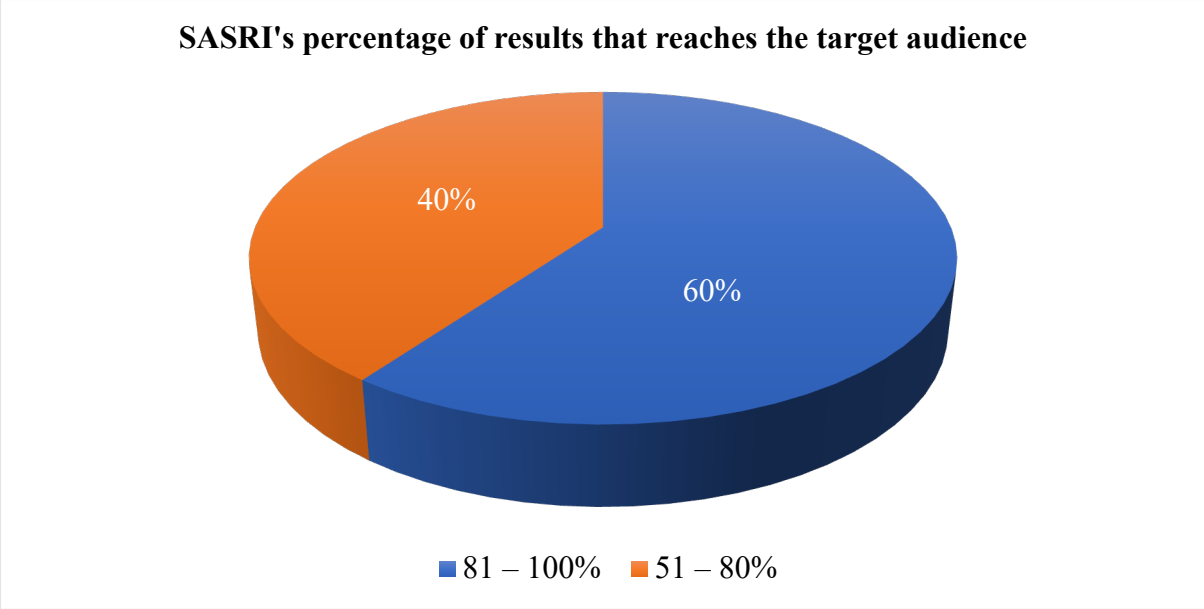

Figure 5.6: SASRI's Percentage of Results that Reaches the Target

Regarding a basic model, crop advisors are divided as to which dissemination model would be most effective. Some felt that after a researcher has concluded the results, it should be a shared responsibility between the researcher and advisor to initiate contact with the target audience and determine the methods and models used to relay the information to the producer. However, slightly more advisors believe that dissemination of information remains the primary function of the advisor and that the researcher should not bear this responsibility and should focus more on research.

In contrast to this opinion, most of the SASRI advisors preferred the second model described above, where the advisor remains responsible for initiating contact with the target audience as soon as the researcher has published the results. This difference of opinion is crucial and is evident in the dissemination problems experienced in South Africa's crop production sector, which again indicates SASRI's successful model.

5.7. OBJECTIVITY OF ADVISORS TOWARDS RESEARCH RESULTS AND SUBSEQUENT DISSEMINATION THEREOF

5.7.1. Advisors' Perception of the Possible Influence of Funding Sources for Research and the Objectivity of Results Generated

As discussed earlier, funding of research can be a controversial issue. Although the government still funds some research through institutions such as the ARC and academic institutions, nowadays, much research in the crop production sector is funded by either crop commodity

organisations, trust funds, or private or supply companies. The funding source with subsequent expected research outcomes may influence the objectivity of the researcher and the advisor. In an attempt to determine advisors' perceptions, the participants were asked if they agreed with this statement.

From the crop production sector, most advisors (80%) felt that the funding source influenced the researcher and generated biased results towards a certain outcome. Researchers need to be objective to prevent funding from having an influence. This group was also of the opinion that the involvement of supply companies would most certainly affect the quality of the results.

> *"Very often the research that is done, is done not as a general research topic, but if is the research is done to get to a final goal then the research will tend to align itself towards that goal, or something like positive reinforcement very often happens, out of natural course" – crop advisor.*

They were, however, more eager to disseminate results funded by crop commodity organisations and regarded this information as significantly more reliable.

Compared to the abovementioned argument, the general feeling from the SASRI advisors was that funding at SASRI does not necessarily influence the results but could rather determine whether research is conducted. Budget constraints might result in some bias. One advisor also mentioned that because the producers subsidise the research, they tend to want their topics prioritised.

> *"The fact that research is generated out of farmers funds plays a role, it's their money going into it, and they want value for money" - SASRI extension specialist (translated from Afrikaans).*

5.7.2. Objectivity of Advisors

As discussed earlier, "agricultural advisor" is often used out of context and without due qualification. Although sales personnel may be advisors to a certain extent and most certainly do advise producers on the application of the products that they supply, a true advisor is a person who is academically qualified, experienced and ethically committed to disseminating scientific results and information towards sustainable agriculture. This study has mainly focused on three types of advisors. The independent advisor, the supply-company advisor and the advisor contracted or employed by a crop commodity organisation. The last-mentioned group is generally perceived as less biased towards the research outcome (L. Pistorius, personal communication, July 23, 2021). Independent advisors face a serious concern, namely, compensation for advice rendered. Interviews with advisers from the Turkish district of

Antalya Province identified difficulty in securing payment for services as the most challenging problem faced (Ates & Sendundar, 2013). Nettle *et al*. (2018) also reported a low-level willingness from Australian farmers to pay for services by private sector extension.

Although one crop advisor felt no bias, the general feeling was that independent advisors tend to have the best outcome at heart. In contrast, an advisor employed by a supply company has the company's interests and products at heart. Financial gain can easily influence objectivity and dissemination of results.

> *"An independent advisor is not worried about a certain company's product but rather stays objective about what is best for the farmer" – crop advisor. (translated from Afrikaans)*
> *"Any form of general financial gain will very easily and subconsciously influence an individual's objectivity" – crop advisor.*

Most SASRI advisors agreed and felt that independent advisors generally base their advice on research outcomes. In contrast, advisors from supply companies tend to lack objectivity, with their main aim being to sell their product to a producer.

> *"I will say independent advisors are always impartial as compared to, to the, you know, supplying company because obviously, their advisor will actually influence the sale of their product" - SASRI extension specialist.*

The move to independent advisors, which will increase objectivity, has been a phenomenon in most countries worldwide. Still, it is not one without its unique problems, and there is a concern about the financial sustainability of independent advisory services that have to be financially viable without the added advantage of a profit margin from selling a product to farmers (Nettle *et al*., 2018).

One of the drivers for the abovementioned phenomenon has been the availability of qualified and accredited advisors. Most of the advisors in the crop production sector initially felt that commercial farmers are neglected in terms of the availability of advisors but later qualified the answer by stating that the problem might not be the availability of advisors but rather the type of information disseminated. Once again, they expressed concern about the advisors from supply companies who may have a monetary motivation when relaying information.

> *"There's enough advisors, but whether the right advice is given is debatable" – crop advisor. (translated from Afrikaans).*
> *"Very often the big commercial farmers are targeted, not through extensive and correct research and crop advice... rather they are targeted with marketing schemes, with sales pitches that seem great, but the actual advisory part of it is not the most effective and most truthful information they receive" – crop advisor.*

On the contrary, all the SASRI advisors felt that growers were not being neglected in terms of agricultural advice but agreed that independent advisors generally based their advice on research outcomes, while advisors from supply companies tend to lack objectivity, with their main aim being to sell their products to a producer.

> *"I will say independent advisors are always impartial as compared to, to the, you know, supplying company because obviously their advisor will actually influence the sale of their product" - SASRI extension specialist.*

The SASRI advisors were of the opinion that they have enough qualified and accredited advisors in the sugarcane industry to supply their growers with a constant flow of objective, scientific results generated by their crop commodity organization. This is testimony to the successful dissemination model applied by SASRI, as confirmed by M. Binedell (personal communication, March 04, 2022).

5.7.3. Pseudo-Science and the Advisor

The definition of pseudo-science is "a collection of beliefs or practices mistakenly regarded as being based on scientific methods" (Oxford Languages, n.d.) and Merriam-Webster (n.d.) defines it as "a system of theories, assumptions, and methods erroneously regarded as scientific".

5.7.4. Advisors' Definition of Scientific Results

The opposite of pseudo-science is true science, and both the groups of advisors from the crop production sector and SASRI were unanimous in their acceptance of the proposed definition of true scientific results as follows: it is data generated by applying scientific principles by qualified and accredited researchers, filtered, and interpreted by qualified and accredited advisors and adapted and communicated to producers, according to their specific needs. Oxford Languages (n.d.) defines science as "the systematic study of the structure and behaviour of the physical and natural world through observation and testing of theories against the evidence obtained". All advisors also agreed that in terms of research results, any information other than what meets these criteria may be pseudo-science.

5.7.5. Advisors' Concerns Regarding Pseudo-Science

All the advisors from the crop production sector believed that pseudo-science was a serious concern towards the sustainability of the specific sector. In contrast, most SASRI advisors had no concerns (Table 5.3).

The general feeling from crop advisors is that pseudo-science is rarely backed by science and too easily accessible on the internet and social media platforms.

"Anybody can come with a new product and through social media easily spread information, with many farmers falling for it" – crop advisor. (translated from Afrikaans).

Most SASRI advisors thought that pseudo-science was not a concern in their area of crop-specific information; others had a slight concern but felt that their effectivity eliminates most pseudo-science concerns because their producers are informed and have direct access to SASRI advisors and researchers. One advisor mentioned that products were sold on presentations, not field trials or scientific research, which might deceive vulnerable producers.

"With my growers, actually, they, they always contact me if you know, there is someone else talking about the new product or those kinds of things" - SASRI extension specialist.

Table 5.3: Percentage of Advisors Concerned About Pseudo-Science Towards Sustainable Crop Production Practices

	Other crops	**SASRI**
Advisors concerned about pseudo-science towards sustainable crop production	100%	0%

5.7.6. Advice Based on Pseudo-Science and its Possible Effect on Yield and Financial Loss

In the preliminary research phase preceding this paper, it became clear that some researchers and advisors assert that many producers experience significant financial- or yield losses because of advice based on pseudo-science, often supplied by an individual or supply company at information days, on social media or any other means of marketing and that these individuals were often gifted marketing specialists. The crop advisors agreed with this statement, whereas the SASRI advisors were divided on this issue. Most had first-hand knowledge of such cases, and only two advisors claimed they did not know growers experiencing yield or financial loss.

5.7.7. The Advisor and Terms Sometimes Associated with Pseudo-Science

It is undisputed that agricultural practices are evolving at an alarming pace and that all the stakeholders in this sector have had to shift their focus towards sustainable practices. Giller *et al*. (2021) state that "a clarion call for Regenerative Agriculture swells against crisis narratives such as agriculture is in crisis, soil health is collapsing, biodiversity faces the sixth mass

extinction and crop yields are plateauing". Oxford Languages (n.d.) defines regenerative farming as "techniques and methods of land management that are designed to restore soil productivity by measures such as crop rotation, planting ground cover, protecting the surface with mulch, and reducing the input of synthetic chemicals and mechanical compaction". One has to agree that this definition qualifies as sustainable practices. Still, the problem seems to be that many other "newer and trendier" concepts such as soil health, organically produced, bio-stimulants and bio-fertigation have latched onto the term regenerative agriculture - these practices are often promoted with little regard to context (Hijbeek *et al*., 2021).

All the crop advisors reported that they had experienced a dramatic increase in terms associated with regenerative farming, such as soil health, organically produced bio-stimulants and bio-fertigation, and an increase in "expert opinions" regarding these concepts. They also confirmed that they were concerned about these terms and thought it might confuse producers. They further reported that many of the terms are 'buzzwords' that lack the proper research and experience, don't contribute to the sustainability of large-scale food production and thus could be misused by advocates of pseudo-science.

> *"I feel the people that regard themselves as experts in this regard have very little practical experience and their research is not done, or tested, on a large enough scale" – crop advisor. (Translated from Afrikaans).*

The SASRI advisors shared the same point of view and felt that many of the so-called expert opinions are not based on proper research findings and could be misleading. However, many SASRI advisors weren't concerned because they felt SASRI was equipped with the right people to disseminate the correct information.

> *"There are those type of people, but I think we still have it under control, the advisors and information that goes out to the producer" - SASRI extension specialist. (translated from Afrikaans).*

5.7.8. The Advisors' Perception on the Importance of Fields of Research

Advisors are very concerned about the possible disastrous effects of pseudo-science on disseminating scientific information and subsequent sustainable agricultural practices. Only the active involvement of the qualified advisor and scientific researcher can combat this problem, as confirmed by Hijbeek *et al*. (2021), stating that reflective engagement by research agronomists is critically important. The question is what the advisor perceives as important research and critical dissemination areas. Based on the preliminary research, eight areas of research and dissemination were identified: soil management, plant nutrition, crop protection

and pest control, regenerative farming, organic farming, bio-stimulants, foliar feeds, and technology hardware and software.

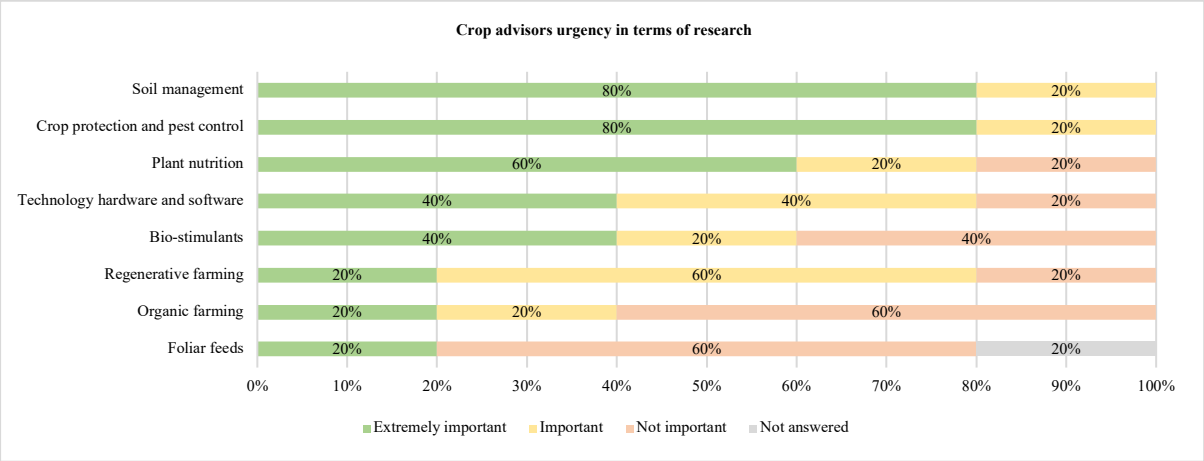

Figure 5.7: Crop Advisor's Perceptions of Areas that Require Urgent Research

Based on the mean, crop advisors felt that the most urgent research in terms of needed research is soil management and crop protection and pest control (ẋ = 2,80 respectively), with 80% of advisors rating these as extremely important. In contrast, foliar feeds were rated the least important regarding current research urgency (ẋ = 1,50), as shown in Figure 5.7.

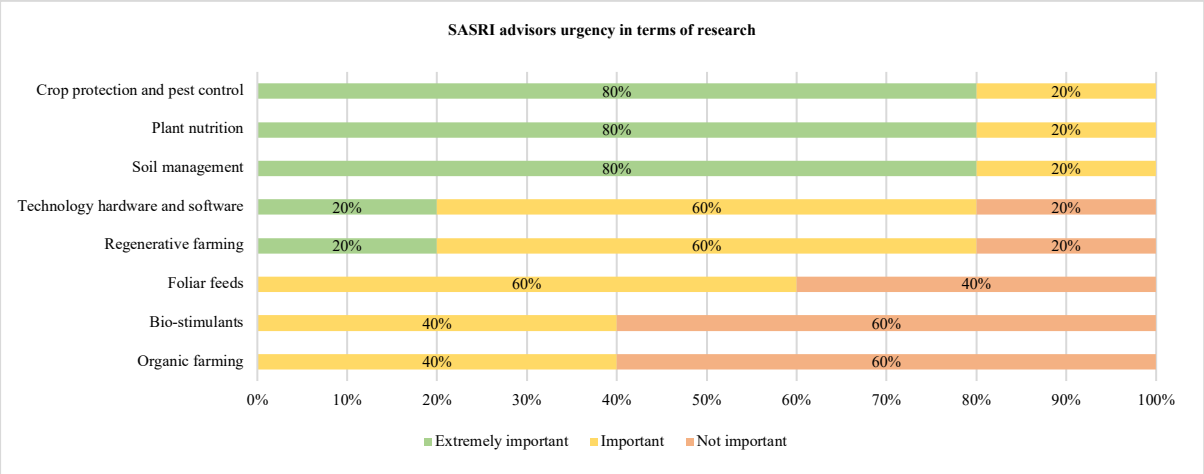

Figure 5.8: SASRI Advisors Perceptions of Areas that Require Urgent Research

Based on the mean, SASRI advisors felt that the most urgent research in advisory services is needed in crop protection and pest control (ẋ = 3,00), with all SASRI advisors rating this as extremely important. In contrast, organic farming was rated as least important regarding current research urgency (ẋ = 1,40), as shown in Figure (5.8).

Both groups of advisors regarded the "conventional" areas of soil management, crop protection, and pest control as extremely important for research. Furthermore, they regarded the "newer and trendier" concepts as less important. From the interviews, it became apparent to both groups that plant nutrition was not considered a priority but for entirely different reasons. All the advisors believed that the principles of plant nutrition were fundamental but well established and, therefore, required no urgent research at this stage.

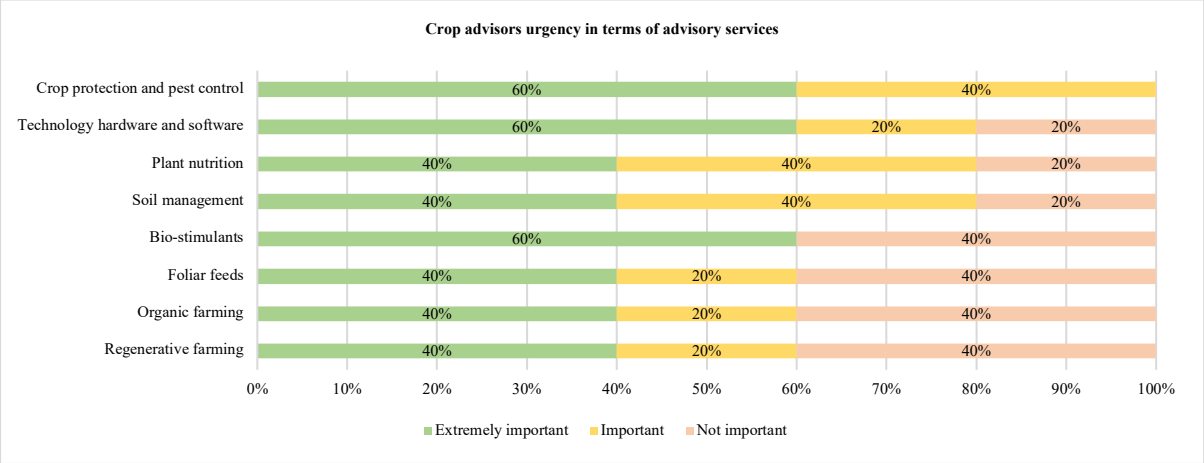

Figure 5.9: Crop Advisor's Perceptions of Areas that Require Urgent Dissemination

Based on the mean, advisors felt that the most urgent research in terms of advisory services is needed in crop protection and pest control ($\dot{x}$ = 2,60), with 60% of advisors rating this as extremely important. In contrast, regenerative farming, organic farming, bio-stimulants and foliar feeds were rated the least important (but still necessary) in terms of current research urgency ($\dot{x}$ = 2,00) (Figure 5.9).

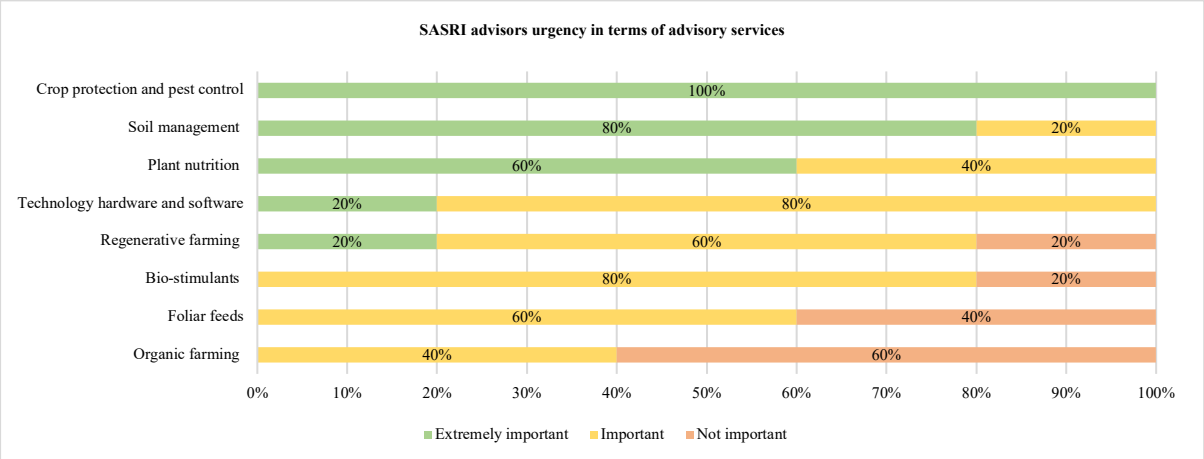

Figure 5.10: SASRI Advisors Perceptions of Areas that Require Urgent Dissemination

Based on the mean, SASRI advisors felt that the most urgent research in terms of advisory services is needed in crop protection and pest control ($\dot{x} = 3{,}00$), with all SASRI advisors rating this as extremely important, while organic farming was rated least important in terms of current research urgency ($\dot{x} = 1{,}40$), as shown in Figure 5.10.

Both groups of advisors felt that basic and scientific principles of plant nutrition remained an essential area of dissemination that should not be neglected and regarded the "newer and trendier" concepts as less important.

5.8. PERCEIVED PROBLEMS AND CONSTRAINTS OF THE CURRENT MODEL

This part of the chapter deals with the different perceptions and importance of communication between advisors, researchers and producers, the importance of feedback and the measurement of the effectiveness of respective advisors.

Communication (and linking activities) is crucial to effective dissemination, where the extension specialist and advisor play a critical role (Modirwa & Oladele, 2017).

Of the crop advisors, only three were confident that all the research results reached the intended audience. In contrast, all the SASRI advisors were confident that all their information reached the growers.

The advisors who were confident their research results reached their target population said so because they, themselves, took the information to them. Other advisors noted that time and information overload (primarily irrelevant information) prevented them from getting all their research results to their target population.

> *"Yes, well I take it to the farmers myself so, it does get to them" – crop advisor. (Translated from Afrikaans).*
>
> *"It's relatively selective, I try to only take the information specific to the cultivars, or area" – crop advisor. (Translated from Afrikaans).*

As opposed to the less-confident crop advisors, the SASRI extension specialists were all very confident about the flow of information from the researcher through the advisor to the producer, so most growers were aware of the current issues or research topics. Many advisors also mentioned that they see growers applying and adopting certain practices they have been made aware of through advisors. Monitoring adopting rates or practices by growers is extremely important and a critical key performance indicator (KPI) of advisory success.

> "*If you speak to 98% of the growers, they know about it. They know the principles behind it. It's just whether they want to apply it or not. So, I think ya, we definitely do reach our target population*"- SASRI extension specialist.

"They are applying uhm, certain research findings that we got it at, at SASRI" - SASRI extension specialist.

5.8.1. Advisors' Perception of Communication and Feedback Towards and From Researchers and Producers

Crop advisors all reported receiving regular feedback from producers (Table 5.4). This feedback is about information relayed to them earlier regarding the adoption and application of results, the practical implications and suggestions. It is mostly done personally via phone calls, WhatsApp messages and personal face-to-face interactions. Regarding whether advisors supplied the researchers with similar feedback regarding their results, only one advisor said that they worked through their in-house R&D regarding communicating with researchers. The other advisors had informal lines of communication that were sometimes utilised. However, they agreed they would be prepared to do so using a formal report if required. Only 20% of advisors received any research feedback (Table 5.4).

"I can supply them with the scientific documents. If the researcher just wants general commentary or opinion-based feedback, then it's done through written communication or verbal communication" – crop advisor.

Table 5.4 shows that SASRI advisors have excellent communication and feedback with and from both growers and researchers. All advisors mentioned that feedback from producers was done directly. There is constant communication with producers using phone calls, meetings, grower days, and personal visits. Most advisors also mentioned the importance of 'pub-talk' to get their information to those not yet reached. "Pub-talk" is an informal and social way of exchanging information and seems to be an important and effective part of the sugarcane industry's communication model. They also reported a constant channel of personal communication (phone calls and e-mail) between the advisor and the researcher. Formal means of feedback include RD&E meetings and extension reports submitted to SASRI.

Table 5.4: Advisors' Perception of Communication Towards and From Researchers and Producers

	Crop advisors		SASRI advisors	
	Yes	No	Yes	No
Feedback from target audience	100%	0%	100%	0%
Feedback from researchers	20%	60%	100%	0%
Feedback to researchers	60%	40%	100%	0%

5.8.2. Advisors Most Likely Means to Monitor Effectivity of Dissemination

Measuring the dissemination model is integral to the successful knowledge transfer process. A range of possible means of measuring effectiveness was identified during preliminary research. Some of these methods are often used for surveys and opinions. All advisors were asked to indicate the preferred means of evaluating their effectiveness if they were obliged to do so. On the one hand, the crop advisors were willing to supply or give feedback on a personal or face-to-face basis, with information days as their first choice, regional and national conferences as their second choice and WhatsApp surveys as a reluctant third (Figure 5.11).

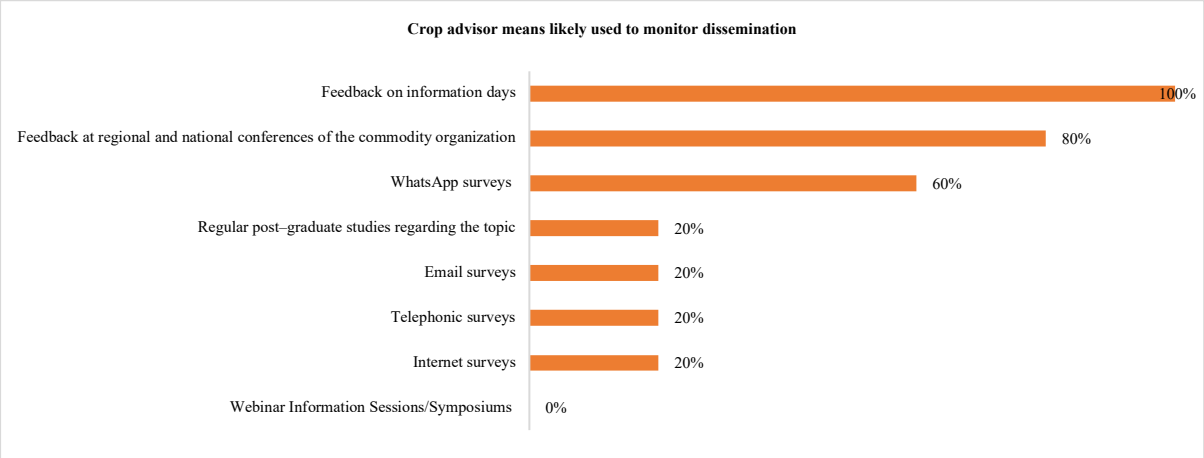

Figure 5.11: Crop Advisors Most Likely Means of Measuring Effectivity of Dissemination

The SASRI advisors, on the other hand, also showed a willingness to supply or give feedback on a personal or face-to-face basis, with information days as their first choice and e-mail surveys, WhatsApp surveys and telephonic surveys a reluctant second choice. Unlike the crop advisors, they did not regard regional and national conferences as important platforms because of SASRI's well-structured communication channels (Figure 5.12).

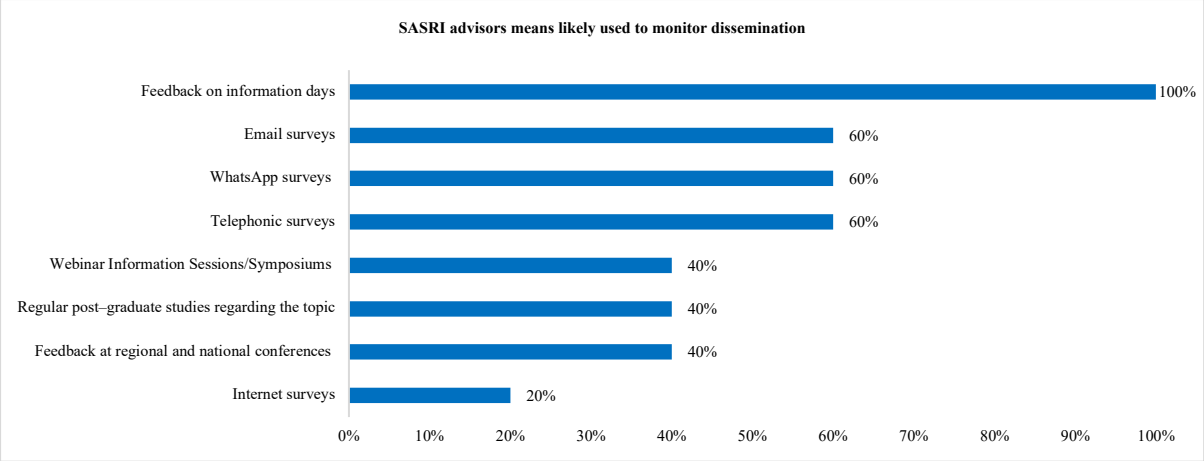

Figure 5.12: SASRI Advisors Most Likely Means of Measuring Effectivity of Dissemination

5.8.3. Advisors' Constraints Regarding Dissemination

The crop advisors reported three major constraints in their current model.

- Time and time management.
- Location (large geographical area to cover).
- Amount of information available (information overload). The issue of information overload has been discussed and is a contributing factor towards the phenomenon of pseudo-science.

The SASRI advisors reported the following major constraints in their current model.

- Time for one-on-one visits.
- Farmers are not reading the information they are given.
- Human nature (fear of change, risks, uncertainty). This impacts the adoption rate and subsequent application of new information by growers.
- Finances.

Some SASRI advisors said they did not encounter any problems getting their information to the producer.

> *"My opinion, I think we've all had the means. We've got cell phones, internet, emails, things like that. So, there's no real obstacle in getting, especially your large-scale grower" - SASRI extension specialist.*

5.9. COMMITMENT TO EFFECTIVE COMMUNICATION AND THE RELATIONSHIP WITH RESEARCHERS AND PRODUCERS

This study originated when several stakeholders raised concerns about the increasing number of "experts" accompanied by their products that appeared in agricultural magazines, some crop commodity publications and on information days. Many of these products are commonly known in agriculture as "wonder products" or "snake oils", and most of these products have been proven to have little or no effect on yield or increased production (Miles, 2019). The author formulated the narrative that there may be a breakdown in communication between researcher and producer that allowed pseudo-science to slip in and replace true science.

5.9.1. Advisors' Perception of a Possible Breakdown of Communication Between Agricultural Researchers and Producers

The crop advisors agreed that there was a definite breakdown of communication between the researcher and producer, whereas all the SASRI advisors confidently disagreed with this statement. It speaks of effective communication channels between stakeholders in the SASRI dissemination model (Table 5.5).

Table 5.5: Communication Between Researcher and Producer

There is a breakdown of communication between researcher and crop producer	**Crop advisors**	**SASRI advisors**
	Agree	Disagree

5.9.2. Advisors Preferred Directions of Communication With Target Audience

As previously discussed, Van der Ban (1987) proposed three directional models of communication:

- Top-to-bottom, where communication originated from the researcher to the advisor to the producer.
- Bottom-to-top is where communication originates from the producer to the advisor to the researcher.
- Bi-lateral is where communication starts with any stakeholders in either direction, and the advisors are pivotal in facilitating this communication.

Both groups of advisors reported good communication with producers and growers and preferred direct contact instead of going through a third person, such as a salesperson.

Most crop advisors preferred bilateral research communication and mentioned the importance of a facilitator between the producer and researcher. In addition, the 'in-house R&D' should be an additional coordinator – an important property of the SASRI model. All crop advisors had a channel with producers and regular contact through face-to-face interactions, telephone calls and WhatsApp messages. Although most crop advisors stated they had an "open line" to researchers, they admitted that communication was minimal.

> *"It should be a case of both the researcher and the producer, both communicate with the advisor; however, there should not, in my opinion, be direct communication between the researcher and the producer, as their language which they work in ... is completely different" – crop advisor.*

Most SASRI advisors also preferred the bilateral communication model with advisors in the middle. They felt that the request should go from the producer through the advisor to the researcher, and the research results should go from the research through the advisor back to the producer. That way, all the stakeholders were aware of and part of the communication. Most SASRI advisors reported that when a grower should contact the researcher directly, that researcher would usually report the conversation to the relevant advisor to ensure that all stakeholders knew about the growers' concerns. That, once again, is proof of effective channels of communication. One SASRI advisor noted that bottom-to-top is also important to keep the producers happy.

> *"I would say bottom to top, between bottom and top to bi-lateral, to be honest. But I think a lot of research, it's important that I think I mean, the grower at the end of the day- Is our customer and we need to address what they are looking for and what they want answers for. So, that's probably more important" - SASRI extension specialist.*

5.9.3. Advisors' Perception on the Importance of Accreditation

All advisors from both groups felt that the relevant regulatory bodies or authorities should accredit advisors disseminating agricultural information and that such accreditation should be compulsory. A list of these institutions was compiled during the preliminary research and includes the Fertiliser Association of South Africa (FERTASA), the Association of Veterinary and Crop Associations of South Africa (AVCASA), CropLife SA, the South African Council for Natural Scientific Professions (SACNASP) and South African Society for Agricultural Extension (SASAE) however, the perceptions from advisors regarding these different regulatory authorities and their contribution towards maintaining agriculture sustainability were very significant as shown in Table 5.6. It is important to note that the functions of

AVCASA were recently taken over by CropLife SA (Theron, 2022). The study included both names as some participants were unaware of this fact and still referred to this body as AVCASA.

Table 5.6: Advisors Rating of the Effectivity of Some Authorities in Terms of Accreditation

	Crop advisors			SASRI advisors		
	Very effective	Effective	Not effective	Very effective	Effective	Not effective
FERTASA	20%	80%	0%%	20%	60%	20%
AVCASA	40%	0%	60%	40%	60%	0%
CropLife SA	40%	40%	0%	40%	60%	0%
SACNASP	0%	20%	60%	60%	0%	40%
SASAE	0%	20%	60%	40%	40%	20%

5.9.4. Crop Advisors and Regulatory Bodies

Most crop advisors and SASRI rated FERTASA effective. The same was found in the case of CropLife SA – crop advisors rated this institution between effective and very effective. Advisors had mixed opinions about AVCASA; some rated them very effective, while others did not. This should be seen against the background that AVCASA, as such, does not exist anymore and that most participants view CropLife SA and AVCASA as the same (Table 5.6). Most advisors rated SACNASP as ineffective, and one advisor rated SASAE as ineffective. As two of the important bodies that regulate qualifications and accreditation in the scientific sector, this is a serious concern that needs to be addressed. In summary, among all the bodies mentioned in the study, CropLife SA was rated the most effective, while SACNASP was rated least effective.

5.9.5. SASRI Advisors and Regulatory Bodies

As stated above, SASRI advisors also rated FERTASA as effective. Like the crop advisors, SASRI advisors also rated CropLife SA institutions as being between effective and very effective. SASRI advisors had equal opinions about AVCASA; some rated them very effective, while others did not. Overall, they were satisfied with AVCASA. Three SASRI advisors rated SACNASP very effective, while two rated them ineffective (Table 5.6).

Two SASRI advisors rated SASAE very effective, while two rated them as effective. As two important bodies regulating qualifications and accreditation in the scientific sector, they faired better in the sugarcane industry. It may be because of SASRI's more effective employment policies, which means more advisors were accredited. In summary, all bodies received a better rating from the SASRI advisors. Once again, CropLife rated the most effective and FERTASA the least, although still rated as effective. The accreditation of SASRI advisors was better managed than that of crop advisors.

5.9.6. Commitment of Advisors Towards Effective Communication Between Researcher and Producer

Most advisors expressed their commitment towards effective communication by one or more of the following means.

5.9.7. Involvement of Producers When Collecting Data Through Participatory Research

The definition of this type of research is where designs, methods and frameworks use systematic inquiry in direct collaboration with those affected by an issue being studied for action or change (Vaughn & Jacquez, 2020). All advisors from both groups felt that it was crucial to involve producers in research, especially during the practical phase, where scientific results had to be applied and tested in practice. This may include testing of new varieties of chemicals, change of practices and many more.

> *"They (producers) must be involved, they are involved throughout the proses and aware of what we do*." *(translated from Afrikaans).*
>
> *"Whichever farm you're hosting the trial on … that grower will be heavily involved in it. And then once you've got your results back then you obviously send it out to the larger population."*

All advisors reported that most producers and growers were eager to participate in research and trials. Nettle *et al*. (2018) also found that advisors were "willing and able to respond" to increased producer demand.

5.9.8. Involvement of Researchers When Collecting Data Through Participatory Research

Most crop advisors said they experienced little or no involvement of researchers when collecting data during the processes, such as the on-farm trials after applying research results.

SASRI advisors, however, mentioned that researchers were very involved from the start of a project and that an important responsibility of an extension specialist is to ensure that the producer and the researcher are both involved in and regularly updated on the progress of on-farm application of results.

"So, we do involve the researchers.... Trial layout plan, we involve the researchers as well, collecting the data, we also involve them, ya. So, in short, yes, we do involve them."

Although both groups of advisors showed total commitment towards communication with producers, this is a significant difference between the crop advisors and the SASRI advisors and shows a lack of communication and commitment to communication towards the researcher. Furthermore, it is important to note that all the crop advisors thought producers had insufficient access to researchers to inform them of their research needs. In contrast, the SASRI advisors all felt that the growers had sufficient access to researchers. This could be a major contributor to perceptions that there may be a breakdown in communication between researchers and producers, especially in the crop production sector.

5.9.9. Involvement of a Qualified Advisor When Collecting Data Through Participatory Research

Both groups of advisors felt that it was very important to involve a qualified advisor in the layout of trials, collecting data and interpreting the collected data for subsequent validation of said results.

"They can effectively, objectively, and scientifically collect, interpret and express data" – crop advisor.

SASRI advisors said it was important to involve a qualified advisor in the layout of trails because each area is specific with its features and characteristics and, therefore, should be customed accordingly. One SASRI advisor emphasised that several variables play a role in trial results; these should be minimalised, declared, and discussed. The interpretation of the results should also be done correctly and scientifically to provide statistical significance and have some sort of scientific background to fall onto as a reference.

"(Advisors) have the local knowledge" - SASRI extension specialist. (translated from Afrikaans).

5.9.10. Most Preferred Way to Communicate Information to the Target Audience

All the advisors, without exception, indicated that their preferred way of communicating with their target audience was through direct or personal contact. All SASRI advisors preferred

direct contact with producers, ideally face-to-face, during farm visits, study groups, and farmer days. One SASRI advisor further mentioned that using several different ways of dissemination ensures a broader scope of the target population is reached.

5.9.11. Frequency of Official Information Sessions

Although all advisors regarded personal interaction with the target audience, either through personal contact or information sessions, as extremely important, the frequency of these sessions was surprisingly low and may be linked to the personality and knowledge of the individual advisor. The frequency of occurrence ranged from weekly to once a year. It must be noted that all the advisors emphasised the importance of this issue and were committed to addressing it.

5.10. SUGGESTED SOLUTIONS FROM THE ADVISORS

5.10.1. Sustainability, Dissemination Models and Measures of Effectivity (KPIs)

All crop advisors and some sugarcane extension specialists confirmed that the availability and accessibility of agricultural information on various platforms contributed largely to the issue of information overload and reported that many producers find this current situation confusing. However, all advisors think that this situation of information overload creates the ideal opportunity for pseudo-science to infiltrate scientific information and contribute to this confusion. Advocates of pseudo-science misuse this state of affairs to exploit producers for monetary gain with possibly disastrous effects on the sustainability of food production but also of agricultural and natural resources. Therefore, most advisors from both groups thought an effective and measurable dissemination model is crucial for sustainable agriculture. Crop advisors were not sure how to measure such models.

SASRI advisors felt that the best way was to monitor the implementation and adoption rates of research information. Furthermore, they believed that effective communication would close the door on pseudo-science. On the one hand, the crop advisors thought that an awareness campaign should be driven to make the agricultural sector aware of the potential dangers of pseudo-science and to assist them in combatting it. On the other hand, the SASRI advisors felt there was no need for any awareness campaign as they were confident they could advise the growers towards sustainable practices.

> "*Farming is not a lifestyle; it's a business and the business needs to be run using the correct information, effective application, and best management practises" - SASRI extension specialist. (translated from Afrikaans).*

The only way to separate science and pseudo-science is to filter through this information overload, and all advisors were confident that the only potential person or institution capable of this function would be the ethical, qualified and accredited agricultural advisor, extension specialist or any institution that employs such experts.

5.11. CONCLUSION

The crop advisors reported unsatisfactory levels of communication with researchers but were confident of their interactions with producers. The crop advisors were aware of and concerned about the dangers of pseudo-science, whereas the SASRI extension specialists were not concerned about it. They were also of the opinion that funding of research and dissemination was managed adequately by SASRI's knowledge managers and not concerned about possible manipulation of priorities or results. The crop advisors, however, felt that funding and the source thereof were problems that could influence the objectivity of researchers and advisors. All the advisors acknowledged the problem of information overload. They agreed that qualified advisors and extension specialists would be the most suitable individuals to filter through this mass of information.

CHAPTER 6: PERCEPTIONS OF KNOWLEDGE MANAGERS AND RESEARCH COORDINATORS IN THE DISSEMINATION OF RESEARCH INFORMATION

6.1. INTRODUCTION

Cambridge Dictionary (n.d.) defines knowledge management (KM) as how knowledge is organised and used within a company or the study of how to organise and use it effectively. McKeen and Staples (2001) state that "knowledge management is an emerging management function with characteristic adherence to the adage anything that can't be measured can't be managed, so organisations began the search for value directly attributable to knowledge". Abbas (2016) explains knowledge management as a discipline that promotes an integrated approach to identifying, capturing, evaluating, retrieving and sharing all information assets. These assets may include databases, documents, policies, procedures and previously un-captured expertise and experience in an individual. KM is the centre from which research and dissemination are coordinated and should not be confused with the model used for dissemination. It is an integral part of the entire information process (Beyene, 2015).

6.2. INSTITUTIONS CONDUCTING RESEARCH AND THE CONCEPT OF KNOWLEDGE MANAGEMENT

Research dissemination from three crop commodity institutions was investigated, and their perceptions were studied. Only one of these organisations, SASRI, referred to the grouping of individuals responsible for coordinating research, results and subsequent dissemination as "the knowledge management team". The participants from the other two organisations referred to their positions as " trust-fund administrators and research coordinators". The Oxford Learner's Dictionary (n.d.) defines a research coordinator as "a person who organises the different parts of an activity (in this case, research) and the people involved in it so that it works well". Unfortunately, these coordinators are not necessarily responsible for disseminating results generated by the researchers (B. Flett, personal communication, February 15, 2022). They are unlikely to be able to measure the effectiveness of relaying this information.

In contrast, the knowledge management team is also responsible for ensuring that these results reach the target audience and may be able to measure its effectiveness. This is an important difference in perception between the commodities' and SASRI's perspective on dissemination and may negatively influence communication between researcher and producer. Moreover, different types of organisations produce different sorts of knowledge. The lack of coordination between public-private agricultural research and extension institutions is often cited as one reason for ineffective knowledge transfer to farmers (Das, 2022).

6.3. DUTIES AND RESPONSIBILITIES OF THE AGRICULTURAL KNOWLEDGE MANAGEMENT TEAM

Kumar *et al*. (2017) mention the main areas of knowledge management in agriculture as follows:

- Dissemination and sharing of agricultural knowledge through value-added information.
- Information products are print, electronic, and internet-based.
- Expansion of e-resources on agricultural knowledge and information for global coverage.
- Strengthening connectivity amongst other research institutions, including public, local and international stakeholders. All the scientific knowledge generated by the scientific community (scientists and researchers) at universities, national and international agricultural research centres, extension specialists and farmers by their knowledge generated over time. This valuable and large amount of scattered information and knowledge must be integrated according to the specific requirement domain (Das, 2022).
- Promoting feedback amongst stakeholders. An important part of measuring dissemination's success is producers' adoption rate. The KM team should be connected to most stakeholders, and feedback and dialogue should be encouraged amongst knowledge users to facilitate access and understanding of scientific knowledge (Ingram *et al*., 2017).
- Capacity building for agricultural knowledge management. This empowers all the stakeholders in the dissemination chain (Kumar *et al*., 2017).

To summarise the responsibilities of the agricultural knowledge manager and the team: performing all the above-mentioned tasks ethically and scientifically to ensure that the results contribute towards sustainable agricultural practices and responsible utilisation of global natural resources.

6.4. KNOWLEDGE MANAGERS AND RESEARCH COORDINATOR DEMOGRAPHIC INFORMATION

6.4.1. Gender and Race

The knowledge managers (KMs) or research coordinators of both crop commodity organisations (CC1 & CC2) from the crop production sector were 50% female and 50% male. At the same time, the KM of SASRI was female (Table 6.1). One-half of the participants from CC1 and CC2 were black/coloured, while the other half were Caucasian/White. The SASRI knowledge manager was white.

6.4.2. Age and Years of experience as a Knowledge Manager or Research Coordinator

The age of all knowledge managers ranged from 35 to 57 years, and most respondents had more than 20 years of experience. Only one participant had less than 10 years of experience. The SASRI knowledge manager has over 20 years of experience managing all research-related topics on behalf of SASRI (Table 6.1).

6.4.3. Highest Qualification and Original Fields of Expertise

Table 6.1 shows that the qualification of the KMs ranged from a Bachelor's degree to a Master's degree to a PhD. The SASRI KM had a Master's Degree. Not all the KMs had an agricultural background. Two of the summer grains KMs held Bachelor of Arts degrees, and on SASRI's side, the respondent originally qualified in microbiology and environmental management. Apart from a basic understanding of the importance of scientific research and the dissemination thereof, an agricultural qualification is not necessarily a requirement for the position of knowledge manager.

Table 6.1: Gender, Age, Racial Group, Qualification and Experience

	CC1	CC2	SASRI
Gender			
Male	1	1	
Female	1	1	1
Age			
20 - 35		1	
36 - 45	1		
46 - 60	1	1	1
60+			
Racial groups			
African/Black		1	
Caucasian/White	2	1	1
Highest Qualification			
PhD		1	
Master's degree		1	1
Honours degree			
Bachelor's degree	2		
Years' experience			
>5 years but <10 years		1	
>10 years but <20 years		1	
>20 years	2		1

6.4.4. Current Employment of Knowledge Managers and Research Coordinators

All the KM's were currently employed. Two each by the different crop commodity organisations. The last one was a full-time employee of SASRI.

Table 6.2: Representation, Structure on Website and Group Structure

	CC1	CC2	SASRI
Representation			
Members/producers	3000	7439	1200
Website			
Staff structure on website	No	No	Yes
Group structure			
Members of a team	8	n/a	7

6.4.5. Representation, Structure on Website and Group Structure

6.4.5.1. Representation

As seen in Table 6.2, CC1 represents less than 50% of the members and producers of CC2. It is also possible that many of these members may be members of both organisations. The reason is that although these organisations have different functions, both serve similar sectors of crop production and are involved in research, development, and extension for those crop production sectors. In the commercial crop production sector, it is accepted that the area under production of a notable crop farmer is 500 hectares. Such a farmer would be considered a commercial or large-scale crop producer (Bruwer, 2021). However, a large-scale grower produces sugarcane on more than 50 hectares (M. Binedell, personal communication, March 04, 2022). It is clear that in terms of area under production, the sugarcane industry is relatively small compared to the broader summer grains sector in South Africa. It is no longer less important or profitable, and it significantly contributes to the agricultural and national economies.

6.4.5.2. Management Team Structure

It can also be seen from Table 6.2 that the teams consist of seven to eight members with responsibilities that range from researchers, administration and financial personnel and social media and marketing. The SASRI team consists of a publications officer, graphic designer, agricultural liaison officer, education coordinator (specialising in small-scale growers), librarian, knowledge product specialist and the manager coordinating all these actions.

Only SASRI's staff structure was reflected on their website. This inspires confidence in all stakeholders, who may easily identify the person to address an issue.

6.5. PERCEPTION OF RESEARCH, FUNDING AND CURRENT DISSEMINATION MODEL

6.5.1. Producers and Growers as a Source of Funding

The crop commodity organisations CC1 and CC2 had different funding sources for research. CC1's funding came from crop commodity trust funds and a research foundation, while in the case of CC2, their funding mainly came from the Department of Science and Innovation (DSI), crop commodity trust funds and a portion from a voluntary contribution made by producers. Both organisations indicated that they felt that producers should accept part of the research responsibility and pay towards research and dissemination. They also added that the ideal situation would be to incorporate the whole value chain if the contribution was made through a statutory levy.

SASRI, on the other hand, received their funding from a statutory levy paid by both growers and sugarcane millers.

6.5.2. Identifying Research Topics and Priorities

Identifying research topics and determining research priorities can be a sensitive issue that needs to be open and transparent. The three crop commodities had different opinions on how to manage this process:

- Crop commodity 1 (CC1): Timely notifications are sent to relevant and interested parties informing them about funding research projects. Project applications are forwarded to the research coordinator, and during specific meetings, projects are discussed by the Research Priority Committee (RPC) and then either accepted or declined. For crop-specific projects (only certain crops), accepted projects are then referred to an Advisory Committee and from them to the development trust. This body has the final say and decides on the application and funding. From here, it goes back to the research coordinator, who sends acceptance letters and researcher contracts. Other accepted projects are sent to a research foundation through a Technology Committee. Once all the processes are complete, the information is posted on the website and social media. Two of the requirements are that on completion of the research, a popular and scientific article needs to be published.
- Crop commodity 2 (CC2): Producers are invited to attend executive meetings twice a year to present their problems and research needs. It can also be presented in the different crop working groups (maize group, soybean-sunflower combined, sorghum group, groundnut group, winter cereals group and alternative crop group). Researchers in the field are consulted based on the topics received, and proposals are compiled with motivations, which are then forwarded to funders. Most topics are determined through economic impact or “real-time” issues.

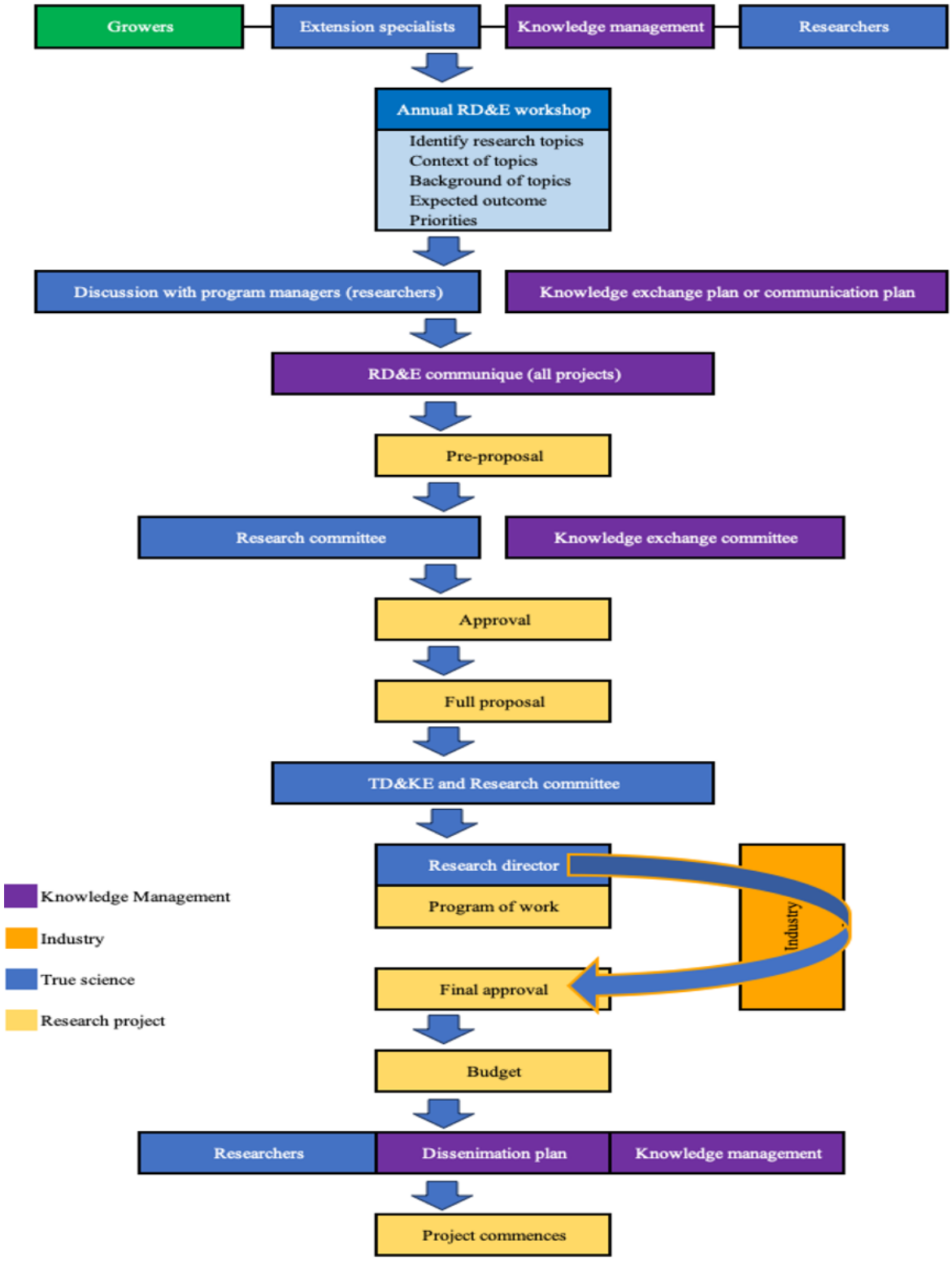

Figure 6.1: SASRI Structure of the Process of a Research Project

- SASRI has a much more refined process of dealing with research topics and related issues (Figure 6.1). The Research, Development & Extension (RD&E) workshops provide a

platform for identifying topics of concern, mainly by growers and advisors. Identified topics are discussed with programme managers and researchers. Topics already researched go into a communication plan, where they are written up in an RD&E communique sent to all interested parties. Short research proposals are written for topics that require research and taken to two committees, the Technical Development and Knowledge Exchange committees (TD and KE). Topics approved require full proposals and are again sent to TD and KE and presented by the researchers in a forum. Approved proposals go into the programme, which is collated by the research director, who then presents it to the industry. Budgets are then approved, and the remaining projects require a communication plan indicating how they plan to disseminate the information. According to M. Binedell (personal communication, March 04, 2022), the most important issue in this communication plan is the structure presented by the researcher, who the target audience is, and what steps will be taken to ensure the results reach the intended target. This implies that the dissemination plan almost gets preference before the proposal or is regarded as equally important as the actual research conducted - a critically important perspective.

6.5.3. Target Audience and Information Successfully Disseminated

Although all the respondents regarded producers, researchers and, in some cases, trainers as their target audience, it is important to note that only SASRI mentioned their extension specialists (the advisors) as part of the audience that needs to receive the research results. This shows a disregard for the crop advisor's importance in the dissemination chain and a problem that needs to be addressed. A list of current ways of transferring knowledge as presented to the participants to determine their preferences and objections towards these methods. A shortlist of methods was compiled after preliminary research was done to determine the most commonly used and thus perceived as conventional. A few modern methods (unconventional and using ICTs) of communicating were added to complete the list. Information Communication Technology (ICT) is a broader term for information technology (IT), which refers to all communication technologies, including the internet, wireless networks, cell phones, computers, software, middleware, video-conferencing, social networking, and other media applications and services enabling users to access, retrieve, store, transmit, and manipulate information in a digital form (Food and Agriculture Organisation, 2023).

The information was grouped into publications, communications, virtual, social media and e-mail. The selected methods were integrated with the knowledge managers and research coordinators' steps to ensure their target audience received the information.

Both crop commodity organisations reported that less than 50% of the research information generated in their production sector reaches the intended target audience. SASRI was confident that 80% and 100% of this information reached the target. SASRI regards the extension specialist as the most important link, which may be the main reason for the high percentage of success.

6.5.4. Steps Taken to Ensure the Target Audience Receives Information

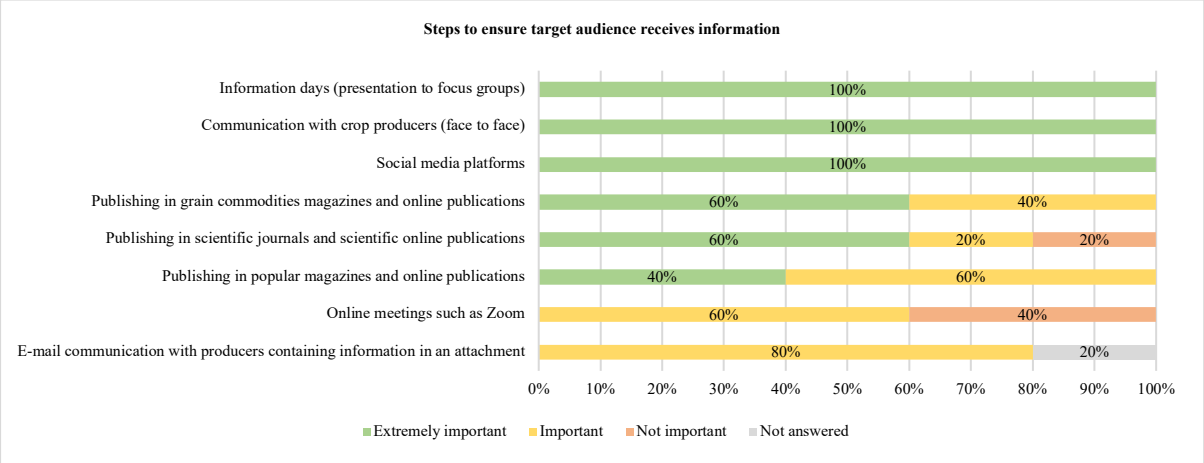

Figure 6.2: Steps Taken to Ensure the Target Audience Receives Information

As shown in Figure 6.2, and based on the mean, personal interaction such as information days, communication with crop producers and social media platforms were rated the most important to ensure information reaches the target population ($\dot{x}$ = 3,00 respectively), with all knowledge managers rating these as extremely important. In contrast, email communication was rated as least important ($\dot{x}$ = 1,60). Publishing in grain commodity magazines and scientific papers was also considered successful and important.

6.5.5. Standard of Research and Advisory Services

All the knowledge managers and research coordinators from the crop commodity organisations agreed that research in South Africa was still *on par* with other crop-producing countries. They emphasised their international interaction with countries and stakeholders involved in the production of crops under similar conditions. Some believe that research in the maize sector is on an international level but not necessarily for the other crops. SASRI researchers regard themselves to a very high standard and may even be world-leaders in specific sectors of the sugarcane industry.

About the advisory services available in the crop production sector, the respondents felt that the private sector has very experienced and knowledgeable advisors as opposed to the situation regarding public advisors. However, they raised concerns about the objectivity of the private advisors employed by supply companies who may have a monetary interest in disseminating certain results. This could be one reason they don't regard advisors as part of their target audience, resulting in a very low success rate. SASRI advisors were very knowledgeable, experienced and well-respected throughout the SASRI organisation. It is important to note that SASRI employs the SASRI advisors and should have no ulterior motive when relaying information to a grower.

6.6. OBJECTIVITY TOWARDS RESEARCH RESULTS AND SUBSEQUENT DISSEMINATION THEREOF

6.6.1. Possible Manipulation of Research Priorities and Influence of Funding on Results

SASRI and CC1 were confident that the structures and policies in place would largely prevent any manipulation of priorities. However, CC2 reported that it was a real concern and that agendas would often be pursued instead of research in the public's best interest. They also noted that in some cases, the government would fund a project with specific instructions on how the outcome should benefit a certain crop production sector.

CC1 and SASRI confidently said that all the researchers they are associated with were ethical and experienced researchers who would under no circumstances allow the source of funding to influence the outcome of a project.

6.6.2. Knowledge Management, Pseudo-Science, and Research

Both CC1 and CC2, as well as SASRI, were of the opinion that they do experience an increase of so-called expert opinions usually accompanied by products and claims to contribute towards soil health and regenerative farming, bio stimulants, organics and bio-fertigation. They were also aware of the risks accompanying pseudo-science advocates who misuse these terms to sell "wonder products" to producers. These products often have little or no scientific basis.

However, none of the respondents regarded fake-science as a notable problem. They were confident that despite a meagre success rate of dissemination in certain sectors by their own admission, producers could still distinguish between real science and pseudo-science. This is a perception not shared by the other participants, namely the researchers and advisors.

During the preliminary research, a list of research areas was compiled that included some of the newer terms sometimes associated with pseudo-science. The list randomly includes soil

management, technology hardware and software, regenerative farming, crop protection and pest control, plant nutrition, foliar feeds, bio-stimulants and organic farming. When asked to share their opinions on the importance of the topics regarding urgent research, the results showed that based on the mean, soil management was rated the most important in terms of research urgency ($\dot{x} = 2,50$), with two knowledge managers rating it important and two ratings it extremely important. Organic was rated least important regarding research urgency ($\dot{x} = 1,00$). The importance of conventional research areas was emphasised, and newer terms such as bio-stimulants and foliar feeds were approached cautiously.

6.7. PROBLEMS AND CONSTRAINTS OF THE CURRENT MODEL

6.7.1. Feedback from Target Audience, Measures of Success of Dissemination and Key Performance Indicators (KPIs)

Feedback from the target audience is the most important KPI, and all the knowledge managers agreed that they get feedback from producers and growers. CC1 explained that they have channels within their structure, such as crop-specific working groups and forum meetings where they specifically ask for feedback on information relayed. On the contrary, CC2 stated that they seldom get feedback from any of the stakeholders in that crop production sector. SASRI have well-established communication channels through growers, advisors, RD&E meetings and workshops and growers' information days. It is regarded as necessary to maintain the needed "cohesion" amongst the different role-players (Figure 6.4).

Advisors have first-hand knowledge of most producers' practices on the farm, and implementation of disseminated results is the second most important KPI. It is successfully measured by the SASRI extension specialists through the growers' adoption rate of certain practices from results generated by research.

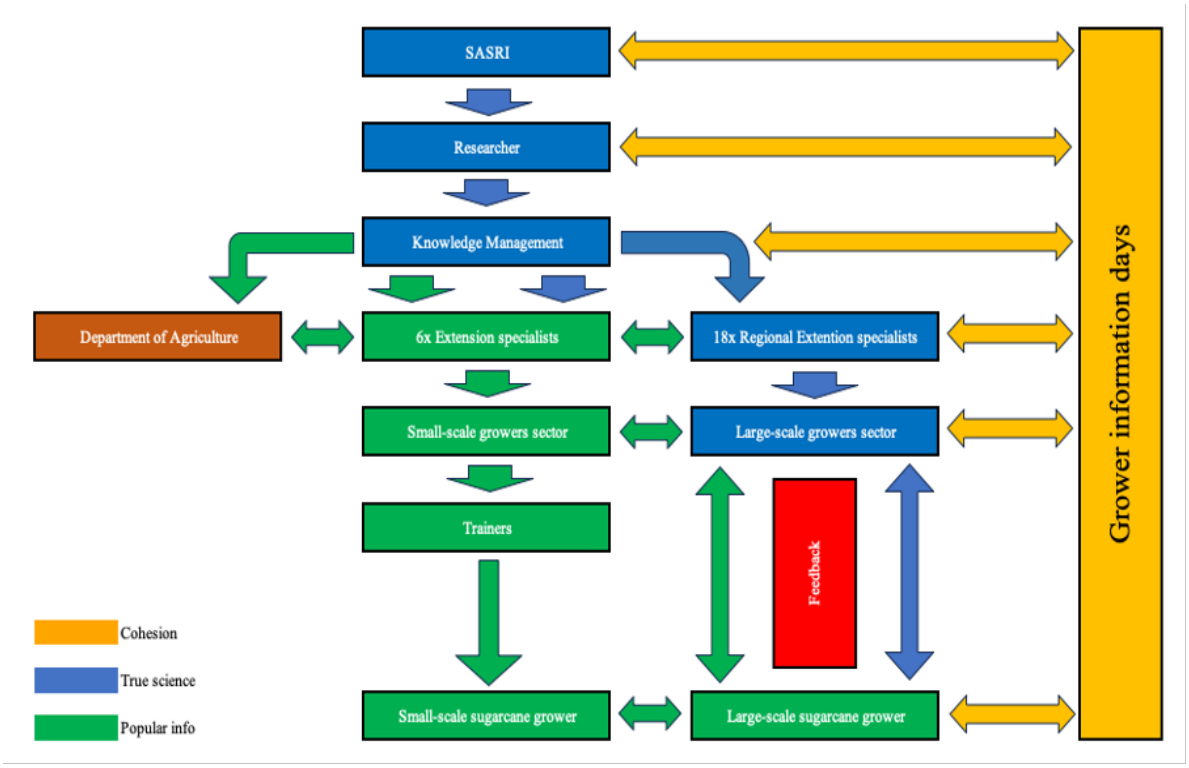

Figure 6.3: Feedback and Cohesion Between SASRI's Stakeholders

Feedback from these advisors is crucial to measure effectiveness, and both CC1 and CC2 reported very little or no feedback from advisors in the crop production sector. They further explained that they have almost no contact with advisors.

"Unfortunately we have very little contact with advisors" – CC2 research coordinator.

6.7.2. Preferred Ways of Measuring Effectivity of Dissemination

Most of the knowledge managers also agreed that their preferred way of receiving feedback from the industry would be on a personal interaction level, such as information days or national and provincial crop commodity conferences. However, the SASRI model regards feedback from advisors as even more important. The crop production sector should take note of this.

6.7.3. Current Obstacles That Prevent Effective Transferring of Knowledge

The crop commodity organisations said that time constraints were a limiting factor along with the timely transferring of knowledge when a certain problem arises in the crop sector.

They also mentioned monetary constraints along with a shortage of advisors in the crop sector.

6.8. COMMITMENT TO EFFECTIVE COMMUNICATION AND THE RELATIONSHIP WITH RESEARCHERS AND ADVISORS

6.8.1. Channels of Communication

CC1 and CC2 agreed with the statement that there seems to be a communication breakdown between the researcher and the crop producers. The SASRI point of view directly contrasts this and believes that their growers have excellent communication with their researchers.

The crop commodity organisations play a vital role in establishing general communication in that particular agricultural sector. One participant of CC1 said that they assumed the forum representatives of producers provided the producers they represent with the relevant information but had no proof of this.

When prompted about the existence of channels for communication with advisors, they all reported yes, but earlier on, they indicated that they had very little or no communication with advisors. Upon explanation, it was found they assumed that communication with agricultural businesses automatically implied contact with the broader agricultural sector and, thus, with advisors, which is not necessarily the case.

It was also stated by these two organisations that they don't provide for independent agricultural advisors or advisors attached to supply companies in their dissemination models unlike SASRI employs advisors who cooperate with advisors from supply companies.

6.8.2. Frequency of Public Knowledge Transfer

Regarding how often these institutions conduct research and organise public information sessions to address individuals, producers, growers, advisors and other stakeholders, the crop commodities replied once a year. SASRI replied that the knowledge management team would communicate with some stakeholders weekly in the dissemination chain. These are very important events and an ideal opportunity to get feedback on results and adoption rates to identify producers' research and advisory needs, and this practice should be encouraged.

6.9. SUGGESTED SOLUTIONS FROM THE KNOWLEDGE MANAGERS

6.9.1. Importance of a Measurable Dissemination Model for Sustainable Agriculture

The respondents all agreed that a measurable model was crucial to promote sustainability in agriculture. They also believed that the different commodity organisations should drive an awareness campaign to increase producers' vigilance towards true science versus pseudo-science. This campaign should investigate all possible avenues of information dissemination to get the message across. All the knowledge managers realised the importance of advisors in

the sector and recommended that advisors be targeted to get them more involved. Additional crop commodity organisation accreditation was mentioned to motivate advisors and get them involved. Producers should then be made aware of the distinction between other advisors and accredited advisors. The target audiences of research institutions should be reviewed and may extend beyond producers.

6.9.2. Information Overload

The respondents all agreed that information overload is a serious concern. Ease of accessibility complicates the quest for true science. They also agreed that one of the most frequently asked questions is not where to find the information but rather what version of information found is true science. They do realise that as knowledge managers, they have a responsibility towards the entire dissemination chain to ensure the pursuit and dissemination of nothing more and nothing less than true science. They agreed that the most suitable person to filter through this massive amount of information would be the qualified and accredited agricultural advisor and extension specialist.

6.10. CONCLUSION

The knowledge management team of SASRI is highly effective in managing the entire research process, from the identification of research needs to the stage where the results need to reach the target audience. Both the administrators and research coordinators of the crop commodity organisations (CC1 and CC2) have a satisfactory success rate regarding the research they conducted. The high success rate of the SASRI team is also the product of a designated team of experts solely responsible for a specific crop. They have an unfair “advantage” over the crop commodities where sometimes more than one commodity organisation takes responsibility for and manages a specific crop and, more often than not, even multiple crops. This situation can only complicate the knowledge management process. The responsibility of these teams and managers should be primarily to identify research topics and to ensure nothing less than true science reaches the producer. General communication to the producer in an understandable format is crucial. It is very positive that all the respondents believed that the independent and qualified advisor is suitably equipped to filter through a confusing mass of information currently available on various platforms. This may be very important for the commercial farming sector but is also consistent with the findings of a study done by Baiyegunhi, Majokweni & Ferrer (2019) on smallholder farms where it was also found that outsourced extension services or independent advisors significantly contributed towards the farmers’

financial success. SASRI places a high importance on the dissemination plan from the onset of a research project, resulting in high farm adoption and implementation rates. Despite relatively effective communication and management of the knowledge system in the crop production sectors, two important factors need urgent attention: more emphasis should be placed on a dissemination plan of generated results and increased collaboration between them, and advisors are needed continuously.

CHAPTER 7: INFERENTIAL ANALYSIS OF CERTAIN PERCEPTIONS FROM THE CROP PRODUCTION SECTOR AND THE SUGARCANE PRODUCTION SECTOR

7.1. INTRODUCTION

This study used a comparative research approach, and inferential statistics were applied to determine the categorical variables related to each other.

Different statistical methods can describe the data and enable the researcher to draw conclusions regarding the populations from which the samples are taken. Two or more samples can be compared with each other to identify potential differences and can also be used for studying the relationship between two or more variables. Such statistics are inferential statistics used to infer generalisations from the sample group that can be applied to a broader population (Marshall & Jonker, 2011). Comparison can serve as an analytical framework—a design rather than a research method. On the other hand, it is fundamentally embedded in most research methods that it can hardly be recognised as a separate method (Miri & Shahrokh, 2019). Furthermore, it is an excellent tool to find fundamental differences in structures that should produce the same results.

7.2. DEFINITIONS

The following definitions apply to the analysis:

- *Spearman's (rho) ρ.* The symbol, ρ, is a letter from the Greek alphabet and is pronounced as *rho*. Thus, Spearman's ρ, or *rho*, sometimes denoted as Spearman's rank correlation coefficient, is a non-parametric test used to measure the strength of association between two variables, where the value $r = 1$ means a perfect positive correlation and the value $r = -1$ means a perfect negative correlation (Social Science Statistics, 2023b).
- *Phi-coefficient (φ):* a measure of association for two dichotomous variables where both variables have only two exclusive responses, such as yes or no, left or right-handed. The phi-coefficient ranges form -1 to +1, with negative numbers representing negative relationships, zero representing no relationship and positive numbers representing positive relationships (Wiedmaier, 2018).
- *P-Value:* in statistics, the p-value is the probability of obtaining results at least as extreme as the observed results of a statistical hypothesis test, assuming that the null hypothesis is correct. The p-value is an alternative to rejection points to provide the smallest level of significance at which the null hypothesis would be rejected. A smaller p-value means that

there is stronger evidence in favour of the alternative hypothesis. A p-value more than the significance level (typically $p > 0.05$) is not statistically significant and indicates strong evidence for the null hypothesis (Mcleod, 2023). P-value is often used to promote credibility for studies or reports by government agencies. For example, the United States Census Bureau stipulates that any analysis with a p-value greater than 0.10 must be accompanied by a statement that the difference is not statistically different from zero. The Census Bureau also has standards stipulating which p-values are acceptable for various publications (Beers *et al*., 2023).

  - A p-value is a statistical measurement used to validate a hypothesis against observed data.
  - A p-value measures the probability of obtaining the observed results, assuming the null hypothesis is true.
  - The lower the p-value, the greater the statistical significance of the observed difference.
  - A p-value of 0.05 or lower is generally considered statistically significant.
  - P-value can serve as an alternative to, or in addition to, preselected confidence levels for hypothesis testing (Beers *et al*., 2023).
  - A p-value less than 0.05 is typically considered statistically significant, in which case the null hypothesis should be rejected. A p-value greater than 0.05 means that deviation from the null hypothesis is not statistically significant, and the null hypothesis is not rejected (Beers *et al*., 2023; Bevans, 2022).

- *Chi-square test:* a chi-square (χ^2) test of independence is a non-parametric hypothesis test. You can use it to test whether two categorical variables are related. The chi-square test of independence is an inferential statistical test that allows conclusions to be drawn about a population based on a sample. More specifically, it allows for a conclusion on whether two variables are related in the population. (Turney, 2022; Social Science Statistics, 2023a).
- *Fisher's Exact Test:* Fisher's exact test considers all the possible cell combinations that would still result in marginal frequencies. The test is exact because it uses the exact hypergeometric distribution rather than the approximate chi-square distribution to compute the p-value.

  It's appropriate to use Fisher's exact test, particularly when dealing with small counts (Bower, 2003).

7.3. RESEARCH FUNDING AND DISSEMINATION MODEL

An important research question was to determine the different agricultural dissemination models available and applied by stakeholders in certain agricultural sectors of South Africa. Key questions were the methods used and preferred by, on the one hand, the crop researchers and advisors to disseminate scientific information to their target audience and, on the other hand, SASRI's researchers and extension specialists to ensure the same result. The data was recoded into two categories: important and not important. Since there were no differences, no inferential statistics were calculated (Table 7.1). It is important to note that the respondents of both groups agreed that contact through personal interaction was their most widely used and preferred way of communication. For comparative reasons, the results of CC1 and CC2 are sometimes combined as "other crops".

Table 7.1: Ways of Disseminating Results

	SASRI	Other crops
Publishing in scientific journals and scientific online publications	60%	40%
Publishing in popular magazines and online publications	70%	70%
Publishing in grain commodities magazines and online publications	80%	80%
Communication with fellow advisors in that field	100%	100%
Communication with crop producers (face-to-face)	100%	100%
Information days (presentation to focus groups)	100%	100%
Online meetings such as Zoom	30%	50%
Social media platforms (such as *YouTube*, Apps, Facebook, and smartphone platforms such as WhatsApp groups)	100%	80%
E-mail communication with producers containing information in an attachment	90%	60%

7.4. OBJECTIVITY TOWARDS RESEARCH RESULTS AND DISSEMINATION

The effectivity of scientific dissemination severely influences the success rate with which advocates and associates of pseudo-science can penetrate the chain of information and "replace" true science.

Inferential statistics using a chi-square test of association were applied (Table 7.2) to test whether there was a difference in the concern regarding pseudo-science between the SASRI researchers and advisors and the crop researchers and advisors. The assumption for a chi-square test is that all expected counts are above 5. From the cross-tabulation in Table 7.3 below, it can be seen that not all expected counts were above 5 (highlighted in yellow); therefore, this assumption was violated. In this case, Fischer's Exact result will be interpreted instead. The

association was: *"are you of the opinion that pseudo-science is a concern in the sustainable production sector of the relevant crop?*

Table 7.2: Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.667[a]	1	0.010		
Continuity Correction[b]	4.267	1	0.039		
Likelihood Ratio	8.630	1	0.003		
Fisher's Exact Test				0.033	0.016
Linear-by-Linear Association	6.333	1	0.012		
N of Valid Cases	20				

a. 2 cells (50%) have expected count less than 5. The minimum expected count is 2.5.

b. Computed only for a 2x2 table.

Table 7.3: Cross Tabulation for the Association

			Are you of the opinion that pseudo-science is a concern in the sustainable production sector of the relevant crop?		
			Yes	No	Total
Association	SASRI	Count	5	5	10
		Expected Count	7.5	2.5	10.0
		% within Association	50.0%	50.0%	100.0%
		% within "Are you of the opinion that pseudo-science is a concern in the sustainable production sector of the relevant crop?"	33.3%	100.0%	50.0%
		% of Total	25.0%	25.0%	50.0%
	Other crops	Count	10	0	10
		Expected Count	7.5	2.5	10.0
		% within Association	100.0%	0.0%	100.0%
		% within "Are you of the opinion that pseudo-science is a concern in the sustainable production sector of the relevant crop?"	66.7%	0.0%	50.0%
		% of Total	50.0%	0.0%	50.0%
Total		Count	15	5	20
		Expected Count	15.0	5.0	20.0
		% within Association	75.0%	25.0%	100.0%
		% within Are you of the opinion that pseudo-science is a concern in the sustainable production sector of the relevant crop?	100.0%	100.0%	100.0%
		% of Total	75.0%	25.0%	100.0%

From Table 7.3, the Fisher's Exact test shows a statistically significant difference in pseudo-science concern between SASRI researchers and extension specialists and other researchers and advisors, $\rho < 0.05$. From Table 7.4, it can be seen that this is a moderate effect size, $\varphi = -0.58$, $\rho = 0.01$.

Table 7.4: Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	-0.577	0.010
	Cramer's V	0.577	0.010
N of Valid Cases		20	

Cramer's V: Cramer's V is an effect size measurement for the chi-square test of independence. It measures how strongly two categorical fields are associated.

A chi-square test of association was run to determine the difference in pseudoscience concern between SASRI researchers and advisors and other researchers and advisors. The assumption of all expected cell counts greater than five was violated; therefore, Fisher's Exact Test was interpreted. The results showed a statistically significant difference in pseudoscience concern between SASRI researchers and advisors compared to other researchers and advisors (ρ = 0,03), with a moderate effect size, φ = -0,58, ρ = 0,01. 50% of SASRI researchers and advisors were concerned about pseudoscience, while 100% of the other researchers and advisors were concerned.

7.5. PROBLEMS AND CONSTRAINTS OF THE CURRENT MODEL

Inferential statistics using a chi-square test of association were applied (Table 7.5) to test whether there was a difference in, firstly, the confidence of the crop production researchers and extension specialists regarding their results reaching the target audience (the growers) and the crop researchers and advisors confidence regarding the same matter in question and secondly, whether there was a difference between the feedback from sugarcane growers to their researchers and extension specialists and from the crop producers to their researchers and advisors. The assumption for a chi-square test is that all expected counts are above five. From the cross-tabulation in Table 7.6 below, it can be seen that not all expected counts were above five (highlighted in yellow); therefore, this assumption was violated. In this case, Fischer's Exact result will be interpreted instead.

The first association was: *"are you confident that all your research results reach the target audience?"*

Table 7.5: Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.810[a]	1	0.051		
Continuity Correction[b]	2.143	1	0.143		
Likelihood Ratio	4.070	1	0.044		
Fisher's Exact Test				0.141	0.070
Linear-by-Linear Association	3.619	1	0.057		
N of Valid Cases	20				

a. 2 cells (50%) have expected count less than 5. The minimum expected count is 3.00.

b. Computed only for a 2x2 table.

Table 7.6: Cross Tabulation for the Association

			Are you confident that all your research results reach the target population		Total
			Yes	No	
Association	SASRI	Count	9	1	10
		Expected Count	7.0	3.0	10.0
		% within Association	90.0%	10.0%	100.0%
		Are you confident that all your research results reach the target population	64.3%	16.7%	50.0%
		% of Total	45.0%	5.0%	50.0%
	Other crops	Count	5	5	10
		Expected Count	7.0	3.0	10.0
		% within Association	50.0%	50.0%	100.0%
		Are you confident that all your research results reach the target population	35.7%	83.3%	50.0%
		% of Total	25.0%	25.0%	50.0%
Total		Count	14	6	20
		Expected Count	14.0	6.0	20.0
		% within Association	70.0%	30.0%	100.0%
		Are you confident that all your research results reach the target population	100.0%	100.0%	100.0%
		% of Total	70.0%	30.0%	100.0%

From Table 7.5 above, Fisher's Exact test shows no significant statistical difference in the confidence of results reaching the target audience, $\rho > 0.05$. (The results showed significance at a 15% level).

A chi-square test of association was run to determine the difference in confidence of results reaching producers between SASRI researchers and advisors and other researchers and advisors. The assumption of all expected cell counts greater than five was violated; therefore, Fisher's Exact Test was interpreted. Although 90% of SASRI researchers and advisors were confident their results reached producers compared to 50% of other researchers and advisors, the results showed no statistically significant difference in the confidence of results reaching the target population, $\rho = 0{,}14$.

The second association was about the implementation of disseminated research results: *"do you ever get feedback from the target audience and do you ever ask?"*

Table 7.7: Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.222[a]	1	0.136		
Continuity Correction[b]	0.556	1	0.456		
Likelihood Ratio	2.995	1	0.084		
Fisher's Exact Test				0.474	0.237
Linear-by-Linear Association	2.111	1	0.146		
N of Valid Cases	20				

a. 2 cells (50%) have expected count less than 5. The minimum count expected is 1.

b. Computed only for a 2x2 table.

Table 7.8: Cross Tabulation for the Association

			Implementation of disseminated research results. Do you ever get feedback from the target population and do you ever ask?		
			Yes	No	Total
Association	SASRI	Count	10	0	10
		Expected Count	9.0	1.0	10.0
		% within Association	100.0%	0.0%	100.0%
		% within Implementation of disseminated research results. Do you ever get feedback from the target population and do you ever ask?	55.6%	0.0%	50.0%
		% of Total	50.0%	0.0%	50.0%
	Other crops	Count	8	2	10
		Expected Count	9.0	1.0	10.0
		% within Association	80.0%	20.0%	100.0%
		% within Implementation of disseminated research results. Do you ever get feedback from the target population and do you ever ask?	44.4%	100.0%	50.0%
		% of Total	40.0%	10.0%	50.0%
Total		Count	18	2	20
		Expected Count	18.0	2.0	20.0
		% within Association	90.0%	10.0%	100.0%
		% within Implementation of disseminated research results. Do you ever get feedback from the target population and do you ever ask?	100.0%	100.0%	100.0%
		% of Total	90.0%	10.0%	100.0%

From Table 7.7 and Table 7.8 above, Fisher's Exact test shows no statistically significant difference in feedback from producers, $\rho > 0{,}05$.

A chi-square test of association was run to determine the difference in producer feedback between SASRI researchers and advisors and other researchers and advisors. The assumption of all expected cell counts greater than five was violated; therefore, Fisher's Exact Test was interpreted. The results showed that there was not a statistically significant difference in producer feedback, ρ = 0,47. All SASRI researchers and advisors had producer feedback, compared to 80% of other researchers and advisors.

7.6. COMMITMENT TO EFFECTIVE COMMUNICATION

Inferential statistics using a chi-square test of association were applied (Table 7.9) to test whether there was a difference in the perception of sufficient access to researchers and extension specialists and the crop researchers and advisors. The assumption for a chi-square test is that all expected counts are above five. The cross-tabulation in Table 7.9 below shows that not all expected counts were above five (highlighted in yellow); therefore, this assumption was violated. In this case, Fischer's Exact result will be interpreted instead.

The association was: *"do you feel that crop producers and sugarcane growers, in general, have sufficient access to researchers to inform them of research needs and priorities from their perspective?"*

Table 7.9: Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	16.364[a]	1	0.000		
Continuity Correction[b]	12.929	1	0.000		
Likelihood Ratio	21.024	1	0.000		
Fisher's Exact Test				0.000	0.000
Linear-by-Linear Association	15.545	1	0.000		
N of Valid Cases	20				

a. 2 cells (50%) have expected count less than 5. The minimum expected count is 4.50.

b. Computed only for a 2x2 table.

Table 7.10: Cross Tabulation for the Association

			Do you feel that crop producers, in general, have sufficient access to researchers to inform them of research needs and priorities from the producer's perspective?		Total
			Yes	No	
Association	SASRI	Count	9	1	10
		Expected Count	4.5	5.5	10.0
		% within Association	90.0%	10.0%	100.0%
		% within Do you feel that crop producers, in general, have sufficient access to researchers to inform them of research needs and priorities from the producer's perspective?	100.0%	9.1%	50.0%
		% of Total	45.0%	5.0%	50.0%
	Other crops	Count	0	10	10
		Expected Count	4.5	5.5	10.0
		% within Association	0.0%	100.0%	100.0%
		% within Do you feel that crop producers, in general, have sufficient access to researchers to inform them of research needs and priorities from the producer's perspective?	0.0%	90.9%	50.0%
		% of Total	0.0%	50.0%	50.0%
Total		Count	9	11	20
		Expected Count	9.0	11.0	20.0
		% within Association	45.0%	55.0%	100.0%
		% within Do you feel that crop producers, in general, have sufficient access to researchers to inform them of research needs and priorities from the producer's perspective?	100.0%	100.0%	100.0%
		% of Total	45.0%	55.0%	100.0%

From Table 7.10 above, Fisher's Exact test shows that there was a statistically significant difference in perception of sufficient access to researchers between SASRI researchers and advisors and other researchers and advisors, $\rho < 0,05$. The table below shows that this is a large effect size, $\varphi = 0,91$ $\rho < 0,001$.

Table 7.11: Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	0.905	0.000
	Cramer's V	0.905	0.000
N of Valid Cases		20	

A chi-square test of association was run to determine the difference in perception of sufficient access to researchers between SASRI researchers and advisors and other researchers and advisors. The assumption of all expected cell counts greater than five was violated; therefore, Fisher's Exact Test was interpreted instead. The results showed a statistically significant difference in perception of sufficient access to researchers ($\rho < 0,001$), with a large effect size, $\varphi = 0,91$, $\rho < 0,001$. A total of 90% of SASRI researchers and advisors perceived that there was sufficient access to researchers. In contrast, no other researchers and advisors had this perception (they all felt there was insufficient access).

7.7. SUMMARY

Table 7.12: Summary of Inferential Statistics

	SASRI	**Other crops**	**Fischer's Exact Sig.**
Are you of the opinion that pseudo-science is a concern in the sustainable production sector of the relevant crop?	50%	100%	0.03
Are you confident that all your research results reach the target audience?	90%	50%	0.14
Do you ever get feedback from the target audience and do you ever ask?	100%	80%	0.47
Do you feel that crop producers, in general, have sufficient access to researchers to inform them of research needs and priorities from the producer's perspective?	100%	0%	< 0,001

7.8. CONCLUSION

The research based on a comparative approach has attempted to study the perceptions of the role-players in successful and less-successful dissemination models. The perceptions have been discussed using descriptive statistics. However, inferential statistics were applied to test the hypothesis, and four main perceptions were identified for this purpose. It is concluded that despite different opinions regarding the participants' confidence about the effectivity of their models in the information reaching the target audience, no statistically significant difference was found.

A similar result was found regarding feedback from their respective target audiences. This indicates that the models used by SASRI and the crop production sector may be regarded as equally successful in knowledge transfer and producer feedback. However, it has to be emphasised that the producer's feedback is an important KPI and should also be encouraged between the advisor and the researcher.

Pseudo-science remains a serious concern in the agricultural sector. The perception that a breakdown in communication leaves the door open for fake science to infiltrate the dissemination process was proven true. Regarding the concerns about the dangers of fake science towards sustainable production, a statistically significant difference was found between the successful SASRI model and the less successful models of the crop production sector.

Finally, when sufficient access to researchers from the side of producers was tested, a statistically significant with a large effect size was also found between the data of the crop sector where communication was insufficient versus the effective SASRI model, confirming a breakdown of communication between the researcher and the crop producer**.**

CHAPTER 8: CONCLUSION AND RECOMMENDATIONS

8.1. CONCLUSIONS

The above chapters of descriptive and inferential statistics were used to describe the data and summarise the findings in the conclusion and recommendations. The crop production sector uses a dissemination model loosely based on the bi-lateral model. In comparison to the effective SASRI model, it has many shortcomings. Most of these shortcomings can be overcome through commitment and organisational restructuring. It was further concluded that the agricultural advisor and extension specialist could establish effective communication between the agricultural researcher and crop producer.

8.1.1. Researchers

Researchers from both groups of participants represented male and female genders from the black and white population. They were well-qualified and very experienced in their respective fields of expertise, and more importantly, they researched on behalf of the institutions or organisations that formed part of this study. It is important to note that according to the perception of "a qualified researcher" from both the advisors and the knowledge managers, all the researchers were held in high esteem, well respected, and considered ethical. Their research was based on scientific (laboratory generated) and field-trial-based research – an important checkpoint when comparing true science to pseudo-science. All the researchers regarded the producers and their experience as the primary sources of research topics. Crop commodity organisations and advisors played a slightly less important role. They mostly agreed on a combination of government, private, commodity organisations, and producers to be responsible for funding. Ideally, producers and other stakeholders in the entire value chain should contribute towards research funding. It is important to note that the crop researchers had different points of view on how research priorities were determined. Most participants in the crop production sector had concerns about the source of funding and its influence on research priorities and sometimes even the results generated. Some participants claimed to have encountered such dubious outcomes before. This is an alarming scenario.

All the participants regarded themselves as objective and ethical researchers. The SASRI model has a pre-determined path through its policy regarding these issues and creates an environment that is not easily influenced by factors such as funding or the expected outcome of research. It is a transparent model where all the stakeholders can keep track of the entire process. The most important part of the abovementioned model is the pre-requirement of the dissemination plan that often precedes the project application. This implies that the SASRI model regards the

effective relaying of the results to the target audiences as equally important as the actual project and to the benefit of the other beneficiaries of such a project. The aim, after all, is not only to generate information towards more sustainable food production but also to ensure that this information reaches the end-user with a subsequent high probability of on-farm adoption. Although the researchers believe that all the available and different ways must be utilised to disseminate information, it is apparent that they mostly prefer personal interaction on an individual or group basis.

According to the perceptions collected, the SASRI participants were confident that their results reached the target audience, whereas the crop production participants were not. However, it is important to note that no statistically significant difference was found in the confidence of the crop production sector versus SASRI. The SASRI model employs the Knowledge Management Team responsible for effective communication. In a post-COVID-19 world, newer ways such as online meetings have made communication easier, less costly and safer. Although all of them agreed on these facts when it comes to transferring scientific knowledge, personal interaction was the unanimous choice. The researchers were confident that they were still relevant and had sufficient interaction with their international peers. However, they were concerned about the future of some of the institutions they were affiliated with, especially the participants employed by governmental institutions. The researchers in the crop sector had concerns about timely advice to the producer. They believed that the large-scale crop production sector was neglected in terms of advisory services. They also had concerns about the number of available and knowledgeable advisors. The SASRI researchers had no such concerns, and once again, the benefits of a structured model became evident. On the side of the crop researchers, it is clear that the effective flow of information is compromised in the absence of advisors, confirming the perception of a breakdown in communication between the researcher and crop producer. Their counterparts from SASRI disagreed with the abovementioned statement.

The dangers of pseudo-science and the terms often associated with it have been extensively discussed in this paper. It is sufficient to say that all the crop sector researchers were seriously concerned about its effect on sustainable agriculture. A statistically significant difference was noted between the SASRI and crop production respondents regarding concerns about pseudo-science. Only through a well-executed research process model can the threat be averted. The following order of importance, namely soil management, crop protection and pest control, and technology hardware and software, is how the researcher sees future important topics for continued research and dissemination. Both groups of participants were mostly of the same

view, indicating a positive trend in scientific thinking across different crop production sectors. Feedback between the SASRI role-players was very effective through the established channels in which the extension specialist played a very important role. There was very little or no feedback from producers to researchers in the crop sector, making measuring the effectiveness of dissemination very difficult. Both groups of participants regarded all the other means of measurement as important contributors to a complete picture. However, once again, preferred one-on-one or group interactions as the best way to provide and receive feedback to and from the target audience. The crop researchers expressed a desire to involve the producers and advisors in a participatory research approach that can benefit all the stakeholders. This approach is nearly impossible without proper communication, as illustrated by the SASRI model. The SASRI extension specialists must be involved whenever a project advances to the on-farm or field-trial stage. The researchers confirmed their commitment towards effective communication and dissemination not only for the transfer of generated results but also to "push pseudo-science out of the way".

A statistically significant difference with a large effect size was found between SASRI researchers and advisors and other (crop production) researchers and advisors regarding the perception of sufficient access to researchers. It confirms a breakdown of communication between crop researchers and crop producers. Researchers believe that an awareness campaign should be launched throughout the agricultural industry of South Africa and driven to create awareness about the importance of true scientific information and the dangers of pseudo-science. Researchers involved in the investigated sectors of agriculture think that the most suitable and best-equipped individual to filter through the mass of information overload, establish effective communication between producer and researcher and continuously measure the effectivity of dissemination is the qualified and preferably also the accredited advisor and extension specialist.

8.1.2. Advisors and Extension Specialists

Advisors from both groups of participants represented the male gender with representation from the black and white population. All the advisors disseminated information generated, both scientific and field-trial-based, by most of the institutions investigated in this study. The importance of this type of research in agriculture has been noted. They were all well-qualified and possessed a tertiary qualification, and most even had a post-graduate qualification. This is an important fact, and it can be concluded that they were adequately qualified to assist producers in the modern era of agriculture. Relevant qualifications should serve as the basis of

the criteria when evaluating the credibility of scientific agricultural advice. Advisors were very experienced in their respective fields of expertise and, more importantly, eager to share their knowledge and experience. It can be perceived as a willingness to share their expertise and comprehension of the desire from most agricultural sectors to improve communication and dissemination. It shows a satisfactory commitment from the advisory services.

One concern, however, is the lack of accreditation with regulatory authorities and bodies and inadequate certification with these institutions, except for AVCASA and CropLife SA. Notably, none of the SASRI extension specialists was FERTASA certified advisors – as advisors in soil management and plant nutrition, it is a situation that should be addressed. All the advisors were duly qualified from an academic point of view. Still, most of them showed little regard for accreditation with the institutions that could promote the credibility of scientific information being disseminated, such as SACNASP and SASAE.

Regarding the very important aspect of identifying research topics, like the researchers, advisors from both sectors viewed the needs of producers and topics identified through their own experience and from the crop commodity organisations as most important. The SASRI extension specialists regarded the abovementioned findings as the most important, and it could be attributed to the role that the Knowledge Management Team fulfils. Funding in the sugarcane sector is regulated, and extension specialists were not too bothered about it, however, advisors in the crop sector had limited knowledge about funding and the process used to prioritise research topics, possibly in the absence of communication with researchers and research coordinators. The crop advisors believed producers and the other stakeholders in the value chain should be liable for research funding. They further believed that the source of funding could influence the results generated, as opposed to the SASRI participants, who had full confidence in their policy regarding the research process.

Although no statistically significant difference was found in the confidence of the crop production sector versus SASRI, the SASRI extension specialists were more confident about the percentage of information that reached their target audience than the crop advisors, indicating the efficacy of their KM Team. Still, both groups overwhelmingly preferred to relay this information through personal and group interaction and stressed the importance of communication with fellow advisors in the broader agricultural sector. This is an important narrative in the context of the research objectives. It proves that despite different “newer and more-advanced” methods of communication, researchers as well as advisors still preferred conventional ways of communication, even more so when communicating science. The crop advisors were unsure about the standard of research and advisory services in South Africa. On

the other hand, the SASRI advisors were confident about both issues, which shows in their opinion of the researchers and their abilities. Although some crop advisors were affiliated with supply companies and others were independent, both groups showed high objectivity and integrity. However, the study indicates that independent advisors with no affiliation to a supply company were regarded as more objective.

The sugarcane research, advisory and production sector is regarded as a world leader. Feedback and the adoption rate of transferred knowledge are crucial elements and tools for measuring a dissemination model's success. The SASRI extension specialists utilise both these measurements on a continuous basis, and the crop advisors should follow this example. Feedback from both target audiences was good, but not so in the case of input to and from researchers in the crop sector where communication between advisor and researcher was not sufficient. Importantly, feedback from producers and growers to advisors and extension specialists seems equally effective, as no statistically significant difference was found between the crop advisors and SASRI extension specialists.

Pseudo-science and its potentially devastating effect on sustainable agriculture have been discussed extensively in this paper. It is sufficient to say that the extension specialists who are part of a well-structured model have very little or no concerns about fake science. It is concluded that in the absence of such a structure, pseudo-science is a reality, a serious concern and the unfortunate result of a breakdown in communication between researcher and producer. A statistically significant difference was noted between the SASRI and crop production respondents regarding concerns about pseudo-science. It emphasises the importance of effective communication from the advisor to the producer. As with researchers, advisors in South Africa still regard the most basic concepts of sustainable plant production, namely soil management, plant nutrition, crop protection, and technological development, as important areas of continued research and dissemination. Without disregarding crop protection, soil management and plant nutrition are two of the main pillars of sustainable crop production, and the advisors' perception shows a commitment towards sustainable practices.

Advisors prefer the bi-lateral model of dissemination, where information flows both ways to and from the researcher and producer but mainly through the advisor and extension specialist, as indicated in Figure 2.4. Participatory research with the involvement of both the producer and the qualified advisor seems to be important to all advisors. It is noted that the SASRI advisors also include the researchers, but as most of the crop researchers and advisors are not necessarily employed by the same institution, it might be an unrealistic expectation. A statistically significant difference with a large effect size was found between SASRI

researchers and advisors and other (crop production) researchers and advisors regarding the perception of sufficient access to researchers. It confirms a breakdown of communication between crop researchers and crop producers.

Advisors and extension specialists believe that an awareness campaign should be launched throughout South Africa's agricultural industry to create awareness about the importance of true scientific information and the dangers of pseudo-science. Advisors involved in the investigated sectors of agriculture are also of the opinion that the most suitable and best-equipped individual to filter through the mass of information overload, establish effective communication between producer and researcher and measure the effectivity of dissemination continuously is the qualified and preferably also the accredited, advisor and extension specialist.

8.1.3. Knowledge Managers and Research Coordinators

The participants from the crop commodity organisations SASRI, Crop Commodity Organization 1 (CC1) and Crop Commodity Organisation 2 (CC2) represented both genders from the black, coloured, and white racial groupings and varied from younger to older individuals. Except for the younger participant, the rest were very experienced in research coordination and knowledge management, and their opinions were therefore much valued. The participants were highly qualified, including two Master's degrees and a PhD, mostly in an unrelated field. Knowledge management and research is a management function, and a relevant qualification could be an added benefit but should not be a requirement. The teams seem to function most effectively, with seven to eight members covering all functions from administration to execution. Part of these committees or teams' responsibilities is the management of funds for research, which is extensively covered in Chapter 7, but most important is the fact that although only SASRI has access to funds through a statutory levy from growers, both CC1 and CC2 expressed the opinion that funds should derive from the entire value chain.

These participants all shared the same definition of their target audiences, but only SASRI mentioned advisors and extension specialists as part of the target audience. This is a notable difference of perception as disregarding the advisor's role in the importance of effective dissemination could be the origin of a communication breakdown between researcher and producer. A very interesting conclusion is the one where all the participants indicated that they also preferred personal interaction on an individual or group basis to transfer knowledge – a significant perception seen against the background that these KMs and coordinators use all

available methods (inclusive of most ICTs) of transferring knowledge. They have, however, concluded that a combination of all methods remains the most effective.

The standard of researchers and advisors is high and comparable with other crop-producing countries in the world; however, concern was also raised about the objectivity of supply-company advisors. The SASRI research process eliminates the possible manipulation of priorities, funding, and research outcomes. Although they experience an increase in opinions and terms often associated with pseudo-science, the crop commodities research coordinators believe that it is not a serious concern. This is in contrast with the opinions of the researchers and advisors in the same sector and could result from ineffective communication between coordinators, researchers, and advisors. Channels and forums for feedback as an important KPI existed within two investigated organisations. CC2 admitted that feedback is seldom received, which should be addressed urgently. CC1 and CC2 admitted to a breakdown of communication between the researcher and producer.

It was concluded that more involvement from other research institutions, especially universities, was desired across the board. More frequent collaboration was required regarding research and dissemination. A statistically significant difference with a large effect size was found regarding the perception of sufficient access to researchers between SASRI researchers and advisors and other (crop production) researchers and advisors. It confirms a breakdown of communication between crop researchers and crop producers.

Knowledge managers and research coordinators are also of the opinion that an awareness campaign should be launched throughout the agricultural industry of South Africa and driven to create awareness about the importance of true scientific information. These participants involved in the investigated sectors of agriculture are also of the opinion that the most suitable and best-equipped individual to filter through the mass of information overload, establish effective communication between producer and researcher and measure the effectivity of dissemination continuously is the qualified, and preferably also the accredited, advisor and extension specialist.

8.2. RECOMMENDATIONS

This study has investigated and compared different perceptions of researchers, advisors, knowledge management and research coordinators to identify the reasons for a possible breakdown of communication between the agricultural researcher and the producer. Furthermore, it was found that the qualified advisor and extension specialist could establish effective communication in this void.

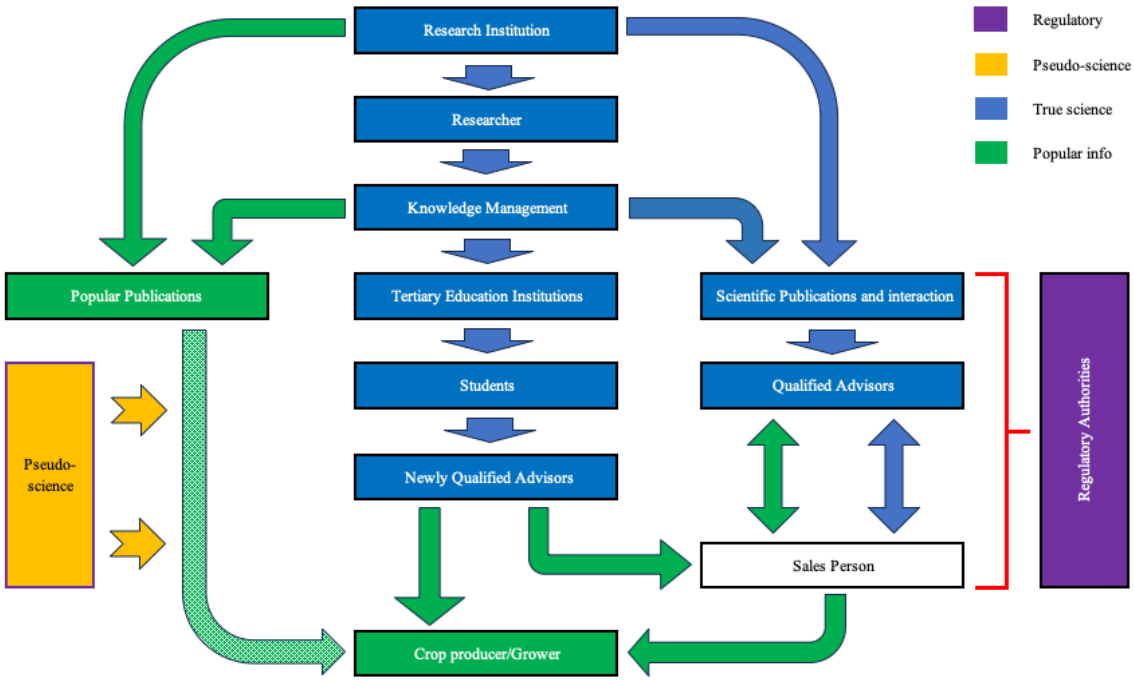

Figure 8.1: The Recommended Flow of Scientific and Popular Knowledge

Figure 8.1 displays a basic suggested model of the flow of scientific information and popular information from the researcher through the various stakeholders of knowledge transfer to the producer. The term "popular information" refers to information associated with articles in popular commodity or agricultural sector-published magazines, inclusive of crop commodity publications. These articles mostly contain scientific data to a certain extent in a readable and understandable language for scientists and non-scientists, such as producers and other stakeholders in the value chain and are sometimes published or disseminated directly by the institute towards the popular publications or, ideally, the knowledge managers. They must evaluate and convert science into a comprehensible language to find the shortest way to the crop producer. The "perforated" nature of these arrows illustrates the probability of fake science's penetration of popular information during this process and will be difficult to control. Scientific information generated by the research institution flows from the researcher in two ways: sometimes directly to the qualified advisor using a scientific publication or, ideally, through the knowledge management team. Both role-players must evaluate and convert science into a more practical language that may be shared with sales personnel producers, where applicable. The importance of bilateral communication between sales personnel and advisors is illustrated by the double-pointed arrows indicating both scientific and popular information.

The solid nature of the blue arrow shows the resistance against infiltration by pseudo-science. Regulatory authorities and those that offer certification and accreditation (on the far right of Figure 8.1) must be the "guardians" of publications, advisors, and sales personnel to maintain the integrity of true science dissemination. This can be done through supporting renewed awareness campaigns and continued renewed accreditation.

Research must be a combination of science (laboratory generated) and field-trial based (where needed) with the involvement of a qualified (and accredited advisor or extension specialist). This, together with publications in reputable scientific journals, should be some of the "check boxes" in identifying true science. The author and the associated institution are also very important.

Participatory research must be encouraged despite its challenges and constraints. This practice will improve the levels of communication between the producer, the advisor and the researcher.

8.2.1. Crop Production Sector

Communication between researchers, coordinators and advisors needs urgent attention.

A Knowledge management concept similar to SASRI's model should be implemented. This body or committee should undertake the entire process from identifying the research topic, prioritising research, funding application, application from researchers, offers sent out to researchers, and responsibility. Although many of these functions are already covered by the current administrators and coordinators, more emphasis should be placed on disseminating the results and interacting with advisory services, which will ultimately interact with the target audience. The dissemination plan should be regarded as important as the research project.

Following the SASRI model, the project proposal should include a detailed dissemination plan.

Adoption and implementation should always be the primary focus of research results.

Implementing KPIs is crucial for continuously measuring the effectiveness and adoption of new technologies and information. Feedback loops should be designed to incorporate all the interested and affected parties, and the knowledge managers must implement measures to ensure feedback becomes an integral part of everyday communication. A practical example could be to motivate advisors to allocate a short discussion about feedback during one-on-one or group interactions such as information days, regional meetings and presentations to study groups. Adoption rates amongst producers are another important KPI, and advisors should be trained to discuss adoption rates with their target audiences and communicate these issues with the knowledge managers. Promotion of the move towards adoption rate and results-related advisory services must be encouraged.

Closer collaboration between the knowledge management teams of institutions that conduct research will become increasingly more critical, especially with academic institutions.

Academic institutions should also consider a similar concept of knowledge management, which must develop the capacity to not only interact with other knowledge managers in certain production sectors but also reach out to advisors from those sectors and create a more comprehensive network of dissemination of the important research conducted by universities. Universities must accept greater responsibility towards knowledge transfer.

Research institutions may consider incentives of accreditation to advisors and extension specialists. Training programmes should be designed to update advisors with the latest results and developments and be accredited by this institution to enhance the advisors' credibility toward the "trusted advisor" concept. A system must be designed where accreditation should be linked to regular updates through training. Accredited advisors should first have access to new research results to enable them to distinguish themselves as trusted advisors. Certified advisors and extension specialists must be subjected to a "code of ethics" to promote true science and sustainable agricultural practices. The future will call for more independent advisors and extension specialists where certification and accreditation with a "code of ethics" will mitigate the effects of pseudo-science.

Lastly, face-to-face and group interactions with the target audience are still, and overwhelmingly so, the most preferred and effective means of knowledge transfer and a post-COVID-19 reinvention strategy should be encouraged. Complementing personal interaction with other channels such as ICT, magazines and social media is important.

8.3. LIMITATIONS OF THE STUDY

The widespread use of comparison can easily create the impression that this method is a firmly established, smooth and unproblematic mode of analysis. Yet, comparison is quite a demanding method and strategy that requires reflection and careful consideration (Azarian, 2011).

One limitation is the number of cases. Although three models of dissemination were investigated, two of those models had to be "combined into one" and be accepted as representative of the crop production sector to allow for the testing of the hypotheses where one, a less successful model (crop sector), could be compared with two, a successful model (SASRI). This study could only allow two models for comparison.

A second limitation was the length of the questionnaires and, especially, the semi-structured interview schedules. The schedules covered too many sections with too many questions. Once the research aim was formulated, thorough preliminary research was done to compile the

research objectives and identify the participants. The final study is based on the participants' perceptions, and to cover most of the relevant issues that emerged from the preliminary research, the interviews were time-consuming and took much longer than anticipated. It must be noted that the participants' responses were overwhelmingly positive and extremely eager to share their perceptions. This was the main reason most interviews took much longer, resulting in an enormous amount of qualitative data that had to be transcribed and analysed. For future research on this topic, it is suggested that shorter, quantitative questionnaires be sent out to a larger sample of the target population, especially if the study's objective is to formulate preferences and suggestions only.

The third limitation of this comparative study was that there may be other stakeholders in the dissemination chain who could make important contributions towards the effectiveness of dissemination. One such example is the omission of more advisors employed by the agricultural supply companies, who may mostly be ethical and experienced extension specialists. Producers rely heavily on their advice even though they may have an added monetary motivation. Another example is the ethical and experienced private advisor. This study could only allow for a certain percentage of respondents who fall into these categories. For future research, it is suggested that advisors who fall into different categories be separated in the study and not be combined.

The researcher who conducted this study is an agronomist with ties to a successful agricultural supply company and is confronted almost daily by advocates of pseudo-science accompanied by their products. These individuals are eager to use established and trusted channels of dissemination of this reputable company and its trusted advisors to sell their products and, in that way, “earn” endorsement for their products. The researcher may be biased towards more traditional and science-based approaches to crop production, and the reader may believe that the researcher is opposed to newer approaches such as regenerative farming, organic products, bio-fertigation, foliar fertigation, bio-stimulants and nanotechnology, to name a few. This is not the case. Although the researcher acknowledges these concepts, it is an undisputed fact that advocates of pseudo-science often misuse these concepts to promote their products. Many of these products are developed with no scientific basis or research whatsoever.

Time and costs were other limiting factors. Not only did the researcher find this study overly time-consuming, but it was also a challenge to arrange suitable dates and times for interviews with the participants. For future similar research, it is suggested that the researcher schedules the interviews over a more extended period.

Lastly, a vast amount of local and international research has been done on dissemination in the small-scale farming sector. Reputable researchers have published many documents. However, it is quite a different situation in the large-scale or commercial crop production sector. Although the researcher found sufficient literature regarding the international scenario, the same cannot be said about the local large-scale crop production sector. It appears that research into dissemination in the large-scale production sector has been neglected over the past decade or longer. Dissemination must keep up with the rapid pace at which technology is evolving, and it is suggested that more frequent research be done to adapt agricultural dissemination models in a timely manner. Sustainable food production and effective transfer are at stake, and the effective transfer of scientific knowledge must be non-negotiable.

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LIST OF APPENDICES

APPENDIX A: INTERVIEW SCHEDULES (KNOWLEDGE MANAGERS)

evasys	ESTABLISHING EFFECTIVE COMMUNICATION BETWEEN THE AGRICULTURAL	evasys

University of the Free State — Pieter Willem Bruwer

Department for Sustainable Food Systems and Development — Interview Schedule for Knowledge managers/Research co-ordinators

Mark as shown: ☐ ☒ ☐ ☐ ☐ Please use a ball-point pen or a thin felt tip. This form will be processed automatically.

Correction: ☐ ■ ☐ ☒ ☐ Please follow the examples shown on the left hand side to help optimize the reading results.

1. OFFICE USE ONLY

1.1 Questionnaire Number:

2. DEMOGRAPHIC INFORMATION

2.1 Gender
☐ Female ☐ Male

2.2 Age
☐ 20 - 35 ☐ 36 - 45 ☐ 46 - 60
☐ 60+

2.3 Racial group
☐ Caucasian/White ☐ African/Black ☐ Indian
☐ Mixed Ancestry/Coloured

2.4 What is your highest level of qualification?
☐ PhD ☐ Masters degree ☐ Honors degree
☐ Bachelor's degree ☐ University of Technology degree ☐ Tertiary diploma

2.5 How long have you been a knowledge manager/research coordinator?
☐ Less than 5 years ☐ More than 5 years, but less than 10 years ☐ More than 10 years, but less than 20 years
☐ More than 20 years

2.6 What is/are your field/s of expertise?

2.7 Current employment
☐ Permanently employed ☐ Private consultant ☐ Part time employed and private capacity

2.8 Are you permanently employed by one of the following organizations?
☐ South African Sugar Cane Research Institute (SASRI) ☐ Grain South Africa (Grain SA) ☐ Oil and Protein Seeds Development Trust/Oilseeds Advisory Committee (OPDT/OAC)
☐ Protein Research Foundation (PRF) ☐ Agricultural Research Council (ARC) ☐ None of the above

2.9 How many commercial producers does your organization represent and total area of production?

2.10 How many small-scale producers does your organization represent and total area of production?

2. DEMOGRAPHIC INFORMATION [Continue]

2.11 How many members are in your team and what are their responsibilities?

2.12 To whom do you report to?

2.13 Is your staff structure reflected on your website?

☐ Yes ☐ No

3. RESEARCH, FUNDING AND DISSEMINATION MODEL

This section is about scientific research results and effectivity of dissemination in the large-scale (commercial) farming sector. The institutions covered are the relevant crop commodity organizations and some supply companies.

3.1 Does your organization receive any funding from producers, statutory or otherwise?

☐ Yes ☐ No

3.2 Do you believe producers should pay a levy towards research, development and extension?

☐ Yes ☐ No

3.3 Funding for research: where does most of your funding for research come from?

3.4 Please explain the process from identifying a research topic to priority to proposal to funding to disseminating:

3.5 Who do you regard as your target population for your research results?

☐ Producers ☐ Advisors ☐ Researchers
☐ Trainers ☐ Technical staff ☐ Other

3.6 If other to question 3.10, please specify:

There are different ways to ensure that research results reach the target population. Once you have obtained results what are the steps taken by you to ensure that the target population receives the information?

		Not important	Important	Extremely important
3.7	Publishing in scientific journals and scientific online publications	☐	☐	☐
3.8	Publishing in popular magazines and online publications	☐	☐	☐

3. RESEARCH, FUNDING AND DISSEMINATION MODEL [Continue]

3.9	Publishing in grain commodities magazines and online publications	☐	☐	☐
3.10	Communication with crop producers (face to face)	☐	☐	☐
3.11	Information days (presentation to focus groups)	☐	☐	☐
3.12	Online meetings such as Zoom	☐	☐	☐
3.13	Social media platforms (such as You-tube, Apps, Facebook, and smartphone platforms such as WhatsApp groups)	☐	☐	☐
3.14	E-mail communication with producers containing information in an attachment	☐	☐	☐

3.15 Do you think that agricultural research, in the soya and maize sector *(select the relevant crop)* in South Africa is *on par* with the rest of the major crop producing countries in the world?

☐ Yes ☐ No

3.16 Please motivate your answer to question 3.23 in a few words

3.17 Do you think that agricultural advisors, in the soya and maize sector *(select the relevant crop)* in South Africa are *on par* with the rest of the major crop producing countries in the world? Please motivate in a few words.

3.18 In general and on average, how much of the results generated your organization reaches the producer?

☐ 81 – 100% ☐ 51 – 80% ☐ 21 – 50%
☐ Less than 20% ☐ Don't know

3.19 Possible manipulation of research priorities. Do you believe it is a major problem? What measures do you have in place to limit this problem, if it exists?

3.20 Do you think that the source of funding can have an influence on the researcher and the results generated? Explain why.

4. OBJECTIVITY TOWARDS RESEARCH RESULTS AND DISSEMINATION THEREOF

This section is about the researcher's perception of scientific research results, factors that may influence objectivity and the possible concerns about pseudo-science and its effect on sustainable agriculture. The definition of pseudo-science is "a collection of beliefs or practices mistakenly regarded as being based on scientific methods".

4.1 Do you agree with the following statement: In South Africa, the large-scale crop producer is neglected in terms of advisory services?

☐ Yes, I agree ☐ No, I disagree ☐ Don't know

4. OBJECTIVITY TOWARDS RESEARCH RESULTS AND DISSEMINATION THEREOF [Continue]

4.2 Are you of the opinion that pseudo-science is a concern in the sustainable production sector of the relevant crop? *(sugar cane, soya or maize).*

☐ Yes ☐ No ☐ Not sure

4.3 If you think it is a problem, explain the reasons why you think so.
Just a reminder. The definition of pseudo-science is "a collection of beliefs or practices mistakenly regarded as being based on scientific methods".

4.4 In terms of sustainability, do you experience an increase of so-called expert opinions accompanied by products that claim to contribute towards practices such as soil health, regenerative farming, organically produced, bio-stimulants and bio-fertigation?

☐ Yes ☐ No

4.5 Are you concerned about it?

☐ Yes ☐ No

4.6 What are your concerns, if you have any?

In terms of research: what field of agriculture currently needs the most urgent research and sharing of these results?

		Not important	Important	Extremely important
4.7	Soil management	☐	☐	☐
4.8	Plant nutrition	☐	☐	☐
4.9	Crop protection and pest control	☐	☐	☐
4.10	Regenerative farming	☐	☐	☐
4.11	Organic farming	☐	☐	☐
4.12	Bio-stimulants	☐	☐	☐
4.13	Foliar feeds	☐	☐	☐
4.14	Technology hardware and software	☐	☐	☐

5. PROBLEMS AND CONSTRAINTS OF THE CURRENT MODEL

This section focuses on problems and constraints currently experienced by researchers conducting research, the dissemination of research results and feedback from the target population. Definitions: Key Performance Indicators (KPI): KPI's refer to a set of quantifiable measurements used to gauge a model's long-term performance.

5.1 Earlier on you indicated that a certain percentage of results reach the producer. Are you confident that all your research results reach the target population?

☐ Yes ☐ No

5.2 Please motivate your answer to question 5.1:

5. PROBLEMS AND CONSTRAINTS OF THE CURRENT MODEL [Continue]

5.3 Let's discuss key performance indicators (KPI) – measures of success of communication and the importance thereof. Do you have any suggestions towards the implementation of effective KPI's?

5.4 Implementation of disseminated research results. Do you ever get feedback from producers and do you ever ask?
☐ Yes ☐ No ☐ I never ask

5.5 If you get feedback from the producer, explain how it happens

5.6 Implementation of disseminated research results. Do you ever get feedback from advisors and do you ever ask?
☐ Yes ☐ No ☐ I never ask

5.7 If you get feedback from the advisor, explain how it happens

5.8 In case you answered no to questions 5.4 and 5.6, how do you know if the results of your hard work even reach the target?
☐ I don't know ☐ I do know

5.9 Please explain your reasons:

If you agree that the effectivity of dissemination should be monitored, select the means that you would most likely support in doing so.

		Not important	Important	Extremely important
5.10	Internet surveys	☐	☐	☐
5.11	Telephonic surveys	☐	☐	☐
5.12	WhatsApp surveys	☐	☐	☐
5.13	Email surveys	☐	☐	☐
5.14	Feedback on information days	☐	☐	☐
5.15	Feedback at regional and national conferences of the commodity organization	☐	☐	☐
5.16	Regular post–graduate studies regarding the topic	☐	☐	☐
5.17	Webinar information sessions/symposiums	☐	☐	☐

5. PROBLEMS AND CONSTRAINTS OF THE CURRENT MODEL [Continue]

5.18 Name your biggest obstacles in getting the information out there to the producer?

6. COMMITMENT TO EFFECTIVE COMMUNICATION AND THE RELATIONSHIP WITH ADVISORS AND PRODUCERS

This section attempts to determine the researcher's perceptions of communication and information dissemination. It also attempts to establish the current relationship between the researcher, advisors, and producers.

6.1 There seems to be a perception that there is a breakdown of communication between researcher and crop producer? What is your opinion about this?

☐ I agree ☐ I disagree ☐ Not sure

6.2 Is there an existing channel of communication between you as the crop commodity organization and the producer/s regarding their specific needs for increased production?

☐ Yes ☐ No

6.3 If yes to question 6.4, please describe this channel of communication.

6.4 Is there an existing channel of communication between you as the crop commodity organization and the agricultural advisor regarding their identified needs for increased production?

☐ Yes ☐ No

6.5 If yes to question 6.6, please describe this channel of communication.

6.6 Describe your perception of a qualified and accredited researcher in the agricultural sector.

6.7 To what extent do you as a knowledge manager involve independent advisors when disseminating research results? *(reference to their involvement in working groups)*

6.8 To what extent do you as a knowledge manager involve advisors from supply companies when disseminating research results? *(reference to their involvement in working groups).*

6. COMMITMENT TO EFFECTIVE COMMUNICATION AND THE RELATIONSHIP WITH ADVISORS AND PRODUCERS [Continue]

6.9 Do you feel that crop producers, in general, have sufficient access to researchers to inform them of research needs and priorities from the producer's perspective?

☐ Yes ☐ No

6.10 How often does your institution that initiated the research, organize information sessions, to address individuals, groups of advisors, producers, or other stakeholders in the dissemination chain, to present them with the latest trends and scientific research results (Online or face-to-face)?

☐ Never ☐ Once a year ☐ 2-4 times a year
☐ Monthly ☐ Weekly

7. SUGGESTED SOLUTIONS

This section is about obtaining suggestions as to which of the current practices or principles can be eliminated, what can be done to improve communication between the producer and the researcher and who should be responsible for these actions.

7.1 Are you of the opinion that an effective and measurable dissemination model is crucial for sustainable agriculture?

☐ Yes ☐ No

7.2 Please explain:

7.3 Do you think that this specific agricultural sector namely soybeans and maize *(choose the appropriate one)* needs to drive a campaign to create an awareness amongst all stakeholders about the importance of effective communication between researchers and producers?

☐ Yes ☐ No

7.4 Any suggestions on how such a campaign should be approached?

7.5 Earlier in the interview we discussed pseudo-science and your opinion about it. Can you relate to the fact that many producers complain about an information overload generated by both science and pseudo-science.

☐ Yes ☐ No

7.6 In your opinion, who would be most suitable to filter this overload and relay only the relevant information and results to a producer and his/her specific needs? In other words, who would be best qualified to establish effective communication between the researcher and the producer?

☐ All advisors ☐ Qualified and accredited advisors ☐ Salespersons

7.7 Should advisors in the agricultural sector of South Africa be subjected to compulsory accreditation with relevant regulatory authorities?

☐ Yes, definitely ☐ Yes ☐ No

Thank you for your time and participation

APPENDIX B: INTERVIEW SCHEDULES (RESEARCHERS)

evasys	ESTABLISHING EFFECTIVE COMMUNICATION BETWEEN THE AGRICULTURAL	evasys
University of the Free State	Pieter Willem Bruwer	
Department for Sustainable Food Systems and Development	Interview Schedule for Researchers	

Mark as shown: ☐ ☒ ☐ ☐ ☐ Please use a ball-point pen or a thin felt tip. This form will be processed automatically.
Correction: ☐ ■ ☐ ☒ ☐ Please follow the examples shown on the left hand side to help optimize the reading results.

1. OFFICE USE ONLY

1.1 Questionnaire Number:

2. DEMOGRAPHIC INFORMATION

2.1 Gender
☐ Female ☐ Male

2.2 Age
☐ 20 - 35 ☐ 36 - 45 ☐ 46 - 60
☐ 60+

2.3 Racial group
☐ Caucasian/White ☐ African/Black ☐ Indian
☐ Mixed Ancestry/Coloured

2.4 What is your highest level of qualification?
☐ PhD ☐ Masters degree ☐ Honors degree
☐ Bachelor's degree ☐ University of Technology degree ☐ Tertiary diploma

2.5 How long have you been an agricultural researcher?
☐ Less than 5 years ☐ More than 5 years, but less than 10 years ☐ More than 10 years, but less than 20 years
☐ More than 20 years

2.6 What is/are your field/s of expertise and preferred fields of research?

2.7 Current employment
☐ Permanently employed ☐ Private researcher ☐ Part time employed and private capacity

2.8 Current employer (if applicable)
☐ Agricultural supply company ☐ Agricultural crop commodity organisation ☐ Government employment
☐ Academic institution ☐ Not applicable

2.9 Are you permanently employed by one of the following organizations or companies?
☐ South African Sugar Cane Research Institute (SASRI) ☐ Grain South Africa (Grain SA) ☐ Oil and Protein Seeds Development Trust/Oilseeds Advisory Committee (OPDT/OAC)
☐ Protein Research Foundation (PRF) ☐ Agricultural Research Council (ARC) ☐ None of the above

2.10 If you are currently a private researcher please state your previous employment (If applicable)
☐ Governmental institution ☐ Agricultural supply company ☐ Academic institution
☐ Private research institution ☐ Agricultural Research Council (ARC) ☐ Other

3. RESEARCH, FUNDING AND DISSEMINATION MODEL

This section is about scientific research results and effectivity of dissemination in the large-scale (commercial) farming sector. The institutions covered are the relevant crop commodity organizations and some supply companies.

Please rate the importance of where or how you identify research topics in agriculture

		Not important at all	Important	Extremely important
3.1	From the government	☐	☐	☐
3.2	Production sector needs from producers	☐	☐	☐
3.3	Production sector needs from your own experience as a researcher	☐	☐	☐
3.4	Production sector needs from advisors	☐	☐	☐
3.5	Crop commodity organizations	☐	☐	☐
3.6	Agricultural supply companies	☐	☐	☐

3.7 Funding for research: where does most of your funding come from?

3.8 How does a research project become a priority or project? Please explain the process

3.9 Who do you regard as your target population for your research results? *Please take note of the difference between target population and producer. The target population may include producers, fellow advisors, trainers, and technical staff.*

☐ Producers ☐ Advisors ☐ Researchers
☐ Trainers ☐ Technical staff ☐ Other

3.10 If other to question 3.10, please specify:

There are different ways to ensure that research results reach the target population. Once you have obtained results what are the steps taken by you to ensure that the target population receives the information?

		Not important	Important	Extremely important
3.11	Publishing in scientific journals and scientific online publications	☐	☐	☐
3.12	Publishing in popular magazines and online publications	☐	☐	☐
3.13	Publishing in grain commodities magazines and online publications	☐	☐	☐
3.14	Communication with fellow advisors in that field	☐	☐	☐

3. RESEARCH, FUNDING AND DISSEMINATION MODEL [Continue]

3.15	Communication with crop producers (face to face)	☐	☐	☐
3.16	Information days (presentation to focus groups)	☐	☐	☐
3.17	Online meetings such as Zoom	☐	☐	☐
3.18	Social media platforms (such as You-tube, Apps, Facebook, and smartphone platforms such as WhatsApp groups)	☐	☐	☐
3.19	E-mail communication with producers containing information in an attachment	☐	☐	☐

3.20 The following institutions indicated that they conduct some form of research for the agricultural sector and may use different models of information dissemination. Indicate the ones that are conducting research applicable to your field/s of expertise.

☐ South African Sugar Cane Research Institute (SASRI) ☐ Grain South Africa (Grain SA) ☐ Oil and Protein Seeds Development Trust/Oilseeds Advisory Committee (OPDT/OAC)

☐ Protein Research Foundation (PRF) ☐ Agricultural Research Council (ARC)

3.21 Do you think that agricultural research, in the sugar cane, soya, and maize sector *(select the relevant crop)* in South Africa is *on par* with the rest of the major crop producing countries in the world?

☐ Yes ☐ No

3.22 Please motivate your answer to question 3.23 in a few words

3.23 Do you think that agricultural advisors, in the sugar cane, soya, and maize sector *(select the relevant crop)* in South Africa are *on par* with the rest of the major crop producing countries in the world? Please motivate in a few words.

3.24 Are you currently, or have you during the past decade, conducted research on a contractual basis on behalf of the following organizations or companies?

☐ South African Sugar Cane Research Institute (SASRI) ☐ Grain South Africa (Grain SA) ☐ Oil and Protein Seeds Development Trust/Oilseeds Advisory Committee (OPDT/OAC)

☐ Protein Research Foundation (PRF) ☐ Agricultural Research Council (ARC)

3.25 Is this research and subsequent results based on scientific research, is it field trial-based, or both? *(Remember the definitions of scientific research and trial-based research).*

☐ Based on scientific research ☐ Field trail based ☐ Both

☐ Other

3.26 If other to question 3.27, please specify:

3.27 Which model, in your opinion, could be the most effective?

☐ Model 1: Researchers publish results and initiate contact with target population ☐ Model 2: Researchers publish results and advisors initiate contact with target population

3.28 In general and on average, how much of the results generated by you as the researcher reaches the producer?

☐ 81 – 100% ☐ 51 – 80% ☐ 21 – 50%

☐ Less than 20% ☐ Don't know

3. RESEARCH, FUNDING AND DISSEMINATION MODEL [Continue]

3.29 Possible manipulation of research priorities. Do you believe it is a major problem? What measures do you have in place to limit this problem, if it exists?

3.30 Do you think that the source of funding can have an influence on the researcher and the results generated? Explain why.

4. OBJECTIVITY TOWARDS RESEARCH RESULTS AND DISSEMINATION THEREOF

This section is about the researcher's perception of scientific research results, factors that may influence objectivity and the possible concerns about pseudo-science and its effect on sustainable agriculture. The definition of pseudo-science is "a collection of beliefs or practices mistakenly regarded as being based on scientific methods".

4.1 Objectivity of researchers. Discuss independent researchers and those employed by supply companies. (What are the different researchers perception of objectivity, in abovementioned context?)

4.2 Do you agree with the following statement: In South Africa, the large-scale crop producer is neglected in terms of advisory services?

☐ Yes, I agree ☐ No, I disagree ☐ Don't know

4.3 Are you of the opinion that pseudo-science is a concern in the sustainable production sector of the relevant crop? *(sugar cane, soya or maize).*

☐ Yes ☐ No ☐ Not sure

4.4 If you think it is a problem, explain the reasons why you think so.
Just a reminder. The definition of pseudo-science is "a collection of beliefs or practices mistakenly regarded as being based on scientific methods".

4.5 Some researchers and advisors assert that producers experience great financial or yield losses because of advice based on pseudo-science, often supplied by an individual or supply company at information days, on social media or any other means of marketing. What is your opinion about this statement?

☐ I agree ☐ I disagree ☐ Not sure

4.6 In terms of sustainability, do you experience an increase of so-called expert opinions accompanied by products that claim to contribute towards practices such as soil health, regenerative farming, organically produced, bio-stimulants and bio-fertigation?

☐ Yes ☐ No

4.7 Are you concerned about it?

☐ Yes ☐ No

4. OBJECTIVITY TOWARDS RESEARCH RESULTS AND DISSEMINATION THEREOF [Continue]

4.8 What are your concerns, if you have any?

In terms of research: what field of agriculture currently needs the most urgent research?

		Not important	Important	Extremely important
4.9	Soil management	☐	☐	☐
4.10	Plant nutrition	☐	☐	☐
4.11	Crop protection and pest control	☐	☐	☐
4.12	Regenerative farming	☐	☐	☐
4.13	Organic farming	☐	☐	☐
4.14	Bio-stimulants	☐	☐	☐
4.15	Foliar feeds	☐	☐	☐
4.16	Technology hardware and software	☐	☐	☐

In terms of advisory services: what field of agriculture currently needs the most urgent attention?

		Not important	Important	Extremely important
4.17	Soil management	☐	☐	☐
4.18	Plant nutrition	☐	☐	☐
4.19	Crop protection and pest control	☐	☐	☐
4.20	Regenerative farming	☐	☐	☐
4.21	Organic farming	☐	☐	☐
4.22	Bio-stimulants	☐	☐	☐
4.23	Foliar feeds	☐	☐	☐
4.24	Technology hardware and software	☐	☐	☐

5. PROBLEMS AND CONSTRAINTS OF THE CURRENT MODEL

This section focuses on problems and constraints currently experienced by researchers conducting research, the dissemination of research results and feedback from the target population. Definitions: Key Performance Indicators (KPI): KPI's refer to a set of quantifiable measurements used to gauge a model's long-term performance.

5.1 Earlier on you indicated that a certain percentage of results reach the producer. Are you confident that all your research results (it may be scientific and field-trial based) reach the target population according to your own definition of your target population?

☐ Yes ☐ No

5.2 Please motivate your answer to question 5.1:

5.3 Let's discuss key performance indicators (KPI) – measures of success of communication and the importance thereof. Do you have any suggestions towards the implementation of effective KPI's? *(Remember, it is based on this concept (the existence of, or the lack of KPI's) that an organization or research institute would confidently admit that the results reach the target population, or not).*

5.4 Implementation of disseminated research results. Do you ever get feedback from producers and do you ever ask?

☐ Yes ☐ No ☐ I never ask

5.5 If you get feedback from the producer, explain how it happens

5.6 Implementation of disseminated research results. Do you ever get feedback from advisors and do you ever ask?

☐ Yes ☐ No ☐ I never ask

5.7 If you get feedback from the advisor, explain how it happens

5.8 In case you answered no to questions 5.4 and 5.6, how do you know if the results of your hard work even reach the target?

☐ I don't know ☐ I do know

5.9 Please explain your reasons:

5. PROBLEMS AND CONSTRAINTS OF THE CURRENT MODEL [Continue]

If you agree that the effectivity of dissemination should be monitored, select the means that you would most likely support in doing so.

		Not important	Important	Extremely important
5.10	Internet surveys	☐	☐	☐
5.11	Telephonic surveys	☐	☐	☐
5.12	WhatsApp surveys	☐	☐	☐
5.13	Email surveys	☐	☐	☐
5.14	Feedback on information days	☐	☐	☐
5.15	Feedback at regional and national conferences of the commodity organization	☐	☐	☐
5.16	Regular post–graduate studies regarding the topic	☐	☐	☐
5.17	Webinar information sessions/symposiums	☐	☐	☐

5.18 Name your biggest obstacles in getting the information out there to the producer?

6. COMMITMENT TO EFFECTIVE COMMUNICATION AND THE RELATIONSHIP WITH ADVISORS AND PRODUCERS

This section attempts to determine the researcher's perceptions of communication and information dissemination. It also attempts to establish the current relationship between the researcher, advisors, and producers.

6.1 There seems to be a perception that there is a breakdown of communication between researcher and crop producer? What is your opinion about this?

☐ I agree ☐ I disagree ☐ Not sure

6.2 Let's talk about top-to-bottom, bottom-to-top and bi-lateral research communication and your preferences towards these models of communication as well as your reasons?

6.3 Is there an existing channel of communication between you as the researcher, and the producer/s regarding their specific needs for increased production?

☐ Yes ☐ No

6.4 If yes to question 6.4, please describe this channel of communication.

6.5 Is there an existing channel of communication between you as the researcher, and the advisor regarding their identified needs for increased production?

☐ Yes ☐ No

6. COMMITMENT TO EFFECTIVE COMMUNICATION AND THE RELATIONSHIP WITH ADVISORS AND PRODUCERS [Continue]

6.6 If yes to question 6.6, please describe this channel of communication.

6.7 Communication with the producers. Indicate if these channels exist through one or more of the following means:

☐ Directly to the producer (personal access) ☐ Through the advisor ☐ Through social media, e-mail and/or internet (electronic media)

☐ Through the printed and online media ☐ Through information sessions

6.8 How often do you conduct field trials on a commercial farm, as part of your research?

☐ Never ☐ Seldom ☐ Often (more than once a year)

☐ Multiple trails every year

6.9 Describe your perception of a qualified and accredited researcher in the agricultural sector.

6.10 To what extent do you as a researcher involve advisors when collecting data? *(reference to their involvement in working groups)*

6.11 To what extent do you as a researcher involve producers when collecting data? *(reference to their involvement in working groups).*

6.12 Do you think the involvement of a qualified advisor in the layout of trials and interpretation of the collected data is crucial to the validity of the results?

☐ Yes ☐ No

6.13 Please provide reasons for you answer above?

6.14 In section 2 you indicated your preferred and effective methods of general results dissemination. What is your preferred way of communicating results to the advisor?

6.15 Do you feel that crop producers, in general, have sufficient access to researchers to inform them of research needs and priorities from the producer's perspective?

☐ Yes ☐ No

6. COMMITMENT TO EFFECTIVE COMMUNICATION AND THE RELATIONSHIP WITH ADVISORS AND PRODUCERS [Continue]

6.16 How often are you invited, as a knowledgeable person, to address individuals or groups of advisors to present them with the latest trends and scientific research results?

☐ Rarely or never ☐ Once a year ☐ Every 3-6 months
☐ Every month ☐ Weekly

6.17 How often are you invited, as a knowledgeable person, to address individual or groups of producers to present them with the latest trends and scientific research results?

☐ Rarely or never ☐ Once a year ☐ Every 3-6 months
☐ Every month ☐ Weekly

6.18 Would you be prepared to transfer your results and knowledge in that way on a regular basis?

☐ Yes ☐ No

6.19 How often do you, or the institution that initiated the research, organize information sessions, to address individuals, groups of advisors, producers, or other stakeholders in the dissemination chain, to present them with the latest trends and scientific research results (Online or face-to-face)?

☐ Never ☐ Once a year ☐ 2-4 times a year
☐ Monthly ☐ Weekly

6.20 Other factors that could influence commitment to transfer of knowledge to the target population?

7. SUGGESTED SOLUTIONS

This section is about obtaining suggestions as to which of the current practices or principles can be eliminated, what can be done to improve communication between the producer and the researcher and who should be responsible for these actions.

7.1 Are you of the opinion that an effective and measurable dissemination model is crucial for sustainable agriculture?

☐ Yes ☐ No

7.2 Why do you say that and please refer to the “sustainable” part of the question.

7.3 Do you think that this specific agricultural sector namely sugar cane, soybeans and maize *(choose the appropriate one)* needs to drive a campaign to create an awareness amongst all stakeholders about the importance of effective communication between researchers and producers?

☐ Yes ☐ No

7.4 How must such a campaign be approached?

7.5 Earlier in the interview we discussed pseudo-science and your opinion about it. Can you relate to the fact that many producers complain about an information overload generated by both science and pseudo-science.

☐ Yes ☐ No

7.6 In your opinion, who would be most suitable to filter this overload and relay only the relevant information and results to a producer and his/her specific needs? In other words, who would be best qualified to establish effective communication between the researcher and the producer?

☐ All advisors ☐ Qualified and accredited advisors ☐ Salespersons

7. SUGGESTED SOLUTIONS [Continue]

7.7 Should advisors in the agricultural sector of South Africa be subjected to compulsory accreditation with relevant regulatory authorities?

☐ Yes, definitely ☐ Yes ☐ No

Thank you for your time and participation

APPENDIX C: INTERVIEW SCHEDULE (ADVISORS)

evasys	ESTABLISHING EFFECTIVE COMMUNICATION BETWEEN THE AGRICULTURAL	evasys
University of the Free State	Pieter Willem Bruwer	
Department for Sustainable Food Systems and Development	Interview Schedule for Advisors	

Mark as shown: ☐ ☒ ☐ ☐ ☐ Please use a ball-point pen or a thin felt tip. This form will be processed automatically.
Correction: ☐ ■ ☐ ☒ ☐ Please follow the examples shown on the left hand side to help optimize the reading results.

1. OFFICE USE ONLY

1.1 Questionnaire Number:

2. DEMOGRAPHIC INFORMATION

2.1 Gender
☐ Female ☐ Male

2.2 Age
☐ 20 - 35 ☐ 36 - 45 ☐ 46 - 60
☐ 60+

2.3 Racial group
☐ Caucasian/White ☐ African/Black ☐ Indian
☐ Mixed Ancestry/Coloured

2.4 What is your highest level of qualification?
☐ PhD ☐ Masters degree ☐ Honors degree
☐ Bachelor's degree ☐ University of Technology degree ☐ Tertiary diploma

2.5 How long have you been an agricultural advisor?
☐ Less than 5 years ☐ More than 5 years, but less than 10 years ☐ More than 10 years, but less than 20 years
☐ More than 20 years

2.6 What is/are your field/s of expertise and preferred fields of information dissemination?

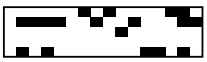
2.7 Current employment
☐ Permanently employed ☐ Private advisor ☐ Part time employed and private capacity

2.8 Current employer (if applicable)
☐ Agricultural supply company ☐ Agricultural advisory/consulting company ☐ Government employment
☐ Academic institution ☐ Agricultural crop commodity organisation ☐ Not applicable

2.9 Are you permanently employed by one of the following organizations or companies?
☐ South African Sugar Cane Research Institute (SASRI) ☐ Grain South Africa (Grain SA) ☐ Oil and Protein Seeds Development Trust/Oilseeds Advisory Committee (OPDT/OAC)
☐ Protein Research Foundation (PRF) ☐ Agricultural Research Council (ARC) ☐ None of the above

2.10 If you are currently a private advisor please state your previous employment (If applicable)
☐ Governmental institution ☐ Agricultural supply company ☐ Academic institution
☐ Private research institution ☐ Agricultural Research Council (ARC) ☐ Other

2.11 Which of the following institutions and regulatory services and their respective functions are you familiar with?
☐ Fertilizer Association of South Africa (FERTASA) ☐ Associations of Veterinary and Chemical associations of South Africa (AVCASA) ☐ CropLife South Africa (CropLife SA)
☐ South African Council of Natural Science Professions (SACNASP) ☐ South African Society of Agricultural Extension (SASAE)



2. DEMOGRAPHIC INFORMATION [Continue]

2.12 Which of the following institutions and regulatory services are you accredited with?

- ☐ Fertilizer Association of South Africa (FERTASA)
- ☐ Associations of Veterinary and Chemical associations of South Africa (AVCASA)
- ☐ CropLife South Africa (CropLife SA)
- ☐ South African Council of Natural Science Professions (SACNASP)
- ☐ South African Society of Agricultural Extension (SASAE)

3. RESEARCH, FUNDING AND DISSEMINATION MODEL

This section is about scientific research results and effectivity of dissemination in the large-scale (commercial) farming sector. The institutions covered are the relevant crop commodity organizations and some supply companies.

Please rate the importance of where or how you identify research topics in agriculture

		Not important	Important	Extremely important
3.1	From the government	☐	☐	☐
3.2	Production sector needs from producers	☐	☐	☐
3.3	Production sector needs from your own experience as an advisor	☐	☐	☐
3.4	Production sector needs from researchers	☐	☐	☐
3.5	Crop commodity organizations	☐	☐	☐
3.6	Agricultural supply companies	☐	☐	☐

3.7 Funding for research: where does most of the funding come from?

3.8 How does a research project become a priority or project? Please explain the process

3.9 Who do you regard as your target population for results dissemination ? *Please take note of the difference between target population and producer. The target population may include producers, fellow advisors, trainers, and technical staff.*

- ☐ Producers
- ☐ Advisors
- ☐ Researchers
- ☐ Trainers
- ☐ Technical staff
- ☐ Other

3.10 If other, please specify:

3. RESEARCH, FUNDING AND DISSEMINATION MODEL [Continue]

There are different ways to ensure that research results reach the target population. Once you have obtained results what are the steps taken by you to ensure that the target population receives the information?

		Not important	Important	Extremely important
3.11	Publishing in scientific journals and scientific online publications	☐	☐	☐
3.12	Publishing in popular magazines and online publications	☐	☐	☐
3.13	Publishing in grain commodities magazines and online publications	☐	☐	☐
3.14	Communication with fellow advisors in that field	☐	☐	☐
3.15	Communication with crop producers (face to face)	☐	☐	☐
3.16	Information days (presentation to focus groups)	☐	☐	☐
3.17	Online meetings such as Zoom	☐	☐	☐
3.18	Social media platforms (such as You-tube, Apps, Facebook, and smartphone platforms such as WhatsApp groups)	☐	☐	☐
3.19	E-mail communication with producers containing information in an attachment	☐	☐	☐

3.20 The following institutions indicated that they conduct some form of research for the agricultural sector and may use different models of information dissemination. Indicate the ones that are conducting research applicable to your field/s of expertise and advice.

☐ South African Sugar Cane Research Institute (SASRI) ☐ Grain South Africa (Grain SA) ☐ Oil and Protein Seeds Development Trust/Oilseeds Advisory Committee (OPDT/OAC)

☐ Protein Research Foundation (PRF) ☐ Agricultural Research Council (ARC)

3.21 Do you think that agricultural research, in the sugar cane, soya, and maize sector *(select the relevant crop)* in South Africa are *on par* with the rest of the major crop producing countries in the world? Please motivate in a few words

3.22 Do you think that agricultural advisors, in the sugar cane, soya, and maize sector *(select the relevant crop)* in South Africa is *on par* with the rest of the major crop producing countries in the world?

☐ Yes ☐ No

3.23 Please motivate your answer to question 3.24 in a few words.

3.24 Are you currently, or have you during the past decade, been involved in the dissemination of research results generated by the following organizations or companies?

☐ South African Sugar Cane Research Institute (SASRI) ☐ Grain South Africa (Grain SA) ☐ Oil and Protein Seeds Development Trust/Oilseeds Advisory Committee (OPDT/OAC)

☐ Protein Research Foundation (PRF) ☐ Agricultural Research Council (ARC)

3. RESEARCH, FUNDING AND DISSEMINATION MODEL [Continue]

3.25 Is this research and subsequent results based on scientific research, is it field trial-based, or both? *(Remember the definitions of scientific research and trial-based research).*

☐ Based on scientific research ☐ Field trail based ☐ Both
☐ Other

3.26 If other, please specify:

3.27 Which model, in your opinion, could be the most effective?

☐ Model 1: researchers publish results and initiate contact with target population
☐ Model 2: researchers publish results and advisors initiate contact with target population.

3.28 In general and on average, how much of the results generated by the researcher reaches the producer?

☐ 81 – 100% ☐ 51 – 80% ☐ 21 – 50%
☐ Less than 20% ☐ Don't know

3.29 Do you think that the source of funding can have an influence on the researcher and the results generated? Explain why.

4. OBJECTIVITY TOWARDS RESEARCH RESULTS AND DISSEMINATION THEREOF

This section is about the advisor's perception of scientific research results, factors that may influence objectivity and the possible concerns about pseudo-science and its effect on sustainable agriculture. The definition of pseudo-science is "a collection of beliefs or practices mistakenly regarded as being based on scientific methods".

4.1 Indicate which definition is the nearest to your own perception of scientific results?

☐ It is data generated by applying scientific principles by qualified and accredited researchers, filtered, and interpreted by qualified and accredited advisors and adapted and communicated to producers, according to their specific needs
☐ It is data generated by a supply company's in-house field trials of which the results are relayed to the producer through the involvement of a qualified and accredited advisor
☐ It is data generated by field trials without the involvement of a qualified and accredited adivsor and relayed to the producers by the salesperson

4.2 Objectivity of advisors. Advisors employed by supply companies may have a monetary motivation when disseminating results. Discuss independent advisors and those employed by supply companies. What are the different advisors perception of objectivity, in abovementioned context?

4.3 Do you agree with the following statement: In South Africa, the large-scale crop producer is neglected in terms of advisory services?

☐ Yes, I agree ☐ No, I disagree ☐ Don't know

4.4 Please motivate your answer to question 4.4.

4.5 Are you of the opinion that pseudo-science is a concern in the sustainable production sector of the relevant crop? *(sugar cane, soya or maize).*

☐ Yes ☐ No ☐ Not sure

4. OBJECTIVITY TOWARDS RESEARCH RESULTS AND DISSEMINATION THEREOF [Continue]

4.6 If you think it is a problem, explain the reasons why you think so.
Just a reminder: The definition of pseudo-science is "a collection of beliefs or practices mistakenly regarded as being based on scientific methods".

4.7 Some researchers and advisors assert that producers experience great financial or yield losses because of advice based on pseudo-science, often supplied by an individual or supply company at information days, on social media or any other means of marketing. What is your opinion about this statement?

☐ I agree ☐ I disagree ☐ Not sure

4.8 In terms of sustainability, do you experience an increase of so-called expert opinions accompanied by products that claim to contribute towards practices such as soil health, regenerative farming, organically produced, bio-stimulants and bio-fertigation?

☐ Yes ☐ No

4.9 Are you concerned about it?

☐ Yes ☐ No

4.10 What are your concerns, if you have any?

In terms of research: what field of agriculture currently needs the most urgent research?

		☐ Not important	☐ Important	☐ Extremely important
4.11	Soil management	☐	☐	☐
4.12	Plant nutrition	☐	☐	☐
4.13	Crop protection and pest control	☐	☐	☐
4.14	Regenerative farming	☐	☐	☐
4.15	Organic farming	☐	☐	☐
4.16	Bio-stimulants	☐	☐	☐
4.17	Foliar feeds	☐	☐	☐
4.18	Technology hardware and software	☐	☐	☐
4.19	Other	☐	☐	☐

4. OBJECTIVITY TOWARDS RESEARCH RESULTS AND DISSEMINATION THEREOF [Continue]

In terms of advisory services: what field of agriculture currently needs the most urgent attention?

		Not important	Important	Extremely important
4.20	Soil management	☐	☐	☐
4.21	Plant nutrition	☐	☐	☐
4.22	Crop protection and pest control	☐	☐	☐
4.23	Regenerative farming	☐	☐	☐
4.24	Organic farming	☐	☐	☐
4.25	Bio-stimulants	☐	☐	☐
4.26	Foliar feeds	☐	☐	☐
4.27	Technology hardware and software	☐	☐	☐
4.28	Other	☐	☐	☐

5. PROBLEMS AND CONSTRAINTS OF THE CURRENT MODEL

This section focuses on problems and constraints currently experienced by advisors with the dissemination of research results and feedback from the target population. Definitions: Key Performance Indicators (KPI): KPI's refer to a set of quantifiable measurements used to gauge a model's long-term performance.

5.1 Earlier on you indicated that a certain percentage of results reach the producer. Are you confident that all your research results (it may be scientific and field-trial based) reach the target population according to your own definition of your target population?

☐ Yes ☐ No

5.2 Please motivate your answer to question 5.1.

5.3 Let's discuss key performance indicators (KPI) – measures of success of communication and the importance thereof. Do you have any suggestions towards the implementation of effective KPI's? *(Remember, it is based on this concept (the existence of, or the lack of KPI's) that an organization or research institute would confidently admit that the results reach the target population, or not).*

5.4 Implementation of disseminated research results. Do you ever get feedback from the target population and do you ever ask?

☐ Yes ☐ No ☐ I never ask

5.5 If you get feedback from the producer, explain how it happens

5.6 Implementation of disseminated research results. Do you ever get feedback from researchers?

☐ Yes ☐ No ☐ Sometimes

5.7 Do you ever supply feedback to the researcher?

☐ Yes ☐ No ☐ Sometimes

5. PROBLEMS AND CONSTRAINTS OF THE CURRENT MODEL [Continue]

5.8 If you do supply feedback to the researcher explain how it is done.

5.9 In case you answered no to questions 5.4 and 5.6, how do you know if this important information even reaches the target?

☐ I don't ☐ I do know

5.10 How do you know if this important information even reaches the target?

If you agree that the effectivity of dissemination should be monitored, select the means that you would most likely support in doing so.

		Yes	No	Not sure
5.11	Internet surveys	☐	☐	☐
5.12	Telephonic surveys	☐	☐	☐
5.13	WhatsApp surveys	☐	☐	☐
5.14	Email surveys	☐	☐	☐
5.15	Feedback on information days	☐	☐	☐
5.16	Feedback at regional and national conferences of the commodity organization	☐	☐	☐
5.17	Regular post–graduate studies regarding the topic	☐	☐	☐
5.18	Webinar Information Sessions/Symposiums	☐	☐	☐

5.19 Name your biggest obstacles in getting the information out there to the producer?

6. COMMITMENT TO EFFECTIVE COMMUNICATION AND THE RELATIONSHIP WITH RESEARCHERS AND PRODUCERS

This section attempts to determine the researcher's perceptions of communication and information dissemination. It also attempts to establish the current relationship between researchers, advisors, and producers

6.1 There seems to be a perception that there is a breakdown of communication between researcher and crop producer, do you agree?

☐ Yes, I agree ☐ No, I disagree ☐ Not sure

6.2 Let's talk about top-to-bottom, bottom-to-top and bi-lateral research communication and your preferences towards these models of communication as well as your reasons?

6. COMMITMENT TO EFFECTIVE COMMUNICATION AND THE RELATIONSHIP WITH RESEARCHERS AND PRODUCERS [Continue]

6.3 Is there an existing channel of communication between you as the advisor, and the producer/s regarding their specific needs for increased production?

☐ Yes ☐ No

6.4 If yes to question 6.4, please describe this channel of communication.

6.5 Is there an existing channel of communication between you as the advisor, and the researcher regarding their identified needs for increased production?

☐ Yes ☐ No

6.6 If yes to question 6.6, please describe this channel of communication.

6.7 Communication with the producers. Indicate if these channels exist through one or more of the following means:

☐ Directly to the producer (personal access) ☐ Through the salesperson ☐ Through social media, e-mail and/or internet (electronic media)

☐ Through the printed and online media ☐ Through information sessions

6.8 Describe your perception of a qualified and accredited researcher in the agricultural sector.

Earlier on you expressed your familiarity and accreditation with the following institutions and regulatory services. In your experience, please rate the effectivity of each one (a mark out of 5) in the contribution towards sustainability.

		Not effective at all	Effective	Very effective
6.9	Fertilizer Association of South Africa (FERTASA)	☐	☐	☐
6.10	Associations of Veterinary and Chemical associations of South Africa (AVCASA)	☐	☐	☐
6.11	CropLife South Africa (CropLife SA)	☐	☐	☐
6.12	South African Council of Natural Science Professions (SACNASP)	☐	☐	☐
6.13	South African Society of Agricultural Extension (SASAE)	☐	☐	☐

6.14 To what extent do you as an advisor involve producers when collecting data? *(reference to their involvement in working groups)*

6. COMMITMENT TO EFFECTIVE COMMUNICATION AND THE RELATIONSHIP WITH RESEARCHERS AND PRODUCERS [Continue]

6.15 To what extent do you as an advisor involve researchers when collecting data? *(reference to their involvement in working groups).*

6.16 Do you think the involvement of a qualified advisor in the layout of trials and interpretation of the collected data is crucial to the validity of the results?

☐ Yes ☐ No

6.17 Please provide reasons for your answer above:

6.18 In section 2 you indicated your preferred and effective ways of research results dissemination. What is your preferred way of communicating results to the producer?

6.19 Do you feel that crop producers, in general, have sufficient access to researchers to inform them of research needs and priorities from the producer's perspective?

☐ Yes ☐ No

6.20 Please explain your answer above:

6.21 How often are you invited, as a knowledgeable person, to address individuals or groups of fellow advisors to present them with the latest trends and scientific research results?

☐ Rarely or never ☐ Once a year ☐ Every 3-6 months
☐ Every month ☐ Weekly

6.22 How often do you, or the institution that initiated the research, organize information sessions, to address individuals, groups of advisors, producers, or other stakeholders in the dissemination chain, to present them with the latest trends and scientific research results (Online or face-to-face)?

☐ Never ☐ Once a year ☐ 2-4 times a year
☐ Monthly ☐ Weekly

7. SUGGESTED SOLUTIONS

This section is about obtaining suggestions as to which of the current practices or principles can be eliminated, what can be done to improve communication between the producer and the researcher and who should be responsible for these actions.

7.1 Are you of the opinion that an effective and measurable dissemination model is crucial for sustainable agriculture?

☐ Yes ☐ No

7. SUGGESTED SOLUTIONS [Continue]

7.2 Why do you say that and please refer to the “sustainable” part of the question.

7.3 Do you think that this specific agricultural sector namely sugar cane, soybeans and maize *(choose the appropriate one)* needs to drive a campaign to create an awareness amongst all stakeholders about the importance of effective communication between researchers and producers?

☐ Yes ☐ No

7.4 How must such a campaign be approached?

7.5 Earlier in the interview we discussed pseudo-science and your opinion about it. Can you relate to the fact that many producers complain about an information overload generated by both science and pseudo-science.

☐ Yes ☐ No

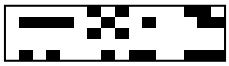
7.6 In your opinion, who would be most suitable to filter this overload and relay only the relevant information and results to a producer and his/her specific needs? In other words, who would be best qualified to establish effective communication between the researcher and the producer?

☐ All advisors ☐ Qualified and accredited advisors ☐ Salespersons

7.7 Should advisors in the agricultural sector of South Africa be subjected to compulsory accreditation with relevant regulatory authorities?

☐ Yes, definitely ☐ Yes ☐ No

Thank you for your time and participation



APPENDIX D: CONSENT FORM

UNIVERSITY OF THE FREE STATE
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YUNIVESITHI YA FREISTATA
UFS UV

RESEARCH STUDY INFORMATION LEAFLET AND CONSENT FORM

DATE

January 2022 – December 2023

TITLE OF THE RESEARCH PROJECT

Establishing Effective Communication between the Agricultural Researcher and the Crop Producer with special reference to the large-scale Sugar Cane, Soybean and Maize industry in two regions in South Africa

PRINCIPLE INVESTIGATOR / RESEARCHER(S) NAME(S) AND CONTACT NUMBER(S):

Pieter Willem Bruwer 1984014629 0630516957

FACULTY AND DEPARTMENT:

Faculty of Natural and Agricultural Sciences

Department of Sustainable Food Systems and Development

STUDY LEADER(S) NAME AND CONTACT NUMBER:

Prof. Johan van Niekerk

051 401-3765

WHAT IS THE AIM / PURPOSE OF THE STUDY?

The aim and purpose of this study is to identify and investigate seemingly successful models of research results dissimenation, less successful models and determine parameters for evaluation and measurement of success (key performance indicators) with stakeholders such as researchers, advisors and producers and recommend an effective dissemination model for the large-scale crop producing sector of South Africa.

WHO IS DOING THE RESEARCH?

Pieter Bruwer, Agronomist at Langfontein Seeds. Part of the BP Greyling group of Companies, Wakkerstroom, Mpumalanga. Also PhD student, doing this study as part of the requirements

for the degree of Doctor of Philosophy in Sustainable Agriculture, with the Faculty of Natural and Agricultural Sciences, Department of Sustainable Food Systems and Development, UFS.

HAS THE STUDY RECEIVED ETHICAL APPROVAL?

Yes

Approval number: UFS-HSD2022/1274/22

WHY ARE YOU INVITED TO TAKE PART IN THIS RESEARCH PROJECT?

As an agricultural researcher, advisor or large-scale farmer involved in the sugar cane, soybean and maize production sector of South Africa you have been chosen to participate in this study for improved sustainability. Permission for an interview or to receive a questionnaire was obtained from you as a participant. A total number of 100 participants have been chosen. You have been chosen, and approached for permission, based on the following criteria: Experience, qualification, accredittation and sustainable practices.

WHAT IS THE NATURE OF PARTICIPATION IN THIS STUDY?

You, as a participant in this study, will be asked to either fill out the questionnaire (crop producers) or be asked for a personal interview (researchers and advisors - individuals and focus-groups). The study will attempt get a better understanding of the perceptions, challenges faced and suggestions for improvement by researchers, advisors and crop producers in the dissemination chain of scientific research results. The data and results will be analyzed and processed with the intention of adding value to the advisory services provided in South Africa. Once you have completed the questionnaire it will be collected in person or you will be asked to send it via e-mail. The interviews are semi-structered which will be audio-taped and transcribed. The contents will be sent to you for confirmation before being applied as data. The questions relate to the current situation regarding dissemination of research results to the crop producer, the effectivity of these models and the impact it may have on the sustainability of resources and crop production. Questionnaires for crop producers: Expected time for completion of the questionnaire is 45 minutes and to complete

the consent form 15 minutes resulting in the total time spent 1 hour. Interviews with researchers and advisors: Expected time for the interviews is approximately 1 hour and to complete the consent form 15 minutes. Total time spent 1 hour 15 minutes. Interviews with focus groups may take a bit longer, approximately 1 hour 30 minutes.

CAN THE PARTICIPANT WITHDRAW FROM THE STUDY?

Participation is voluntary and there is no penalty or loss of benefit for non-participation. Being part of this study is voluntary and you are under no obligation to consent to participation. If you do 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. Once you have read through this document and are satisfied that the study can provide the whole spectrum of role players of a better understanding of the importance of abovementioned subjects and have submitted the non-identifiable questionnaire and non-identifiable transcribed interview schedules, you will respectfully have to accept that the data will be captured and that you won't be able to withdraw from this research.

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

The study will attempt to prove that the breakdown in communication between agricultural researcher and crop producer has allowed the phenomenon called pseudo-science to enter the crop production environment creating an information overload and confusion and this could have a devastating effect on the sustainability of crop production and its resources. Your participation is this study is crucial for a better understanding of the reasons that created this situation and more importantly, your contribution towards the development of an effective and measurable dissemination model to establish communication between researchers and crop producers. Your information will be kept confidential and the only parties that will have access to this information would be the researcher and the analysts. In this case the University of the Free State.

WHAT IS THE ANTICIPATED INCONVENIENCE OF TAKING PART IN THIS STUDY?

Care will be taken by the researcher to ensure questionnaires are sent or handed out at a convenient pre-arranged time that suits the participant. This will also apply to interviews. Respondents will be contacted by e-mail or telephonically for arrangements of a suitable time and place of the interviewee's choice. Operational hours will be respected. A few hours of discomfort (maximum of 15 minutes to read and sign the consent form, 1 hour for the interview (researchers and advisors), 45 minutes for the questionnaire (crop producers) and 1 hour 30 minutes (focus groups) is all that is requested of you. Even in the unlikely event of confidential information leaked the risk of harmful consequences is very low.

WILL WHAT I SAY BE KEPT CONFIDENTIAL?

The following information will be kept confidential: your name, the total area of your crop production, your field of expertise, your opinion of your current employer, sponsor (funder), the researcher, advisor or the crop producer. Your answers will be given a fictitious code number, or a pseudonym and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings. The researcher, transcriber and analyst will have access to the data. These individuals will be required to sign a confidentiality agreement. Furthermore, your answers may be reviewed by people responsible for making sure that research is done properly, including the transcriber, external coder, and members of the Research Ethics Committee. Please take note that your anonymous data may be used for other purposes, e.g. research report, journal articles, conference presentations etc. Individual participants will not be identified in such reports or publications or presentations. The only exception will be where you have given written consent that your personal data/views/records may be shared. However, it is not expected of any participant to give such consent. Focus groups: Please keep in mind that it is sometimes impossible to make an absolute guarantee of confidentiality/anonymity, e.g. when focus groups are used as a data collection method. A focus group is where the researcher conducts an interview with more than one individual at the same time such as a group. While every effort will be made by the researcher to ensure that you will not be connected to the information that you share during the focus group, it cannot be guaranteed that other

participants in the focus group will treat information confidentially. The interviewer shall, however, encourage all participants to do so. For this reason, it is advised that you do not disclose personally sensitive information in the focus group. The transcriber/external coder will have access to the data but will sign a confidentiality agreement to maintain confidentiality.

HOW WILL THE INFORMATION BE STORED AND ULTIMATELY DESTROYED?

Hard copies of your answers will be stored by the researcher for a period of five years in a locked cupboard/filing cabinet at Plot 41 Wakkerstroom, Mpumalanga, 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. After a period of five years the information will be destroyed by burning the hard copies and the electronic storage be deleted.

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

None of the participants or the researcher will receive any kind of payment or any incentive for taking part in this study. The cost incurred by the researcher in the process of obtaining data such as travel costs, accommodation etc. will be the researcher's responsibility and you as a participant should have no expense for being a participant.

HOW WILL THE PARTICIPANT BE INFORMED OF THE FINDINGS / RESULTS OF THE STUDY?

If you would like to be informed of the final research findings, please contact Pieter Bruwer on 063 051 6957 or pieter@bruwer.net. The findings will be accessible by February 2023. Should you have concerns about the way in which the research has been conducted, you may contact Prof Johan van Niekerk at 051- 401 3765 (between 14:00 and 16:00, weekdays) or by e-mail at vNiekerkJA@ufs.ac.za.

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

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YUNIVESITHI YA FREISTATA
UFS UV

CONSENT TO PARTICIPATE IN THIS STUDY

I, the undersigned,

_____ (*participant's full names to be included*), (the "**Participant**")
confirm that I voluntarily agree to participate in the research of

ESTABLISHING EFFECTIVE COMMUNICATION BETWEEN THE AGRICULTURAL RESEARCHER AND THE CROP PRODUCER WITH SPECIAL REFERENCE TO THE LARGE-SCALE SUGAR CANE, SOYBEAN AND MAIZE INDUSTRY IN TWO REGIONS OF SOUTH AFRICA

Referred to as (the **"Study**") *in relation to dissemination models in sugar cane, soybean and maize crop production sector of South Africa and which study is being conducted by Pieter Willem Bruwer*, (the "**Researcher**").

I, the undersigned Participant, further confirm that–

1. the Researcher has explained the nature, procedure, potential benefits and anticipated inconvenience of my participation in the Study;
2. I have read (or had explained to me) and understood the Study as explained in the attached information sheet;
3. I have had sufficient opportunity to ask questions and am prepared to participate in the Study;
4. I understand that my participation in the Study is entirely voluntary and that I am free to withdraw at any time without penalty (if applicable);
5. I voluntarily provide the UFS and the Researcher with my personal information and consent to the UFS and the Researcher collecting, disclosing and processing my personal information in order to conduct the Study and any related activities in relation thereto;
6. I hereby acknowledge and confirm that I understand the purpose for which the UFS and the Researcher may collect, store, use, delete, destroy, outsource, transfer or otherwise process, as the context and circumstances may require and as contemplated in terms of POPIA, my personal information as set out herein;
7. I am aware that the findings of the Study will be anonymously processed into a research report, journal publications and/or conference proceedings and that my personal information will be aggregated and deidentified at such stage;
8. I also give the UFS permission to share, without notification, the collected data with other researchers at the UFS or other Higher Education Institutions. This permission is dependent on the same principles of ethical research practices, anonymity/confidentiality, safekeeping of information, and other issues listed above applying.

I, the Participant, agree to the recording of the *insert specific data collection method*.

Full Name of Participant: _____

Signature of Participant: _____ Date: _____

Full Name(s) of Researcher(s): _____

Signature of Researcher: _____Date: _____

APPENDIX E: ETHICAL CLEARANCE

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS UV

GENERAL/HUMAN RESEARCH ETHICS COMMITTEE (GHREC)

16-Sep-2022

Dear Mr Pieter Bruwer

Application Approved

Research Project Title:
ESTABLISHING EFFECTIVE COMMUNICATION BETWEEN THE AGRICULTURAL RESEARCHER AND THE CROP PRODUCER WITH SPECIAL REFERENCE TO THE LARGE-SCALE SUGAR CANE, SOYBEAN AND MAIZE INDUSTRY IN TWO REGIONS OF SOUTH AFRICA

Ethical Clearance number:
UFS-HSD2022/1274/22

We are pleased to inform you that your application for ethical clearance has been approved. Your ethical clearance is valid for twelve (12) months from the date of issue. We request that any changes that may take place during the course of your study/research project be submitted to the ethics office to ensure ethical transparency. furthermore, you are requested to submit the final report of your study/research project to the ethics office. Should you require more time to complete this research, please apply for an extension. Thank you for submitting your proposal for ethical clearance; we wish you the best of luck and success with your research.

Yours sincerely

Dr Adri Du Plessis
Chairperson: General/Human Research Ethics Committee

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APPENDIX F: RECORD OF DATA CAPTURED AND ANALYSED

		2023/06/01			PW BRUWER								
	SASRI	date interviewed	Transcription received	Otter.ai link shared	Otter.ai link shared	data captured	KM copies	A copies	R copies	Growers copies	evasys done	scanned & saved	UFS hard copies	evasys analysis
1 **Knowledge manager**	Participant 1	26/01/2023	✓	patrickma@ufs.ac.za	melaniedebruyn@gmail.com	✓	1				✓	✓	✓	✓
2 **Extension specialists**	Participant 1	13/01/2023	✓	patrickma@ufs.ac.za	melaniedebruyn@gmail.com	✓		1			✓	✓	✓	✓
3	Participant 2	17/01/2023	✓	patrickma@ufs.ac.za	melaniedebruyn@gmail.com	✓		1			✓	✓	✓	✓
4	Participant 3	12/01/2023	✓	patrickma@ufs.ac.za	melaniedebruyn@gmail.com	✓		1			✓	✓	✓	✓
5	Participant 4	13/01/2023	✓	patrickma@ufs.ac.za	melaniedebruyn@gmail.com	✓		1			✓	✓	✓	✓
6	Participant 5	02/02/2023	✓		melaniedebruyn@gmail.com	✓		1			✓	✓	✓	✓
7 **Researchers**	Participant 1	23/01/2023	✓	patrickma@ufs.ac.za	melaniedebruyn@gmail.com	✓			1		✓	✓	✓	✓
8	Participant 2	24/01/2023	✓	patrickma@ufs.ac.za	melaniedebruyn@gmail.com	✓			1		✓	✓	✓	✓
9	Participant 3	24/01/2023	✓	patrickma@ufs.ac.za	melaniedebruyn@gmail.com	✓			1		✓	✓	✓	✓
10	Participant 4	25/01/2023	✓	patrickma@ufs.ac.za	melaniedebruyn@gmail.com	✓			1		✓	✓	✓	✓
11	Participant 5	25/01/2023	✓	patrickma@ufs.ac.za	melaniedebruyn@gmail.com	✓			1		✓	✓	✓	✓
	Crop commodity 1													
12 **Knowledge manager**	Participant 1	03/02/2023	✓		melaniedebruyn@gmail.com	✓	1				✓	✓	✓	✓
13	Participant 2	03/02/2023	✓		melaniedebruyn@gmail.com	✓	1				✓	✓	✓	✓
14 **Advisors**	Participant 1	21/12/2022	✓	patrickma@ufs.ac.za	melaniedebruyn@gmail.com	✓		1			✓	✓	✓	✓
15	Participant 2	08/11/2022	✓	patrickma@ufs.ac.za		✓		1			✓	✓	✓	✓
16	Participant 3	08/09/2022	✓	Sumari		✓		1			✓	✓	✓	✓
17	Participant 4	14/10/2022	✓	Sumari		✓		1			✓	✓	✓	✓
18	Participant 5	04/01/2023	✓	patrickma@ufs.ac.za	melaniedebruyn@gmail.com	✓		1			✓	✓	✓	✓
19 **Researchers**	Participant 1	23/11/2022	✓	patrickma@ufs.ac.za		✓			1		✓	✓	✓	✓
20	Participant 2	21/12/2022	✓	patrickma@ufs.ac.za	melaniedebruyn@gmail.com	✓			1		✓	✓	✓	✓
21	Participant 3	28/10/2022	✓	Sumari		✓			1		✓	✓	✓	✓
22	Participant 4	31/10/2022	✓	Sumari		✓			1		✓	✓	✓	✓
23	Participant 5	30/11/2022	✓	patrickma@ufs.ac.za		✓			1		✓	✓	✓	✓
	Crop commodity 2													
24 **Knowledge manager**	Participant 1	06/02/2023	✓		melaniedebruyn@gmail.com	✓	1				✓	✓	✓	✓
25	Participant 2	06/02/2023	✓		melaniedebruyn@gmail.com	✓	1				✓	✓	✓	✓
26 **Growers**	Respondent 1	13/03/2023				✓				1	✓	✓	✓	✓
27	Respondent 2	13/03/2024				✓				1	✓	✓	✓	✓
28	Respondent 3	13/03/2025				✓				1	✓	✓	✓	✓
29	Respondent 4	13/03/2026				✓				1	✓	✓	✓	✓
30	Respondent 5	13/03/2027				✓				1	✓	✓	✓	✓
31	Respondent 6	13/03/2028				✓				1	✓	✓	✓	✓
32	Respondent 7	13/03/2029				✓				1	✓	✓	✓	✓
33	Respondent 8	13/03/2030				✓				1	✓	✓	✓	✓
34	Respondent 9	13/03/2031				✓				1	✓	✓	✓	✓
35	Respondent 10	13/03/2032				✓				1	✓	✓	✓	✓
36	Respondent 11	13/03/2033				✓				1	✓	✓	✓	✓
37	Respondent 12	14/03/2023				✓				1	✓	✓	✓	✓
38	Respondent 13	14/03/2023				✓				1	✓	✓	✓	✓
39	Respondent 14	14/03/2023				✓				1	✓	✓	✓	✓
40	Respondent 15	14/03/2023				✓				1	✓	✓	✓	✓
41	Respondent 16	14/03/2023				✓				1	✓	✓	✓	✓
42	Respondent 17	18/03/2024				✓				1	✓	✓	✓	✓
43	Respondent 18	21/03/2024				✓				1	✓	✓	✓	✓
44	Respondent 19	27/03/2023				✓				1	✓	✓	✓	✓
45	Respondent 20	27/03/2023				✓				1	✓	✓	✓	✓
							5	10	10	20				

APPENDIX G: PERMISSION FROM ARC TO PARTICIPATE

From: **Kingstone Mashingaidze** MashingaidzeK@arc.agric.za
Subject: RE: PhD research project
Date: 19 August 2022 at 12:45
To: Pieter Bruwer pieter@bruwer.net
Cc: Brad Flett FlettB@arc.agric.za

KM

Dear Pieter
Thanks for your e-mail. The ARC-Grain Crops (Potchefstroom) conducts research on soybean and maize, and I hereby grant you the necessary permission to interview the relevant researchers in Agronomy and Crop Protection, on the condition that they will do so voluntarily. Dr Bradley Flett should assist you to identify the relevant researchers.
Kind regards
Kingstone

From: Pieter Bruwer <pieter@bruwer.net>
Sent: Thursday, 18 August 2022 14:31
To: Kingstone Mashingaidze <MashingaidzeK@arc.agric.za>
Subject: PhD research project

Dear Dr Kingstone
As I understand it you are the Senior Manager Research at ARC and I trust this e-mail finds you well?
I am conducting research for a PhD through the Department of Sustainable Food Systems and Development at UFS of which the title is:
ESTABLISHING EFFECTIVE COMMUNICATION BETWEEN THE AGRICULTURAL RESEARCHER AND THE THE CROP PRODUCER WITH SPECIAL REFERENCE TO THE LARGE-SCALE SUGAR CANE, SOYBEAN AND MAIZE INDUSTRY IN TWO REGIONS of SOUTH AFRICA.
My Supervisor is Prof Johan van Niekerk and Co-supervisors are Dr JW Swanepoel and Dr Bradley Flett. Although I am going to interview researchers at academic institutions, I am of the opinion that the ARC plays such an important role in the generation of research results in South Africa that any study of this nature needs the respected input of their researchers.
My application for ethical clearance is currently being considered by the relevant committee at UFS but to save time I would prefer to get all the necessary permissions in place.
I hereby request the ARC's permission to interview some researchers currently employed by the ARC. The data generated by the study will be anonymous and no person or institution will be identified. A consent form will be sent to prospective respondents. This consent form is POPIA act compliant and also includes a non-disclosure section where the researcher (myself) commits to the confidentiality of data generated.

I trust you will favourably consider my request.
Regards

BP LANGFONTEIN

Pieter Bruwer
(Pr.Ext.Sci)