# ENGAGED SCIENCE: MULTIMEDIA AS A TOOL FOR ENGAGEMENT BETWEEN RESEARCHERS AND GROWERS ON GM SUGARCANE

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# Abstract

This study investigates how media could foster engagement between sugarcane growers, extension officers, and scientists around a genetically modified variety of sugarcane. The research focused on two research sites in the north and south coasts of KwaZulu-Natal (KZN), where both small-scale and commercial sugarcane growers were interviewed. Using participative action research methodology, the researcher developed and tested various multimedia materials – specifically animated explainer videos and an accompanying information booklet. These materials were shaped by various interactions with both growers and scientists, including questionnaires, individual and focus group interviews, ensuring that the content would both be scientifically accurate and aligned with the concerns of grower communities.

The study aimed to establish their foundational understanding of GM products and identify the specific concerns that growers had regarding adopting GM crops. The research sought to create media resources to serve as an entry point for growers interacting with the GM sugarcane variety to foster engagement. The materials were tested through focus group discussions with growers, providing direct feedback on their effectiveness in conveying key information, addressing concerns, and fostering a constructive dialogue among stakeholders.

The feedback was analysed to identify areas for improvement. The analysis revealed several recurring themes and concerns, including limited land availability, scepticism towards GM crops, environmental concerns, and the necessity for clear and effective communication channels between scientists, extension officers, and growers.

The thematic analysis underscored the critical role of tailored media and communication strategies in successfully introducing GM crops to different grower communities. It became evident that creating media content that speaks to growers' specific concerns while presenting balanced information is crucial in overcoming barriers to adopting GM technologies. The insights suggest that effective communication and engagement strategies must be responsive to the local context, address environmental and economic concerns, and provide a platform for continued dialogue among all stakeholders.

The findings emphasise that communication strategies must be nuanced, context-specific, and inclusive, particularly in areas where small-scale and commercial farmers are present, and their needs may differ.

## Media produced

This praxis thesis is accompanied by a series of media products that form an integral part of the research. These materials consist of four videos and two informational booklets, each designed to convey key concepts related to genetically modified (GM) sugarcane in an accessible manner.

The first video is an animated production that provides a foundational explanation of genetically modified organisms (GMOs) and their relevance to developing a genetically modified sugarcane variety. The second video outlines growers' responsibilities should they adopt the GM sugarcane variety developed by the South African Sugarcane Research Institute (SASRI).

These videos have also been produced in isiZulu to ensure accessibility for a wider audience. In addition to the videos, an informational booklet has been developed, presenting the same content in written form. This booklet has also been translated into isiZulu.

These media products were developed to provide clear, practical, and engaging explanations of the subject matter. They aim to facilitate a broader understanding of and engagement around genetically modified sugarcane.

**https://drive.google.com/drive/folders/1nJU41vo0HGPu5OVckf0Itm5LxFGOMnNt?usp=sharing**

## Declaration

I hereby declare that this thesis is my own work. I have acknowledged all other authors' ideas and referenced direct quotations from their work. I have not allowed anyone else to borrow or copy this research.

Kyran Phil Blaauw

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## Dedication

This research is dedicated to my father, George Blaauw, who instilled the value, importance and power of education.

This labour of love is dedicated to my dearly departed mother, Katie and my aunt, Maggie.

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# Chapter 1: Introduction and Social Context

## 1.1. Introduction

This thesis, entitled *'Engaged Science: Multimedia as a Tool for Engagement Between Researchers and Growers on GM Sugarcane'*, bridges the fields of Biotechnology and Science Communication. The study emphasises engaged journalism and participant-centred Biotechnology that uses living organisms to develop GM products, a cornerstone of modern agricultural advancements (Glick, 2010). This study is informed by the principles of engaged research, which prioritises active collaboration and mutual learning between researchers and community stakeholders (Chevalier & Buckles, 2019). This approach is particularly relevant in the South African sugar industry, which has a complex and historically fraught backdrop that significantly influences the reception and integration of biotechnological innovations (Dubb, 2016).

This introductory chapter to this thesis, contextualises an exploration into science communication and engagement around a South African-developed genetically modified (GM) sugarcane variety. This GM sugarcane variety will be available for South African sugarcane growers for commercial use in the next decade. This chapter will first contextualise the South African sugar industry, situating it within South Africa's socio-economic landscape. The focus will then shift to a description of the common challenges that South African sugarcane growers experience. These challenges can potentially be addressed by implementing genetically modified (GM) sugarcane. However, as it will become apparent in the findings chapter of this thesis, small-scale growers, and to some degree, commercial growers, have concerns about GM sugarcane, particularly about accessibility to land. Thirdly, I will describe the organisations that support sugarcane farmers with these challenges, such as the South African Sugarcane Grower Association (SAGA), the South African Sugar Association (SASA), and its research institute, the South African Sugarcane Research Institute (SASRI). Finally, this chapter will examine the GM product that SASRI has developed in response to the challenges and problems faced by these growers, locating sugarcane GM technology in relation to the development of other GM crops in South Africa and globally.

## 1.2. Study background

In the past, science communication and engagement tended to model a deficit approach. The deficit approach is when institutions of knowledge and power disseminate the communication on scientific development top-down without consulting these communities and assuming that the public needs more scientific knowledge (Bucchi, 2008**).** Instead, this study aims to understand how concepts from the field of journalism studies can facilitate a more engaged and collaborative approach to science communication and engagement and enable these agricultural biotechnologists to develop technology specific to its contexts. This study, which forms part of a more extensive study, values and understands that engagement in science communication is crucial in democratising science and shifting it from being understood in deficit terms to being considered collaborative.

To develop a communication strategy as set out above, this study draws on communication for development, development journalism, engaged journalism and public journalism approaches for engaging the public to develop a science communication and engagement strategy for South African sugarcane farmers in KwaZulu-Natal.

### 1.2.1. Contextualising Biotechnology

Biotechnology is considered a crucial part of science and technology. This is because the field of Biotechnology has the proven potential for developing life-saving medication, food, and agricultural technology – all elements that can significantly contribute to socio-economic development. Biotechnology can be defined as "any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use" (Gastrow et al., 2017: 1). However, over the last few years, the public's understanding and perhaps even the lack thereof, has created an environment that has seen many people expressing their concerns about the impact Biotechnology could have on health, the environment and expressed moral concerns.

It is imperative to understand that biotechnology is not a field of research that has surfaced in recent years; it has been around for several decades and has deep roots in most cultures. The development and cultivation of GM crops for commercial purposes sparked debates related to product labelling, health concerns, and crop safety (Bauer & Gaskell, 2005). Subsequently, these debates continue in the media and other public sphere. Part of the public's grappling with the complexities of GM technology could be attributed to a need for more understanding. Still, part of it can also be attributed to how these technologies and innovations are communicated. And so, perhaps metaphors and appropriate imagery, if used effectively, can help us better understand and inform our thinking around GM crops and other Biotechnology innovations. Nelkin (2001: 556) writes, "metaphors are a prevalent and important vehicle of public communication, and they are essential in conveying scientific information." However, it is crucial to understand that such metaphors should be clearly defined and culturally appropriate when developing communication. When used correctly, metaphors enable us to communicate highly scientific and technical matters in a simple and culturally meaningful approach (Nelkin 2001).

Therefore, the central focus of this study is to develop a science engagement strategy for this genetically modified sugarcane variety. This chapter offers critiques of GM technology that are rooted in anti-science and perpetuated by anti-science lobby groups, but it also provides concerns raised by scientists. The need for this study is further strengthened by the lack of science communication and engagement communicators in South Africa, which can be attributed to South Africa's history with science and technology, which this chapter will explore.

### 1.2.2. Developing a pest-resistant and herbicide-tolerant sugarcane variety

The South African Sugarcane Research Institute (SASRI) is developing a genetically modified (GM) sugarcane variety that is pest-resistant and herbicide-tolerant. By incorporating insecticidal properties derived from the bacterium *Bacillus thuringiensis* (Bt), SASRI aims to develop sugarcane that is resistant to an insect pest, *Eldana saccharina* Walker (Lepidoptera: Pyralidae), reducing crop losses and minimising the need for chemical insecticides. Additionally, introducing a herbicide-tolerant trait will enable farmers to apply broad-spectrum herbicides without harming the sugarcane plants, simplifying weed control and improving agricultural efficiency. This dual approach reflects a broader global trend in biotechnology, where GM crops are designed to enhance productivity while promoting more sustainable agricultural practices.

#### 1.2.3.1. Pest-resistant sugarcane

The earliest recorded use of pest control can be traced back to the ancient Sumerians, who used sulphur compounds as insecticides (Unsworth et al., 2019). The development of modern organic pesticides began with the introduction of dichlorodiphenyltrichloroethane (DDT) in the 1950s (Turusov et al., 2002). However, due to its high toxicity to both humans and animals, its use was increasingly restricted and eventually criminalised (Rogan & Chen, 2005). This restriction and subsequent prohibition spurred investment in sustainable and responsible pest management practices.

The stalk boring insect, *E. saccharina* causes substantial damage to sugarcane plantations in South Africa (Carnegie, 1974). The larvae burrow into the stalks, reducing sucrose levels and consequently leading to significant financial losses for farmers (King, 1989; Keeping, 2006). The stalk borer results in financial loses to the South African sugar industry of about R 1 billion per year (https://sasri.org.za/pest-control/). Due to the economic impact of this pest, SASRI has been developing technologies to mitigate its effects. An Integrated Pest Management (IPM) approach, including genetically modified (GM) sugarcane, aims to offer a sustainable solution to pest-related losses.

The first genetically modified crop with insecticidal properties was maize (Camerini et al, 2024; Chassey, 2007). Its insecticidal properties were derived from *B. thuringiensis* (Bt). This innovation reduced reliance on sprayed chemical pesticides, which mitigated potential adverse effects on non-target organisms, such as bees, and lessened the labour required for pest control.

As part of an insect resistance management strategy, the practice of planting GM crops alongside non-GM crops, known as a refuge strategy, was introduced (Gould, 1998). The rationale behind this approach is to slow the development of resistance by ensuring that a portion of the pest population continues to feed on non-GM plants (Qiao, 2006). This prevents the dominance of pesticide-resistant pests within the population, thereby prolonging the effectiveness of GM crops as a pest control measure.

SASRI's research involves incorporating *Cry* genes from Bt bacterium – also utilised in GM maize—into the genetic makeup of sugarcane. This modification enables the sugarcane plant to express the same insecticidal proteins that are lethal to *E. saccharina*.

The toxicity of *Bacillus thuringiensis* (*Bt*) to *E. saccharina* is attributed to the production of insecticidal *Cry* and *Vip* proteins, which disrupt the pest's digestive system. This mechanism has been extensively studied in pest-resistant genetically modified (GM) crops (Schnepf et al., 1998; Bravo et al., 2007).

When *E. saccharina* larvae feed on GM sugarcane expressing Bt proteins, they ingest the CRY or VIP proteins and the plant tissue (James, 2011). The Bt proteins are activated in alkaline conditions of the insect's midgut. The proteins bind to receptors on the epithelial cells lining the insect's digestive tract (Bravo et al., 2007), and once bound, the Bt proteins form pores that damage the cells and compromise the insect's ability to absorb nutrients (Vachon et al., 2012).

#### 1.2.3.2. Developing a herbicide tolerant crop

Herbicide-tolerant (HT) crops were introduced to improve weed control in agriculture. Before their development, farmers relied on labour-intensive mechanical weeding or selective herbicides that targeted specific weeds but could also harm crops. The introduction of HT crops allowed farmers to use broad-spectrum herbicides, which could eliminate weeds without damaging the crop, reducing labour costs and improving yields (Duke, 2011).

The first HT crops were commercialised in the mid-1990s, with glyphosate-tolerant soybeans introduced in 1996 (James & Krattiger, 1996). These crops were designed to withstand glyphosate, a widely used herbicide that effectively kills weeds by disrupting an essential plant enzyme. With HT crops, farmers could spray entire fields with glyphosate, killing weeds while leaving the crop unharmed (Bonny, 2016). Following this success, crops such as maize, cotton, and canola were developed with similar herbicide-tolerant traits (Tsaftaris, 1996).

HT crops are developed by altering specific enzymes or herbicide binding sites to resist specific herbicides. This is done in two main ways: by introducing a new gene and altering the target plant's genes.

A number of HT crops are modified by adding a gene from bacteria that naturally tolerate herbicides. For example, glyphosate-tolerant crops contain a gene that enables them to survive exposure to the herbicide, allowing farmers to apply it broadly without harming their crops (Krimsky, 2019; 2021; Nandula, 2010). Some crops are developed by making small changes to their genes so they no longer respond to the herbicide. This can be done using traditional plant breeding or newer gene-editing techniques (Powels & Yu, 2010).

Adopting HT crops has transformed farming by making weed control easier and reducing the need for repeated ploughing, which can lead to soil erosion. However, widespread use has also contributed to the emergence of herbicide-resistant weeds, prompting concerns about long-term sustainability. As a result, many farmers now use integrated weed management approaches that combine different control methods rather than relying solely on HT crops (Owen, Beckie, Leeson, 2015).

## 1.3. Positioning the South African Sugar Industry

Agriculture is a crucial part of any developing country like South Africa, especially for those living in its rural parts (Aliber & Hall, 2012). Generally, the agricultural sector is a vital economic contributor in countries like ours. Agricultural commodities like maize tend to draw significant public attention, and sugar is one such commodity. There are nearly 100 sugar-producing countries, and South Africa is only one of five sugar-producing and exporting countries in Sub-Saharan Africa (Hess et al., 2016). The sugar, currently traded globally, is sold under bilateral agreements. Because of government policies and influences, sugar prices tend to need to be more balanced in the global markets (Pop et al., 2013). The sugar sector of South Africa is cost-competitive; South Africa regularly emerges as one of the top 15 from close to 120 other sugarcane-producing countries worldwide. In South Africa, sugarcane is primarily grown in KwaZulu-Natal, Mpumalanga, and the northern parts of the Eastern Cape, progressively changing the lives of South African citizens and contributing generously to the socio-economic development of these communities (SASA, 2022). The South African sugar sector garners close to R6 billion rand on exports supplied to the Southern African Customs Union (SACU) and other corners of the world. The industry also generously contributes to the national GDP through employment, education, and partnerships with major industry stakeholders. The sugar sector accounts for at least 4.5% of the agricultural sector (Sibiya & Hurly, 2011).

While sugarcane is essential for nutritional and economic purposes, South Africa's sugar sector declined from the early 2000s and continues to fluctuate (Zulu et al., 2019). These declines cause distress to the industry (Garside & Bell, 2007). The decrease in sugarcane production in South Africa means there has been an increase in these role-players' reliance on the government for financial support like social grants because farmers are not making a profit. A 2009 study found that poor weed control contributes to lower yields, furthermore inadequate grower education, and crop management also contributes to a decline in the South African sugar sector (Mandla et al., 2011). For sugarcane producers, the cost of labour is also a cause of the decrease in production in the sugar sector (Armitage et al., 2009). Climate change has also contributed to a continuous change in the sugar sector. For example, Dubb (2013) notes that extreme climate, such as drought, ravages the KwaZulu-Natal region. Because farmers fail to implement adaptive strategies, combined with low levels of education, their farms succumb to bankruptcy (Zulu et al., 2019).

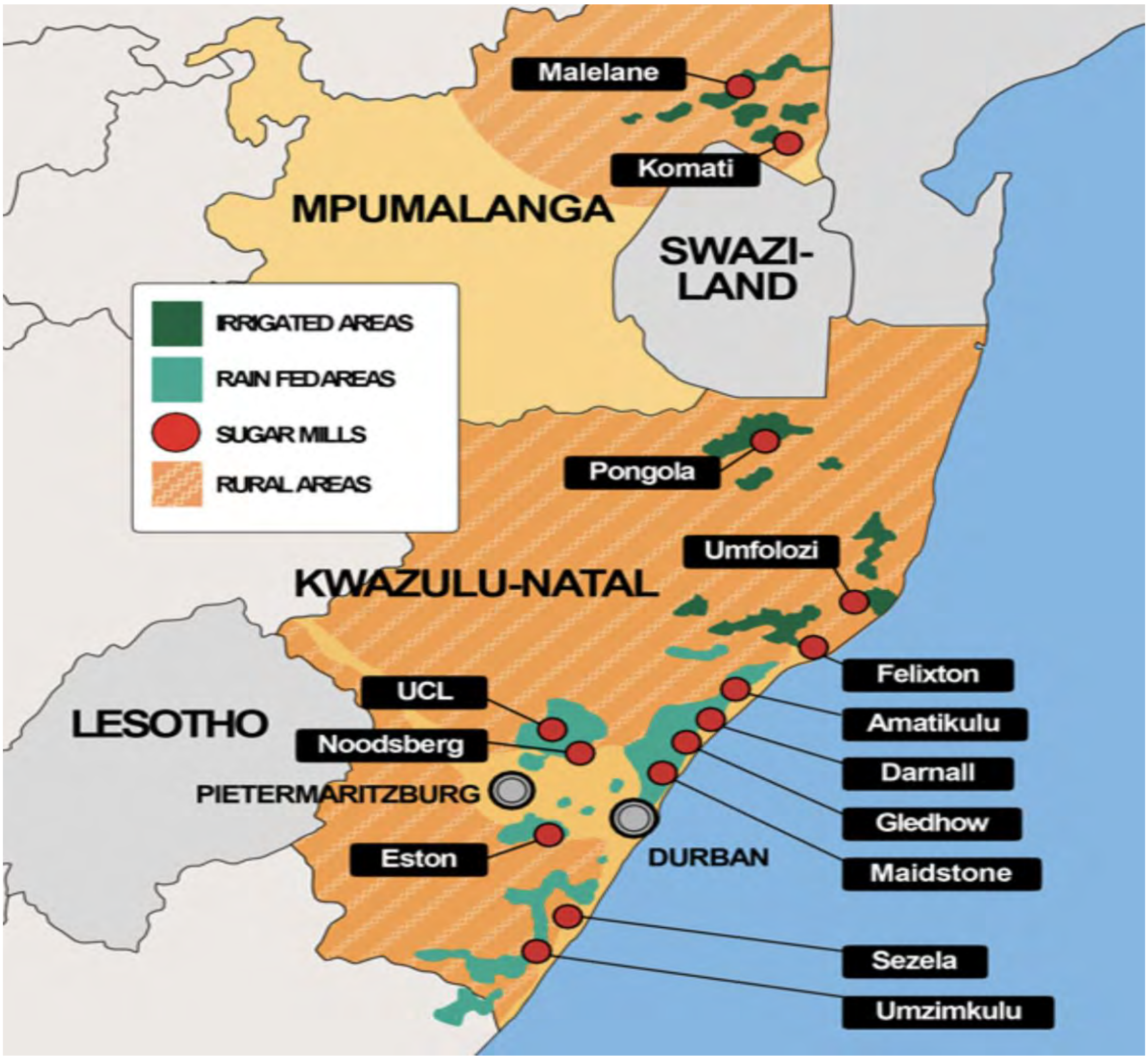



*Figure 1 Detailed map of the South African sugar production regions (South Africa Sugar Association, 2022).*

### 1.3.1. The managing and grower representative bodies within the South African sugar industry

Millers and growers belong to the South African Sugar Association (SASA), who are governed by governed by the Sugar Act (1978), the Sugar Industry Agreement (2000, amended in 2024) and the SASA Constitution. SASRI consists of numerous departments that primarily deal with research and development to address agricultural production challenges that growers face SASRI, the research and development unit of SASA, is responsible for developing the genetically modified sugarcane crop, which is currently being developed and tested in a controlled environment, under a GMO facilities registration permit in Mount Edgecombe, KwaZulu-Natal. The unit has close relationships with numerous universities in South Africa and abroad with whom they collaborate to conduct specialist research. SASRI communicates research developments with stakeholders via its extensive network of extension specialists. They form crucial links to the technology transfer process, and their primary role is encouraging growers to adopt improved science-based framing practices and to provide other support, such as skills development.

The South African sugarcane industry is built on profit sharing among the millers and growers. The South African Sugar Association's role is to facilitate the growers' partnership through the South African Cane Growers' Association (SACGA) and the South African Millers' Association Limited. Each of these stakeholders has an equal number of representatives that make up the governing council of the SASA, which is an independent organisation with no relationships with the South African government. Their sole regulatory framework is the South African Sugar Act. The organisation consists of numerous divisions that primarily deal with research and development to address agricultural production challenges that growers face. The South African Sugarcane Research Unit (SASRI) has three programmes, including variety improvement, crop protection, and resource optimisation, each having close to 85 subprojects (Snyman et al., 2008). SASRI, the research and development unit of SASA, is responsible for developing the genetically modified sugarcane crop, which is currently being tested in a controlled environment at the research facilities in Mount Edgecombe, KwaZulu-Natal. The unit has close relationships with numerous universities in South Africa and abroad with whom they collaborate to conduct specialist research, much like this study. The South African Sugarcane Research Institute needs to get the developments from their research facilities to the people they are accountable to and who can benefit from their work. The unit does this through its extensive network of extension specialists. These extension specialists form crucial links to the technology transfer process. Their primary role is encouraging growers to adopt improved science-based framing practices and other economic support, such as skills development, to acquire funding.

### 1.3.2. The dissemination of information to and support for growers

Because the sugar sector operates quickly, these extension specialists are strategically located throughout the industry, with some working closely with the Department of Agriculture, Land Reform, and Rural Development (DALRRD). These skilled extension officers are strategically located across South Africa's sugarcane industry. They ensure that growers access research outcomes and other crucial research outputs. The South African Sugarcane Research Institute Extension Services Unit plays an integral part in their research programmes by communicating stakeholder needs to SASRI researchers so that they can develop an appropriate research program. They facilitate effective technology transfer and enable growers to access various support services. Bembridge et al. (1983) note that these extension officers are near sugarcane growers. The sugarcane growers they serve show strong determination to disseminate essential research outcomes and are skilled at effective communication with growers around research outcomes. The primary purpose of agricultural extension services is to promote development (Kepe, 2004).

The idea of extension can be interpreted in several ways. According to Saville (1965), extension is a system and a process of education for rural people who are often involved in agricultural practices. Adding on to this, Maunder (1972) states that the idea should be viewed as a holistic package that enables agrarian communities, by employing educational methods, to inform them about best farming practices and production processes to increase the productivity of food and see a higher profit. Furthermore, extension services can be viewed as the necessary state-provided support given to agricultural producers to empower, enable, and equip them to establish and assess the difficulties in their production process. This ensures that they can devise solutions to these challenges (Adams, 1982). According to Bembridge (1979), extension is a communication mediation focused on improving and facilitating these improvements to solve challenging circumstances agricultural producers face. Agricultural extension support is fundamental in distributing agricultural best practice insights and practical skills and offering guidance on best farming practices by connecting agricultural producers with other vital economic actors. Currently, South Africa needs more extension support in some regions of South Africa. The extension support to farmer ratio is 1:1033 for non-governmental support and 1:170 for government extension support (Koch & Kralik, 2006). This dire state of affairs has placed several agricultural producers in challenging positions, making them unable to keep up with changing agricultural technological developments.

## 1.4. Challenges faced by sugarcane growers in South Africa

South African sugarcane farmers face a myriad of challenges. This study acknowledges the wide range of hardships these growers face that need urgent attention to avoid the collapse of an essential part of the economy. However, this research will primarily focus on two critical challenges that might be addressed by introducing GM sugarcane.

The first of these challenges is the *Eldana saccharina* Walker, a stalk borer primarily found in Africa that thrives in wetlands and grasses with warmer temperatures and areas that receive high rainfall (Atkinson, 1980). In South Africa, the *Eldana saccharina* Walker has become a severe pest in the sugarcane areas of KwaZulu-Natal and Mpumalanga. Where infestations are severe, they often lead to sugarcane yields being rejected by mills. The life cycle of the *Eldana* *saccharina* Walkeris like that of other insects, starting with eggs, then larvae, pupae, and then moths (Sampson & Kumar, 1985). Climate and access to food play a significant role in the life of the *Eldana saccharina* Walker (Way, 1995). The *Eldana saccharina* Walker eggs generally hatch after eight days, and the larvae, during summer seasons, take 20 days and 60 days in winter to mature; it takes about ten days for the moth to emerge from the pupae (Carnegie, 1974). These moths then live for no more than seven days. The populations of moths are at their highest during summer seasons, and the larval populations peak usually in winter (Carnegie & Leslie, 1979). There are usually some moth peaks during autumn, but this can primarily be attributed to old carry-over cane in the fields when the mills are closed.

In Africa, stalk borers like the *Eldana saccharina* Walkercause the most damage to sugarcane. Studies indicate a close relationship between the reduced sucrose content of sugarcane and *Eldana saccharina* Walker infestations ( Way & Goebel, 2003), meaning that sugarcane farmers have little recoverable value. Recoverable value (RV) refers to the total recovered value of sugar and molasses extracted from the cane that individual sugarcane delivers to the mill. Wynne et al. (2009) argue that this payment method has provided essential benefits so that growers take the necessary steps to produce higher-quality sugarcane harvests for mills. The highest sucrose amount is extracted and not reduced by unwanted materials. Peacock and Schorn (2002) note that recoverable value (RV) is the most popular and recent way of assessing sugarcane quality used by South African millers to pay sugarcane producers. In South Africa today, *Eldana saccharina* Walker costs the sugarcane industry close to R 1 billion in annual loss (Jone & Singles, 2015).

The second core challenge that sugarcane growers face is the use of multiple herbicides. As Carson (1962) has argued in her seminal study, pesticides and herbicides do not just target pests but these chemicals remain in the soil for long periods and disturb surrounding ecosystems. In addition to adverse environmental impacts in using multiple herbicides targeting different weeds, there is an economic aspect because growers need to invest significant expenditure in purchasing herbicides, which is difficult for small-scale farmers (Mpandeli & Maponya, 2014). Alternatively, more environmentally conscious ways to cultivate and preserve crops should exist. Broad spectrum glyphosate herbicides for single usage on GM herbicide-tolerant crops offer one possible solution to reduce herbicide usage.

## 1.5. Sugarcane growers in South Africa: Differentiating between small-scale and commercial growers

This is located on KwaZulu-Natal's North and South Coast. On the North Coast, which is more inland. Large-scale growers, also known as commercial sugarcane growers, were interviewed in the Amatukulu region. Where a sugarcane producer yields >1 600 tons of sugarcane in a year, they are classified as a large-scale sugarcane producer. Small-scale sugarcane growers in the Sezela and Umzimkhulu regions on the South Coast, which is more coastal, also form part of this study. A small-scale sugarcane grower producer yields <1 600 tons of sugarcane annually.

It is also imperative to note that the study is located in two different regions of KwaZulu-Natal. This given the distinct climatic differences between the North and South Coasts. These variations, the temperature, humidity, and rainfall between the North and South Coasts, influenced by factors such as ocean currents and latitude, offer a compelling basis for understanding the cultivation of sugarcane.

The North Coast is generally considered a subtropical region warmer than the South Coast. In summer, temperatures often exceed 30°C and receive significant rainfall, particularly in the summer months (November to March), because of the influence of tropical systems from the Indian Ocean. The annual rainfall ranges from 900 to 1,200 mm.

On the other hand, the South Coast is also subtropical. However, it is slightly more relaxed than the North Coast. Summer temperatures are warm but generally do not reach the same highs as the North Coast, and winter temperatures can be mild to cool. The region receives significant rainfall, particularly in summer. The annual rainfall ranges from 800 to 1,000 mm.

### 1.5.1. Decision to focus on small-scale growers

During the initial phase of this study most participants were large-scale growers. It soon became apparent that there was a noticeable pattern: most of these individuals were male and white. This posed a challenge as this demographic does not represent the entirety of the sugar industry. Upon further investigation, I discovered that the extension officer I was consulting primarily worked with commercial growers, which explains the prevalence of large-scale growers among my interviewees. While the insights from these growers are valid, it is crucial to acknowledge that they already have access to information and resources, a privilege not typically available to small-scale growers. Recognising this disparity, I understood the necessity of including small-scale growers in my research to ensure a more comprehensive and representative understanding of the sugar industry.

At the centre of this study are small-scale growers. However, to understand why this decision was made, it is essential first to understand what small-scale farmers mean. There have been variations in terminology when referring to this subset of farmers. According to Cousins (2013), it is difficult to define this group of farmers because of the need for more data on small-scale farmers.

In the South African context, according to Kirsten and Van Zyl (1998), the term small-scale farmers is often used when referring to non-commercial and subsistence agriculture. It is also used when referring to the total number of farmers involved in the production, mainly if it is small-scale.

However, it is imperative to understand that small-scale farmers can be divided into two subsets. The first is when referring to emerging small-scale farmers. These are generally Black farmers who trade their goods commercially (Aliber & Hall, 2010). The second group of small-scale farmers are known as subsistence farmers, who, as the phrase describes, produce goods for sustenance.

In South Africa, small-scale farming typically occurs within a specific socio-economic condition. When one looks at rural communities, they develop strategies to adapt to their condition based on the opportunities at their disposal (Tittonell et al., 2005). According to Pauw (2007), many rural communities are directly or indirectly involved in farming, given South Africa's fraught history, to ensure their existence.

One would typically find small-scale farmers in South Africa's former homelands, and as previously mentioned, are previously disadvantaged groups. The land these farmers produce their assets on varies in size (Lahiff, 2000; Chipokolo, 2006).

According to Aliber and Hall (2010), it was the Development Bank of Southern Africa that, in the 1980s, first offered support to small-scale farmers. Some of this support varied from training, capital inputs and marketing.

After the dawn of democracy, there was a shift in how small-scale farmers were viewed. A spike was to assist these farmers in becoming commercial and expanding their operations (Aliber et al., 2008). This shift aimed to narrow the gap between small-scale and large-scale farmers, of whom the latter tends to be primarily White and male. However, policy interventions have yet to do much; if anything, they were done very slowly (Lahiff & Cousins, 2005).

In South Africa, small-scale farmers face several challenges that hinder their ability to grow. These constraints can be classified as endogenous and exogenous constraints. Endogenous or internal constraints could negatively impact a farmer's ability to operate efficiently, regardless of their high farming potential and knowledge of utilising resources efficiently. Exogenous or external constraints are challenges beyond the farmer's control, such as lack of access to credit, agricultural inputs, mechanisation, markets, and insecure land tenure (DBSA, 2009). Additional challenges could include the lack of skills, lack of extension services, poor institutional arrangements, and poor infrastructure challenges.

Small-scale farmers in South Africa operate under numerous constraints that significantly hinder their agricultural activities. Access to land remains a challenge for many small-scale farmers. Historically rooted in colonial and apartheid-era land policies, land distribution in South Africa remains highly skewed, with large tracts of fertile land owned by a few commercial farmers (Aliber & Hall, 2010). Small-scale farmers are often confined to less fertile lands and more susceptible to environmental stresses, further exacerbating their vulnerability.

Furthermore, small-scale farmers need more access to financial services. Compared to large-scale farmers with the financial standing to secure loans and invest in modern agricultural inputs, small-scale farmers are often included in formal financial systems (Cousins, 2013). This financial exclusion limits their ability to purchase quality seeds, fertilisers, and equipment, resulting in low crop yields and, in some instances, unprofitable operations. The inability to access credit also hampers their capacity to adopt new technologies and improve their farming practices.

Another significant challenge small-scale farmers face is the need for more market access. Large-scale farmers benefit from established supply chains, marketing networks, and infrastructure that facilitate the efficient sale of their produce. In contrast, small-scale farmers often need more means to transport their goods to markets and cannot compete with larger commercial entities (Perret & Kirsten, 2000). This market exclusion reduces their income potential and diminishes their motivation to increase production, trapping them in a cycle of subsistence farming.

The marginalisation of small-scale farmers is further compounded by insufficient institutional support. Government policies and development programs tend to favour commercial agriculture, providing subsidies, technical assistance, and training programs that are not equally accessible to small-scale farmers (Aliber & Hall, 2010). The lack of tailored support services leaves small-scale farmers without the necessary knowledge and skills to improve their agricultural practices, making them more vulnerable to economic and environmental shocks.

In light of these challenges, the decision of this study to include small-scale farmers is driven by the urgent need to address their marginalisation and support their development. Small-scale farmers are crucial in ensuring food security and promoting rural livelihoods. Enhancing their productivity and resilience makes it possible to contribute to broader socio-economic development goals and reduce rural poverty (Aliber & Hall, 2010). Providing targeted support to small-scale farmers can also promote more equitable and inclusive agricultural growth, addressing historical injustices and fostering social cohesion.

## 1.6. GM crops as a response to grower challenges

Some of the challenges these growers face could be addressed through genetic modification. Genetic modification is the process of directly transferring genes from one living organism to a living host organism with the intention for that host organism to produce desired traits such as herbicide tolerance, pest resistance, or increased yield. Plants that have received these natural genes artificially are called transgenic or genetically modified organisms. The method of genetically modifying crops, particularly in the agricultural sector, is aimed at developing crops that can withstand environmental changes (Raman, 2017). A few steps are involved when producing genetically modified crops, focusing on identifying the target gene (Becker et al., 2000). Since 1996, herbicide-tolerant and pest-resistant crops have been some of the most common traits in commercially produced GM crops (James, 2011).

Part of this reimagination of science for social and economic good made South Africa one of the first African countries to adopt genetically modified crops (Kirsten & Gouse, 2002). GM technology was adopted especially in the commercial crop production sectors with regards to food security, the generation of the economy for the agricultural industry, and those living below the breadline (Bothma et al., 2010). South Africa first adopted GM technology in 1997, starting with GM cotton. GM technology is currently being used to experiment with maize, soybean, and sugarcane, whereas other parts of the world already have herbicide-tolerant GM sugar beet (Dewar et al., 2003). The most prevalent traits in GM crops produced in South Africa are *Bt* insect-tolerant maize, herbicide-tolerant maize, and cotton (Bothma et al., 2010). GM crops are highly regulated in South Africa with regards to the specific health and environmental processes that they must go through before being released for commercial cultivation; this process is generally managed by the Department of Land Reform and Rural Development under the Genetically Modified Organisms Act 15 of 1997 (South African Government, 2022). The Act oversees the development and implementation of policies and strategies around GMOs, and makes provision for technical advice related to GMOs, ensures due diligence and compliance, and provides overall administrative support to oversee the introduction of genetically modified food (Bothma et al., 2010).

## 1.7. Understanding the debates around GM corps

As the adoption of genetically modified (GM) crops continues to rise, with food security as the primary focus, debates surrounding GM crops and technology have also intensified. The research and development of this GM sugarcane variety occur within a polarised society where GM crop technology is subject to scientific and unscientific critiques. One of the most significant debates is the claim that GM crops are unnatural. This argument originated from anti-GMO lobby groups in Europe, which asserted that introducing such crops into agricultural systems posed undocumented health and environmental risks (Lassen et al., 2002). However, multiple studies contend that GM crops are safe for human consumption. Countries like South Africa have stringent biosafety protocols that must be met before any new GM crop can be approved for commercial use (König et al., 2004; Smyth & Phillips, 2014; Clark & Lehman, 2001).

A common concern is that *Bacillus thuringiensis*, a key component in developing insect-resistant crops such as this GM sugarcane variety, may be toxic to essential insects and humans. While potential impacts on general insect populations have been acknowledged, studies have shown that beneficial pollinators such as the ladybird (*Propylea japonica*), the green lacewing (*Chrysoperla nipponensis*), and the honeybee (*Apis mellifera*) are not adversely affected by this soil bacterium (Xie et al., 2018).

Another widespread but unfounded claim is that GM crops are linked to congenital disabilities, infertility, and homosexuality. This form of propaganda is particularly prevalent in African societies, where anti-GM lobbyists exploit deeply rooted cultural values—where fertility is paramount and congenital disabilities are considered a curse. Homosexuality is deemed unacceptable in certain cultures (Lynas, 2018). According to Lynas (2018), these lobbyists often operate under the guise of aid workers in financially vulnerable African nations, leveraging their influence over government officials to restrict the cultivation and importation of GM crops. The media plays a crucial role in shaping these anti-GM narratives, particularly in emerging economies that could benefit from the technology (Esquivel et al., 2023).

One of the most legitimate criticisms of GM crops concerns the monopolisation of seed ownership and patents by multinational corporations. A key argument against the commercialisation of GM crops, particularly in emerging economies such as South Africa, is that this technology diminishes the control of small-scale farmers over their food production systems (Holt-Giménez & Wang, 2011). The industrialised food production model prioritises large-scale mass production and limits access to farming resources for smaller producers. National governments have played little to no role in regulating these production systems, as the World Trade Organisation governs them. Holt-Giménez and Wang (2011) argue that such a system sustains a neoliberal agenda that primarily serves the interests of multinational corporations through mass overproduction. Opponents of GM crops view these crops as an intrinsic component of this exploitative model.

La Via Campesina, a European non-governmental organisation advocating for small-scale farmers' rights, has widely criticised this neoliberal approach to food production. The organisation strongly opposes the introduction of GM crops in economically vulnerable and emerging nations, seeing it as a mechanism for multinational corporations to dominate not only small-scale farmers but also the food production processes of these economies (Menezes, 2004). La Via Campesina argues that if GM technology genuinely benefits all nations seeking to incorporate it into their agricultural systems, then both the science and the seeds should be freely accessible rather than controlled by a handful of corporations (Desmarais et al., 2008). According to Naylor (2017), including GM crops will only exacerbate social and economic inequalities within food production. However, this concern does not apply to GM sugarcane, as sugarcane is not propagated through seeds, but vegetatively through cuttings.

Another point of contention is the belief that GM crops guarantee increased yields. Some scholars argue that emerging nations are often misled into believing that GM crops will automatically enhance agricultural productivity (Bawa & Anilakumar, 2013). Herrera-Estrella and Alvarez-Morales (2001) caution against the assumption that GM crops consistently yield higher yields, urging nations to evaluate their expectations critically.

### 1.7.1. Socio-economic Aspects and the Debate Around Interests of Global North Interests/corporates

Many large corporations own patents for GM crops, which has resulted in marginalisation (Smith & Tilman, 2020). As Kloppenburg and Kleinman (1987) argued, patents grant corporations control over seed distribution, potentially marginalising small farmers and creating dependencies on proprietary technologies. This monopolistic control can exacerbate socioeconomic disparities, particularly in developing countries like South Africa. Shiva (2016) argued that multinational corporations' control of GM seeds undermines food sovereignty and threatens traditional agricultural practices and local food security.

Environmental risks are another contentious point in the anti-GM debate. Critics argue that GM crops can have unintended ecological consequences, including the potential for gene transfer to non-target species. This phenomenon, known as gene flow, could create "superweeds" resistant to herbicides, complicating weed management and harming biodiversity (Bain et al., 2017). Warwick et al. (2009) found that gene flow from GM crops to wild relatives can indeed occur, raising concerns about the long-term ecological impacts of GM cultivation.

One of the primary advantages of GM crops is increased agricultural productivity (Pellegrino et al., 2018). These varieties can yield higher yields because GM crops resist pests, diseases, and extreme environmental conditions. These gains apply to crops such as maize, cotton, and soybeans.

Lechenet et al. (2014) argue that another benefit of GM crops is the reduced use of chemical pesticides. GM crops, such as Bt cotton, are engineered to produce toxins harmful to specific pests, like the *Eldana saccharina* Walker, but safe for humans and other non-target organisms, like bees. This reduced pesticide usage decreases production costs and reduces the environmental impact. Brookes and Barfoot (2018) found that GM crops have reduced pesticide spraying by 8.2% globally, equivalent to 671.5 million kilograms less active ingredients being used.

The economic advantages of GM crops extend beyond direct farm income. GM crops provide consistent yields by improving crop reliability and reducing losses due to pests and environmental damage. This stability is crucial for smallholder farmers in developing countries, where agriculture is often the primary source of income. Smale et al. (2009), who examined the economic impacts of GM maize in South Africa, found that small-scale farmers who adopted GM maize saw a 10-20% increase in their income compared to those who grew conventional maize.

Furthermore, adopting GM crops can significantly save labour and operational costs. For example, herbicide-tolerant crops allow for more effective weed control with fewer labour inputs, as seen with GM soybean farming in Argentina. The study by Qaim and Traxler (2005) showed that Argentine farmers saved approximately $400 million annually in weed control costs due to adopting herbicide-tolerant soybeans.

Reduced pesticide use has a direct environmental benefit, as it leads to less chemical runoff into water bodies, reduced soil contamination, and decreased harm to non-target species, including beneficial insects and soil microorganisms. Marvier et al. (2007) found that fields of *Bt* cotton were more useful for insects than non-GM cotton fields due to the reduced need for broad-spectrum insecticides, however more research around this claim is needed

Additionally, GM crops can contribute to soil conservation and reduce greenhouse gas emissions. Conservation tillage, which involves minimal soil disturbance, is facilitated by herbicide-tolerant GM crops. This practice helps maintain soil structure, reduce erosion, and increase carbon sequestration in the soil. Tillman et al. (2012) found that cultivating GM crops has significantly reduced greenhouse gas emissions, estimated at 23.1 billion kilograms of $CO_2$ in 2010 alone, equivalent to removing 10.2 million cars from the roads for a year.

From a health perspective, GM crops offer several advantages. They can be developed to improve nutritional content, a process known as biofortification (Bouis & Saltzman, 2017). One well-known example is Golden Rice, genetically modified to produce beta-carotene, a precursor of vitamin A. Vitamin A deficiency is a significant health issue in many developing countries, leading to blindness and increased mortality. Tang et al. (2012) found that Golden Rice effectively provides vitamin A and could significantly reduce the prevalence of vitamin A deficiency among children in affected regions.

Moreover, reduced pesticide use also decreases the risk of pesticide exposure to farm workers and nearby communities, thus improving public health. Benbrook (2012) argues that *Bt* crops, which require fewer insecticides, have resulted in fewer incidences of pesticide poisoning among farm workers.

### 1.7.2. Concerns around glyphosates and pesticides

Glyphosate, the active ingredient in many herbicides such as Monsanto's Roundup, is another concern and topic of extensive debate regarding its safety and environmental impact. This debate has generated numerous myths, some based on misunderstandings or misinterpretations of scientific data.

While more research is needed, one of the most pervasive discussions about glyphosate is that it is carcinogenic (Solomon, 2016). This belief gained significant traction following a 2015 report by the International Agency for Research on Cancer (IARC), which classified glyphosate as "probably carcinogenic to humans" (IARC, 2015). However, this classification was based on "limited evidence" of carcinogenicity in humans and "sufficient evidence" in animals, mainly from studies where animals were exposed to high doses.

However, several regulatory bodies, including the U.S. Environmental Protection Agency (EPA), the European Food Safety Authority (EFSA), and the Food and Agriculture Organization (FAO), found that glyphosate is unlikely to pose a carcinogenic risk to humans when used according to labelled instructions (EPA, 2020; EFSA, 2015; FAO, 2016). The EPA's 2020 interim decision stated that glyphosate is not likely to be carcinogenic to humans based on a thorough review of the available scientific evidence (EPA, 2020).

A further contention is that glyphosate causes significant environmental damage (Giesy et al., 2000). While it is true that glyphosate can impact non-target plant species and aquatic ecosystems if not used properly, its environmental persistence and toxicity are generally low compared to other herbicides (Williams et al., 2000; Duke & Powles, 2008). Glyphosate binds tightly to soil particles, reducing mobility and potentially contaminating groundwater (Torretta et al., 2018). It degrades relatively quickly through microbial activity, resulting in low environmental persistence (Giesy et al., 2000).

However, concerns remain about the impact of glyphosate on biodiversity, particularly regarding its use in agriculture, leading to monoculture practices, like only growing sugarcane, and the decline of certain species like milkweed, which is crucial for monarch butterflies (Pleasants & Oberhauser, 2013). While glyphosate may not be highly toxic to the environment, its role in broader agricultural practices can have indirect ecological consequences.

People fear that glyphosate residues in food can pose health risks. Regulatory agencies worldwide have established maximum residue limits (MRLs) for glyphosate in foods based on rigorous risk assessments to ensure consumer safety (Codex Alimentarius Commission, 2018).

Studies have shown that the glyphosate residues found in food are generally well below these MRLs (Benbrook, 2016).

The U.S. Food and Drug Administration (FDA) and the European Food Safety Authority (EFSA) conduct regular monitoring of glyphosate residues in food products and consistently report that the detected levels are within safe limits (FDA, 2018; EFSA, 2018). When regulatory limits are adhered to, the risk to human health from glyphosate residues in food is considered very low (Williams et al., 2000).

Proponents of glyphosate argue that it is essential for modern agricultural practices, particularly for no-till farming, as it helps reduce soil erosion and improve soil health. While glyphosate has undoubtedly facilitated these practices, it is optional. Integrated pest management (IPM) strategies and alternative herbicides can also effectively control weeds (Liebman & Davis, 2009). Moreover, relying heavily on glyphosate has led to the emergence of glyphosate-resistant weed species, necessitating a more diverse approach to weed management (Heap, 2020).

## 1.8. Towards a Balanced Conceptual Framework: Integrating Critical Perspectives and Journalism Models

The complex landscape of genetically modified (GM) sugarcane technology demands a nuanced understanding that neither dismisses potential benefits nor overlooks substantive critiques. This study acknowledges that whilst GM technology offers promising solutions to agricultural challenges, it operates within contested terrain characterised by legitimate environmental, economic, and social concerns that require careful examination alongside potential advantages.

### 1.8.1. Reframing the GM Technology Discourse: Beyond Binary Perspectives

Contemporary scholarship increasingly recognises that GM technology presents a paradox of promise and peril (Howard, 2015; Glover, 2010). The technology's capacity to address pressing agricultural challenges, such as pest resistance and herbicide tolerance in sugarcane cultivation, must be understood alongside mounting evidence of associated risks. Critical analyses reveal that glyphosate-tolerant GM crops, whilst increasing short-term productivity, have contributed to the emergence of herbicide-resistant weeds and raised serious health concerns (Benbrook, 2016; Mesnage & Antoniou, 2018). Recent studies have demonstrated correlations between glyphosate exposure and adverse health outcomes, including reduced birth weights and shortened gestational periods, particularly affecting vulnerable rural populations (Lesseur et al., 2022).

Furthermore, the corporate concentration of seed ownership represents a fundamental restructuring of agricultural systems that extends beyond technical considerations to encompass questions of food sovereignty and economic justice (Shiva, 2016; Howard, 2021). The control exercised by multinational corporations over patented GM seeds has transformed traditional farming practices, creating dependencies that critics argue undermine farmers' autonomy and perpetuate inequalities (Kloppenburg, 2014). These concerns are particularly pertinent in the South African context, where historical inequalities intersect with contemporary technological adoption patterns.

### 1.8.2. Integrating Critical Perspectives into the Conceptual Framework

Rather than treating critiques of GM technology as peripheral considerations, this study positions them as integral elements within a comprehensive analytical framework. The responsible research and innovation (RRI) approach, as conceptualised by Stilgoe, Owen, and Macnaghten (2013), provides a robust foundation for this integration through its four dimensions: anticipation, reflexivity, inclusion, and responsiveness.

Anticipation requires acknowledging potential long-term consequences of GM adoption, including ecological disruption, economic dependency, and social displacement (Stilgoe et al., 2013). Reflexivity demands critical examination of the assumptions underlying technological solutions, questioning whose interests are served and whose voices are marginalised. Inclusion necessitates meaningful engagement with diverse stakeholders, particularly smallholder farmers who may experience differential impacts from technological adoption (Stilgoe et al., 2013). Responsiveness ensures that research directions and innovation pathways remain adaptable to emerging evidence and changing societal needs (Stilgoe et al., 2013).

This integrated approach recognises that the scientific validity of GM technology does not automatically resolve its social acceptability or long-term sustainability. Environmental concerns regarding gene flow, biodiversity impacts, and herbicide resistance patterns must be considered alongside agronomic benefits (Ervin et al., 2021). Economic critiques highlighting corporate concentration and farmer dependency require attention equal to productivity gains. Cultural and ethical objections rooted in diverse worldviews deserve consideration alongside scientific assessments of safety and efficacy.

### 1.8.3. Clarifying journalism models for science communication

The distinction between journalism models becomes crucial in determining how these complex issues are communicated to diverse publics. This study employs a multi-model approach that recognises the unique contributions and limitations of different journalistic paradigms.

Development journalism, whilst valuable for its focus on social progress, risks reproducing top-down communication patterns that privilege expert knowledge over local wisdom (Waisbord, 2001). In the context of GM technology, this model might emphasise potential benefits for agricultural development whilst inadvertently marginalising farmers' experiential knowledge or cultural concerns. However, when applied reflexively, development journalism can effectively communicate how technological innovations align with broader development goals whilst acknowledging associated trade-offs.

Public journalism offers a more democratically engaged approach by positioning journalists as facilitators of public discourse rather than merely information transmitters (Rosen, 1999). This model proves particularly valuable for GM-related coverage as it encourages deliberative discussion about complex technological choices that affect entire communities. Public journalism's emphasis on civic engagement aligns with RRI principles by fostering informed democratic participation in technology governance.

Engaged journalism represents the most participatory model, leveraging digital platforms to create ongoing dialogue between journalists, scientists, and communities (Lewis et al., 2014). This approach proves especially relevant for biotechnology communication as it enables iterative feedback, addresses community concerns in real-time, and builds trust through sustained interaction. Engaged journalism's emphasis on community agency resonates with community-based participatory research (CBPR) principles whilst maintaining journalistic integrity.

### 1.8.4. Methodological Implications

Development journalism techniques will be employed to communicate scientific findings and policy implications clearly, ensuring accessibility without oversimplification. Public journalism approaches will guide the facilitation of community discussions about GM technology adoption, creating spaces for democratic deliberation. Engaged journalism methods will enable ongoing dialogue between researchers and farming communities, ensuring that communication remains responsive to evolving needs and concerns.

The integration of these models reflects recognition that effective science communication requires multiple approaches tailored to diverse audiences and communicative contexts (Bucchi, 2008). Rather than privileging any single model, this study employs each strategically whilst maintaining transparency about their respective strengths and limitations.

## 1.9. The history of biotechnology and science communication in South Africa

The secretive and exclusionary practice of scientific research and development during the colonialism and apartheid regimes would lay the foundation for the top-down approach to science communication and engagement in South Africa. In the early years before Dutch and British rule, African civilisation had a thriving indigenous science and technology culture. When colonialism was in full effect, the colonialists claimed ownership of this intellectual property for their imperial gain and disrupted this expanded science and technology industry (Heldring & Robinson, 2012). Colonial science was designed to serve the elite minority and exclude the Black communities subjected to intellectual oppression and exploitation (Kohn, 2010). Settlers viewed the African continent as dark and its peoples as primitive, lacking modern rationality. For these settlers, science was one of many ways for those now in the claws of oppression to be ushered into 'modernity' (Maldonado-Torres, 2004). Following colonialism, apartheid emerged. The apartheid regime seemingly adopted the same isolated scientific research and development approach. During the apartheid period, science was still highly secretive, taking place in isolation from the public, and characterised by self-serving interest and profits as well as stringent censorship around the apartheid South Africa's government research into the development of nuclear weapons (du Plessis, 2017). Those who wanted access to science or to conduct scientific research required a high-level security clearance. Although science was conducted behind the veil of secrecy, it was framed to align with white Afrikaner nationality. Somehow, the church often played a crucial role in this development, notably denying human evolution (du Plessis, 2017). Furthermore, oppressed black communities had to endure the Bantu Education Act, which ensured that these communities only obtained the basic primary forms of reading and writing skills, ensuring that they were alienated and kept from science.

After years of oppression and exploitation, the South African government welcomed democracy in 1994. The elected government understood the value of publicly accessible science and that science engagement was crucial to the redress process and the democratisation of science in South Africa. The transformation of science was underwritten in the White Paper on Science and Technology (DACST, 1996), which sets out the government's plan to take science to communities to ensure democratisation accessibility and participation in science (Cambridge et al., 2005). The first and most notable initiative was branding 1998 as the Year of Science and Technology, where the government repositioned how people viewed science by taking it to all nine of the country's provinces, framing it as accessible and representative of all those living in South Africa accessing science (du Plessis, 2017). The government released funding for projects and established campaigns intending to demystify science. At that time, the government held the position that science was a foreign concept and unfamiliar to people (du Plessis, 2017). While it was a fair assumption because of how secretively science was practised years before, this thinking is seemingly vested in the deficit model approach. Bucchi (2008) conceptualises the deficit model as an approach that views the public as lacking in education or as 'scientifically illiterate' and thus needing to be 'educated' by scientists following a top-down approach – a view in some cases held by institutions involved in scientific research and development or government. Lewenstein (2003) notes that scholars critiqued this understanding as too linear, simplistic, and paternalistic and argued it was rooted in a deficit model (Trachtman, 1981). So, to some degree, the government successfully democratised science because they had initiatives that took science to the people through expos, exhibitions, public talks, science festivals, and legislation.

## 1.10. Exploring a new framework for science engagement

Limson (2019) argues that the public has historically played a passive role in scientific research and technological advancements. She advocates for new models of education that actively involve and engage the public, a shift from traditional practices in higher education.

Limson acknowledges the challenges of encouraging scientists to adopt these participatory approaches. Although engaging the public is generally accepted, its practical application often meets with resistance (Limson, 2018). Since most scientific research occurs within institutions, integrating public engagement into ongoing and future research and teaching programmes is particularly challenging (Limson, 2018). To overcome this, more innovative teaching and learning methods are necessary to embed science engagement effectively.

Rhodes University's Biotechnology and Innovation Centre (RUBIC) has pioneered several initiatives that involve public participation through participatory research. Students at RUBIC have explored various models for science engagement, including citizen science, co-creation, and participatory research, all of which embed Responsible Research and Innovation (RRI) principles.

Teaching these approaches to science engagement has become integral to the curriculum at RUBIC, which aims to create an experimental, trans-disciplinary training environment for postgraduate Biotechnology students (Limson, as cited in Weingart, Joubert, & Falade, 2019). The Centre aims to integrate biotechnology research and teach courses that promote entrepreneurship and science engagement. Several projects have been undertaken to incorporate science engagement into the postgraduate program, including:

1. Direct engagement between scientists and the public at science fairs.
2. Active public participation in laboratory-based research.
3. Engaging the public to gather their views on new products.
4. Consulting specific publics about their perspectives on current and future research.

However, these initiatives have revealed several challenges. Many postgraduate biotechnology students often lack prior experience in science engagement. Additionally, the specialised nature of their research sometimes limits effective public communication. Developing the skills to engage communities requires training. Limitations also arise from the time required for relationship-building between scientists and the public. One of the primary barriers has thus been the need for more training in the tools and skills necessary for societal engagement in research (Limson, 2019; Weingart et al., 2021).

RUBIC has taken proactive steps by partnering with socially trained stakeholders to enhance public engagement in science-related research projects. RUBIC has collaborated with the School of Journalism and Media Studies to bridge this gap, involving Journalism lecturers and students. More recently, Journalism students have been experimenting with creating media content based on their interactions with science students, such as an animated video explaining how aptamers are made. The success of these projects has sparked interest in further research on how collaboration between science and journalism students can promote public engagement.

### *1.8.1. Responsible Research and Innovation (RRI)*

Limson (2020;2021) highlights Responsible Research and Innovation (RRI) and South Africa's National Research Framework in Engaged Research as crucial in ensuring scientific advancements align with societal values and ethical norms. She argues that RRI requires the involvement of diverse stakeholders, including the public, to foresee and address potential societal impacts of research. This approach is vital in Biotechnology, particularly with genetically modified crops (GM crops). The development and deployment of GM crops often spark debates around environmental sustainability, food security, and ethical concerns. RRI principles may resonate well with the Biotechnology sector, where integrating public concerns, ethical considerations, and long-term environmental impacts into the research process is essential. By applying RRI principles, in theory, researchers and innovators can ensure that GM crops are scientifically viable, socially acceptable, and beneficial, addressing potential risks while maximising societal benefits.

## 1.11. Research aims and questions

This study aimed to develop thought-provoking media to facilitate engagement between growers, extension officers, and scientists around a genetically modified sugarcane variety. I produced multimedia through an action research process, including two animated videos and an information booklet about the GM sugarcane variety. The goals of the research were:

- To establish a basic understanding of GM products and growers' concerns through initial interviews.
- To produce media based on these interviews and information from scientists, and elicit engagement their around the GM product.
- To test multimedia publications with groups of growers and scientists in focus groups.
- Following focus group engagement, to modify the media products.
- To critically reflect on the overall research process.

The study seeked to answer the question: How can journalism practices, using animated videos and an information booklet, facilitate horizontal engagement between sugarcane growers and scientists working on a new genetically modified sugarcane variety?

## 1.12. Thesis outline

**Chapter one** provides the context for understanding the sugarcane industry and the challenges growers face, a basic overview of GM crops, a description of the South African Sugarcane Research Institute, and how they communicate with growers. **Chapter two** outlines the theoretical underpinnings that inform the research. In **Chapter three,** the research design, I offer a detailed account of the study's research steps and methodological approach. In **Chapter four** of the thesis, I provide an analysis and present the data collected. Lastly, **Chapter five**

outlines the central findings, revisiting the study's goals and critically examining the findings that emerged from the research.

## 1.13. Conclusion

This chapter presented the context and foundational ideas for this thesis. The chapter contextualised the South African sugarcane agricultural sector with Kwa-Zulu Natal as the backdrop of this study. Following the contextualisation of this study, the chapter then highlighted the challenges that sugarcane growers face, specifically for this study, the *Eldana saccharina* Walker, and how it damages crops and reduces recoverable value. The focus was then on the solutions developed by the South African Sugar Association and its research unit, the South African Sugarcane Research Institute, and how they ensure technology transfer from scientists to growers through their extensive network of extension specialists. This study must contextualise what genetically engineered foods are, as this is the underlying premise of this overall study. An overview of GM crops was given, which allowed us to provide insights into the history of science and GM crops in South Africa. It is also essential to contextualise GM crop uptake in Sub-Saharan Africa. South Africa is a prominent exporter of GM crops and an earlier adopter of GM crops. Lastly, because this study has no specific position for or against GM crops, it was imperative to outline some of the debates in which it is located.

# Chapter 2: Conceptual Framework

## 2.1. Introduction

Engagement is a democratic process rooted in speaking, listening, and collaboration. When these elements are not present, the democratic process is undermined. As discussed below, science communication and engagement have traditionally adopted a deficit model and this has provoked various critiques. Scientists and government science institutions therefore need help to facilitate engagement and ensure that science is publicly centred. This chapter outlines the fundamental theoretical underpinnings that inform this study. I start by making sense of this thesis's understanding of engagement and, in doing so, link a social science-based account of engagement to understand how natural scientists understand engagement through their Responsible Research and Innovation (RRI) framework. Voice and listening are central components of engagement; these two actions are not mutually exclusive in a collaborative setting. The chapter then draws on thinking from Journalism Studies that lends itself towards democratic engagement and a collaborative approach to extend science communication and engagement from a deficit model to a participative one. The chapter outlines public journalism, which has the potential to facilitate public discourse and ensure a new way of being inclusive with the public (Rosenberry & John, 2009). The public journalism model soon developed into a model of engaged journalism as a promising way of re-establishing the public trust in journalism and assisting in community development (Das, 2017; Green-Barber & McKinley, 2019). Thirdly, the chapter outlines communication for development (C4D) vested in development theories which suggests that dialogue is central to development (Servaes, 1995). Then lastly, I draw on development journalism to present an argument for collaboration between journalists and the government to ensure the development of a country through a participatory social process based on dialogue (Fraser & Villet, 1994).

## 2.2. Understanding the process of engagement

A social science-based and journalistic definition of engagement means different things to journalists; the concept does not necessarily have one definition. For some, engagement with audiences is a way of making their reporting easier. In Journalism, Guzmán (2016: 5) describes engagement as "making sure your work matters to your audience." Perhaps we can apply this understanding and definition of engagement to scientific innovation and development, particularly regarding how scientists understand engagement. For some scientists, engagement is also a way of shifting their approach to science from deficit to collaborative. Engagement between scientists and the public has been chiefly that of a top-down approach with inactive public agents. This deficit and diffusionist approach to science communication and engagement creates opportunities for members of the public and scientists to engage in a more collaborative horizontal approach. When public members adopt a more active role in scientific research, it could improve how science is conducted and implemented.

One approach that advocates for more engaged scientific inquiry is the European Union's Responsible Research and Innovation (RRI). This approach encourages scientists to actively involve members of the public directly impacted by their innovation at the earliest stages. This inclusive approach may help to ensure that any innovation will be successful and generally accepted (Limson, 2018). When scientists actively and collaboratively engage the public in their innovations, they will gain better insights into societal challenges faced by the people impacted by their innovations (Almeida & Quintanilha, 2017).

The foundational RRI framework, developed by Stilgoe, Owen, and Macnaghten (2013), is structured around four integrated dimensions that collectively guide responsible innovation: anticipation, reflexivity, inclusion, and responsiveness. Anticipation involves systematic thinking about potential impacts and unintended consequences before they materialize. Reflexivity requires critical self-examination by researchers regarding their assumptions and the broader implications of their work. Inclusion emphasizes meaningful stakeholder participation in innovation processes, while responsiveness demands the capacity to adapt innovation trajectories based on new knowledge and stakeholder input (Stilgoe et al., 2013). This framework provides a comprehensive approach to ensuring that research and innovation serve societal needs while maintaining democratic accountability.

Biotechnology can generally be grouped into five categories: foodstuff, energy, water, medicine, and agriculture (Ratledge & Kristiansen, 2001). A part of agricultural Biotechnology includes genetically modified (GM) crops.

While genetically modified organisms (GMOs) have demonstrated significant benefits including increased crop yields, reduced pesticide use, and improved food security (Klümper & Qaim, 2014), they have also faced decade-long public scrutiny reflecting legitimate concerns about environmental risks, socioeconomic impacts, and democratic governance. This questioning stems from various factors including corporate concentration in the seed industry, potential ecological effects such as gene flow to wild relatives, and concerns about farmer dependence on proprietary technologies (Howard, 2009; Lu et al., 2012). Rather than dismissing public concerns as misinformation, this ongoing debate has proven beneficial by placing science advancement in the public domain, open to scrutiny and engagement from public members. Such democratic dialogue is essential for addressing both the documented benefits and legitimate concerns surrounding GM technology through evidence-based assessment and inclusive governance processes. For example, the South African government has generously invested in public science engagement efforts. Similarly, additional White papers (DST, 2007, 2013, 2015) have also been implemented that call for publicly-centred science that address localised problems (Limson, 2020).

There are close similarities between community-based participatory research (CBPR) and RRI. Jull and Giles (2017) describe CBPR as a collaborative research approach where stakeholders are equitably involved in the research and development because they bring valuable insights to problems. CBPR is pro-poor and marginalised communities where members of that specific community hold the knowledge that shapes research (O'Fallon & Dearry, 2002). Central to engaged methods of research is mutual trust. A benefit of CBPR and Action Research (AR) is that these approaches help shift science engagement and communication from a diffusionist approach and ensure that trust is established between communities of interest and researchers (Israel et al., 1998).

### 2.2.1. Voice in engagement

Voice is central to engagement. When members of a society have a voice, they can express themselves and the challenges they experience. Having a voice is a democratic process that we understand has a participatory bottom-up approach where people are encouraged to influence their social change (Tacchi, 2008). When people are denied inclusion and participation, what scholars call voice poverty, there is no engagement (Lister, 2005; Tacchi, 2008). Voice poverty is when people do not have the agency to participate and are excluded in decision-making that will impact their lives.

In the case of this study, participation and inclusion are central to the reimagined idea of an engaged horizontal approach to science communication and engagement, in contrast to a top-down model. Equal to voice in engagement is listening. Couldry (2010: 580) states that:

> *We have an obligation to listen [and] all human beings have the capacity for voice, to give an account of their lives. This is an irreducible part of their human agency. If to acknowledge this is humanism, so be it: it should be obvious it need not rest on any simple notion of agency or on any complacent notion of*

> *superiority of human life over other forms of life, let alone on the privileged attempt to 'speak for' humanity from one site or another.*

It is essential to understand that voice and listening are not separate matters; one should only be considered with the other.

## 2.3. Theorising science communication and engagement

It is helpful to understand the traditional approaches to science communication and how these have been critiqued, specifically regarding the deficit model that became the dominant approach to science communication in the 1980s. The movement is called the Public Understanding of Science (PUS). Scientific literacy became one of the main concerns of scientists and government institutions who felt that the public lacked scientific knowledge (Miller, 2001). This lack of knowledge was perceived to slow down scientific progress, economic growth, and industrial competitiveness (Wynne, 1995). The underlying assumptions of this approach are that science can speak for itself; it is the truth, and it is objective. Secondly, any resistance to science is due to a deficit in understanding and a problem in the public (Wynne, 1995).

The assumptions mentioned above have been critiqued by science communication scholars who found that the public's knowledge about science does not correlate to their attitudes about science (Allum et al., 2008). These critics have argued that science is socially constructed. The public has legitimate concerns about how science is conducted, what it achieves, and who it benefits (Wynne, 1992a). Members of the public have social intelligence about science and should be considered legitimate knowledge holders (Wynne, 1992a). For example, in the UK, there were debates about the foot and mouth disease where the government and its scientists disregarded farmers' experiential knowledge. When farmers' local knowledge was eventually considered, the spread of the disease was contained (Wynne, 2001).

In South Africa, the same deficit model was prevalent. Science was conducted in isolation from society and was not meant to address societal challenges (Dubow, 2006). There was a realisation that science in South Africa needed to be reimagined to address the country's unique and contextual challenges, especially post-democracy (Academy of Science of South Africa, 2011). There has been a concerted effort to move away from a deficit model that will help reposition public engagement as "with and not to the public" (Burns & Squires, 2011: 780). Scholars and practitioners have since termed this paradigm Public Engagement with Science and Technology (PEST). This new approach encourages two-way conversations between scientists and the public. It promotes dialogue where the public and scientists learn from each other instead of only listening to scientists (Rowe & Frewer, 2005). Dialogue is vital to this new approach as it is seen as creating "shared ownership of policy decisions and mutual respect for the diverse values and types of knowledge that different parties contribute to the dialogue" (Rowe & Frewer, 2005: 259).

The dialogical PEST model represents a significant advancement over traditional deficit approaches by emphasising conversational, bidirectional communication that acknowledges the legitimacy of public concerns while creating opportunities for scientists to share their expertise. This approach recognizes that effective science communication must navigate tensions between promoting evidence-based understanding and respecting legitimate democratic concerns about scientific developments, particularly for technologies like GM crops where benefits and risks require ongoing evaluation and inclusive governance.

### 2.3.1. Measuring engagement

Engagement has multiple meanings and therefore needs nuanced tools for measurement. Fredricks et al. (2004) suggest that engagement can be understood on four levels: behavioural, emotional, cognitive, and motivational. Behavioural engagement looks at people's participation, effort, persistence, and attention. Emotional engagement looks at students' feelings of belonging, interest, and values. Cognitive engagement examines people's thoughtfulness and willingness to master difficult skills and understand complex ideas. Motivational engagement refers to people's goals, autonomy, and beliefs about their ability to succeed.

A framework to measure engagement is also offered by Brossard and Lewenstein (2009), who developed a knowledge-attitude-behaviour framework often used in science communication research. The knowledge aspect refers to the understanding of the content. The attitude or opinion is linked to emotions, judgements, and feelings. Lastly, behaviour refers to the action people take due to the content (Brossard & Lewenstein, 2009). This approach to measuring engagement is often used as a framework for designing effective science communication and determining whether the intervention has increased the intended impact.

Other measures have been developed to try and understand engagement. For example, self-assessment questionnaires help develop an understanding of people's perceptions about their involvement (Schreiner & Sjøberg, 2004). Other measurements include third-party observation of people's level of involvement and interest in the content (Rotgans & Schmidt, 2011).

Similarly, social media analytics can be used to measure if and how people are engaging with content, especially social media posts, including the number of likes, shares, and comments (Vraga et al., 2015).

## 2.4. Shifting Science Engagement: From a deficit model to engagement communication

This chapter argues that journalism can offer models to adopt a more democratic and collaborative approach to science communication. I explore four different journalism approaches/philosophies: public journalism, engaged journalism, communication for development (C4D), and development journalism. These approaches prioritise dialogue, public participation, collaboration, and an alternative means of news reporting that differs from traditional journalistic approaches. Lastly, I outline citizen journalism and how ordinary people have taken up the role of journalism and impacted the traditional journalistic approach. These approaches also encourage critical thinking and acknowledge different epistemologies for understanding societal realities.

### 2.4.1. The emergence of public journalism

Public journalism was a movement introduced in the 1990s; it became popular in American journalism. The movement believes that journalism has a responsibility to public life, and democracy should be actively nurtured (Rosen, 1995). Public journalism places the audience at the centre of the news, making them central actors in the news, not passive recipients of information. The movement was developed to bridge the gap between journalism and its audiences to encourage collaboration (Rosenberry & St. John, 2010). This new approach focused on facilitating public debate and discourse and sought to involve people in the news as it developed. News organisations that adopted public journalism created opportunities for audiences to interact with their content and voice their opinions about their communities' concerns (Rosenberry & St. John, 2010).

Public journalism emerges from democratic theory, emphasising journalism's role in facilitating democratic discourse across broad civic issues. It conceptualizes audiences as citizens with democratic rights who should participate actively in public discourse and collective decision-making, while maintaining traditional professional journalism roles but expanding their democratic functions.

Unfortunately, public journalism was short-lived and suffered several criticisms. Opponents argued that public journalism was merely a marketing ploy by news organisations to regain their audiences (Rosenberry & St. John, 2010). Similarly, opponents of public journalism argued that journalists have specific responsibilities, and these should not be conflated with other democratic functions (Gans, 2003). Public journalism was also critiqued for failing to address the economic challenges facing news organisations and, therefore, being a superficial solution to more systemic problems (Carey, 1995). The rise of the internet also contributed to the decline of public journalism as it provided alternative platforms for public discourse and participation.

### 2.4.2. Public journalism revived: the dawn of engaged journalism

Even though public journalism did not survive, engaged journalism drew lessons from public journalism and adopted a more refined approach to audience engagement (Das, 2017). Engaged journalism believes in collaboration between journalists and audiences as a way of building public trust in journalism (Green-Barber & McKinley, 2019). Like public journalism, engaged journalism also attempts to ensure that journalism is responsive to its audience (Green-Barber & McKinley, 2019). Engaged journalism also attempts to make journalism inclusive. It calls for journalists to be a bridge that brings people together, especially around issues affecting them (Das, 2017).

Engaged journalism builds on public journalism while incorporating relationship-based communication theory and digital media studies. It treats audiences as ongoing collaborative partners in knowledge production, emphasizing sustained relationship-building across diverse topics rather than episodic coverage. This model adapts professional practices to digital environments while maintaining commitments to accuracy and accountability.

Trust is critical to engaged journalism. Engaged journalists achieve this goal by establishing relationships with their audience and being accountable (Green-Barber & McKinley, 2019). Trust is also established when journalists work with the audience to address the concerns raised by the content (Green-Barber & McKinley, 2019). Similarly, engaged journalism encourages transparency from journalists; how they gather their information, who they speak to, and why specific sources are used or not used (Wenzel, 2019). Engaged journalism differs from public journalism because engaged journalism addresses the failures of public journalism and, more importantly, adapts to the digital age where the audience has more power and agency than before (Green-Barber & McKinley, 2019).

### 2.4.3. Communication for Development (C4D)

Communication for Development is an approach that applies participatory communication to facilitate social change and address challenges such as poverty, education, health, and agriculture (Dagron, 2009). The goal of C4D is to include and ensure that affected groups participate in determining their own needs and developing appropriate solutions (Servaes, 2008). At the heart of C4D is the promotion of dialogue as a democratic solution for everyone to contribute to solving problems (Dagron, 2009). C4D places affected people at the centre of the development agenda and believes they should be active participants rather than passive recipients of aid and development (Dagron, 2009).

Communication for Development integrates participatory development theory with communication studies, positioning communities as primary decision-makers and change agents. It draws from critical development studies and social justice frameworks, specifically targeting structural inequalities through community empowerment and participatory dialogue processes.

C4D believes in a bottom-up approach where solutions are developed from within communities and contexts rather than imported from elsewhere (Servaes, 2008). The approach also acknowledges the epistemologies of the people it seeks to assist (Dagron, 2009). This approach understands that affected communities have knowledge that should be privileged when developing solutions. Therefore, dialogue is essential to this approach as it allows knowledge to be shared, especially local and indigenous knowledge (Servaes, 2008). C4D believes that solutions to problems can only be achieved through dialogue, partnership, and the active participation of the people (Dagron, 2009). Active listening and trustworthiness are essential tools that enable the success of C4D interventions (Dagron, 2009).

### 2.4.4. Development journalism

Development journalism was practised in developing countries during the 1960s and focused primarily on how media could contribute to socio-economic development (Fraser & Villet, 1994). Unlike conventional news reporting that focuses on events, development journalism focuses on processes, particularly those linked to national development (Fraser & Villet, 1994). Development journalism attempts to understand the causes of problems and suggest possible solutions to them (Shah, 1996). This approach allows journalists to be advocates for the communities they serve (Fraser & Villet, 1994).

Development journalism balances advocacy for social justice with professional independence and critical analytical capacity. It serves communities affected by development issues while maintaining professional distance, focusing on structural inequalities and evidence-based solutions rather than institutional or commercial interests.

Development journalism encourages journalists to collaborate with government institutions (Fraser & Villet, 1994). This collaboration has made development journalism an essential tool for ensuring development is achieved. However, this close relationship with government institutions has been a weakness of development journalism as journalists have struggled to maintain their independence and objectivity (Fraser & Villet, 1994). Opponents of development journalism also argue that this approach is not journalism because it conflicts with the objectivity and neutrality that characterises journalism (Fraser & Villet, 1994). Similarly, opponents argue that this approach allows the government to use journalism for their political agenda (Xiaoge, 2009). Development journalism survives and has been used as a transformational tool by journalists, especially in the Global South (Loo, 2009).

### 2.4.5. Citizen journalism

Citizen journalism refers to ordinary people carrying out journalistic activities. Citizen journalism is a grassroots, bottom-up activity that challenges the traditional gatekeeping role of professional journalism (Gillmor, 2004). The rise in the use of digital technologies such as the internet, mobile phones, and social media platforms has facilitated the growth of citizen journalism (Beckett, 2010). Through these platforms, ordinary people can gather, edit, and distribute news and information (Gillmor, 2004). Citizen journalism aims to democratise information and include voices that mainstream media might ignore (Allan & Thorsen, 2009).

Citizen journalism challenges professional journalism's institutional gatekeeping role by transforming traditional audience-producer distinctions. It emerges from democratic media theory and digital culture studies, focusing on media democratization while raising important questions about training, accountability, and quality control in science communication contexts.

Citizen journalism has brought diversity to journalism and has been responsible for breaking several big stories that traditional media missed (Beckett, 2010). Citizen journalism has also been helpful in ensuring that local and grassroots stories are given attention (Gillmor, 2004). The approach is also important in countries where media freedom is restricted as it provides alternative platforms for people to access and share information (Allan & Thorsen, 2009).

However, citizen journalism has been criticised for lacking professional standards and accountability (Beckett, 2010). There have also been concerns about the spread of misinformation and the quality of citizen journalism content (Gillmor, 2004). Despite these challenges, citizen journalism continues to grow and influence mainstream journalism.

For science communication, these journalism models offer distinct but complementary approaches: public journalism's democratic discourse across broad civic issues; engaged journalism's sustained relationship-building and digital adaptation; C4D's community empowerment and participatory development focus; development journalism's structural analysis and social justice orientation; and citizen journalism's democratisation of information production. The choice of model depends on specific contexts, audiences, and communication objectives, with many effective science communication strategies integrating elements from multiple approaches.

## 2.5. How journalism practices can help shift science engagement

Journalism practices offer several models that can be adapted to help shift science engagement from a deficit model to a more participatory approach. The journalism approaches discussed above share common principles that can inform science communication: collaboration, dialogue, participation, and responsiveness to audience needs.

Collaboration between scientists, journalists, and the public can help ensure that science communication serves the needs of all stakeholders. Like engaged journalism, scientists can work with communities to identify research priorities and develop solutions to problems. This collaborative approach can help build trust between scientists and the public and ensure that scientific research addresses real-world problems.

Dialogue is central to effective science engagement. Like C4D, science communication should facilitate dialogue between scientists and the public. This dialogue should be based on mutual respect and should acknowledge the different types of knowledge that each party brings to the conversation. Scientists should be willing to listen to public concerns and incorporate public input into their research.

Participation is essential to democratic science engagement. Like public journalism, science communication should create opportunities for the public to participate in scientific discourse. This can include involving the public in research design, data collection, and analysis. It can also include creating platforms for public input on science policy and regulation.

Responsiveness to audience needs is critical to effective science communication. Like engaged journalism, science communication should be responsive to public concerns and should adapt to changing circumstances. Scientists should be willing to modify their research based on public input and should communicate openly about uncertainties and limitations in their work.

## 2.6. Conclusion

This chapter has outlined the theoretical foundations that inform this study's approach to science communication and engagement. The chapter has argued for a shift from deficit models of science communication to more participatory approaches that prioritise dialogue, collaboration, and democratic participation.

The chapter has drawn on insights from journalism studies to suggest that journalism practices can offer valuable models for science communication. Public journalism, engaged journalism, communication for development, development journalism, and citizen journalism all offer different approaches to engaging audiences and facilitating democratic discourse. These approaches share common principles that can inform science communication: collaboration, dialogue, participation, and responsiveness to audience needs.

The chapter has also highlighted the importance of voice and listening in engagement processes. Effective engagement requires creating opportunities for diverse voices to be heard and ensuring that these voices influence decision-making processes. This is particularly important in science communication, where public concerns about scientific developments are often dismissed or marginalised.

The theoretical framework outlined in this chapter emphasises the importance of moving beyond traditional approaches to science communication that treat the public as passive recipients of information. Instead, the framework advocates for approaches that recognise the public as active participants in scientific discourse and that create opportunities for meaningful engagement between scientists and the public.

This framework will guide the empirical research presented in subsequent chapters, which will examine how these theoretical insights can be implemented in practice through multimedia journalism approaches to science communication about biotechnology and GM crops in South Africa.

# Chapter 3: The Research Design

## 3.1. Introduction

This chapter will provide a general outline of the research methodology that was used for this research on how multimedia can facilitate engagement between sugarcane growers and scientists on GM sugarcane. This research was conducted using a qualitative methodology as the primary approach, incorporating some quantitative elements through survey data. I decided to use a qualitative methodology because it aligns well with the action research approach. In this study, I worked with communities of sugarcane growers in KwaZulu-Natal, South Africa. I sought to understand their attitude towards GM-crops, particularly GM sugarcane, their understanding of science and their preferences for receiving scientific information. This information was used to develop media that was responsive to the community's communication preferences.

for the research design required a qualitative approach rather than a quantitative one. This preference was based on the need to capture participants' rich, detailed insights and experiences, which a qualitative approach is particularly suited to uncover. By focusing on qualitative data, the study aimed to explore the subtleties of how multimedia tools could influence communication dynamics and facilitate better understanding among stakeholders.

Geographically, the research is situated in KwaZulu-Natal, a region that provides the context for this investigation. The chapter will detail how the regional context impacted the study and why KwaZulu-Natal was selected as the focus area.

Methodologically, the study employed a mixed-method sampling approach, integrating both convenience and purposive sampling techniques. Convenience sampling was used to access readily available participants, while purposive sampling ensured that critical individuals with specific knowledge or stakes in the issue were included.

Finally, the chapter will outline the data collection process employed in the research. This section provides an in-depth examination of the methods used to gather information, including how data was collected, managed, and analysed. The chapter aims to offer transparency and insight into the research process by detailing the data collection procedures chosen to ensure that the findings are credible and replicable.

It is important to acknowledge that this study adopted a pragmatic approach to participatory action research (PAR)due to COVID-19 restrictions and institutional constraints. Therefore community members did not fully co-define the initial research problem, instead it was primarily identified through prior scientific research on GM sugarcane needs. The participatory elements emerged more prominently during data collection, media development, and testing phases (MacDonald, 2012; Bergold & Thomas, 2012).

## 3.2. Research Goals and Questions

The goal of this research was to create multimedia that would serve as a tool to help facilitate engagement between scientists and sugarcane growers regarding GM sugarcane. Through multimedia production, insights were gathered to understand the engagement potential between the growers and the scientists. The central research question is: How can multimedia production guided by journalism practices facilitate engagement between sugarcane growers and scientists regarding GM sugarcane?

- Establishing through initial interviews what basic understandings of GM crops growers have and their concerns about cultivating such crops.
- Producing media based on these interviews and scientists' information will elicit engagement around the GM product.
- To test the multimedia products with groups of growers in focus groups.
- Following focus group engagement, the media products will be modified.
- To critically reflect on the overall research process.

The study sets out to answer the following question:

- How can conceptual frameworks and tools in Journalism lend themselves to facilitate engagement around a genetically modified sugarcane variety?

## 3.3. Action Research

Action research is a methodology that allows the researcher to take up a mixed-method approach to the data collection process that involves both qualitative and quantitative methods. Action research, according to Reason and Bradbury (2001: 2), can be described as:

> *A participatory, democratic process concerned with developing practical knowing in the pursuit of worthwhile human purpose. It seeks to bring together action and reflection, theory, and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people, and more generally the flourishing of individual persons and their communities.*

It is important to note that this study is informed by action research. It does however draw from elements of action research that permit it to, as Herr and Anderson (2015) put it, be orientated to some action or cycle of action that organisational or community members have taken, are taking, or wish to take to address a particularly problematic situation. These cycles of action include planning, action, and reflection, all aimed at achieving the core goal of using journalism studies to facilitate engagement with sugarcane growers and scientists working on a new GM sugarcane variety. Action research is suitable for this study because it is geared toward this type of cyclical, in-action research that is an inquiry that is done by or with outsiders to an organisation or community, but never to or on them (Herr & Anderson, 2015). When action research is employed, research participants are actively involved and not merely studied by the researchers. As such, what happens is that the researcher, along with their participants, learn and participate in the process. It is essential to acknowledge my position as a researcher, that I am not a sugarcane grower or scientist, and that I have no prior background in either of these fields. I am, however, a journalist interested in Science Communication and Journalism Studies has informed me.

Action research is considered critical because it aims to facilitate ongoing change. According to McNiff and Whitehead (2006), at the heart of action research is improving practice instead of creating knowledge. At the heart of this research is knowing that science communication and engagement have previously, and perhaps still are, framed within a deficit model. This research aims to ensure engagement between scientists and sugarcane growers.

McNiff and Whitehead (2006) note that action research is cyclical, and each cycle builds on the previous process. According to Selenger (1997), there are seven characteristics of participatory action research. The first is that the community should define the problem. The second tenet uses participants' knowledge and lived realities to develop a collective solution. The third characteristic is full and active community participation in the research. The fourth component deals with representing various voices and how they are impacted. The fifth tenet is creating great awareness so that the participants/community are equipped with the necessary resources to mobilise their development and build their capacity. The sixth aspect of participatory action research is understanding that the methods are more than a scientific approach because the participation of the community in the study ensures an accurate and authentic analysis of social reality. Then lastly, a researcher who employs participatory action research becomes a committed participant, facilitator, and learner of the research process. However, I could not follow the action research process precisely because of the challenges of the outbreak of COVID-19 when field work was meant to take place. Instead, I adapted the method demonstrated in the five research cycles below, drawing on the seven characteristics of participatory action research mentioned above.

*Cycle 1: Initial interviews and entering the field*

The first cycle involved entering the sugarcane growing community and interviewing scientists and sugarcane growers. This cycle aimed at collaborating with the community of growers to develop an understanding of the research problem. However, due to the COVID-19 pandemic and its restrictions, my access to the community was limited. I had to develop other research techniques to enter the community and access sugarcane growers. Instead of conducting Community entry as it is typically done in action research, I conducted a series of interviews with scientists first and then with sugarcane growers. Through the interviews with scientists, I developed an understanding of the issues that affects sugarcane growers and how they can benefit from engaging with scientists. Due to COVID-19 restrictions, the participatory element was limited during this initial phase, with the research problem having been pre-defined based on prior scientific work rather than emerging from community consultation.

Engaging directly with the impacted community to collaboratively identify and address problems is essential in participatory action research. Initially, the fieldwork was scheduled to begin in early 2020. However, due to the outbreak of COVID-19 and the resulting national lockdown, it was postponed until early 2021.

Ideally, the research problem would have been identified in collaboration with the sugarcane growers. However, the constraints of the pandemic required an alternative approach. Instead, I relied on the insights from extension officers and scientists from the South African Sugarcane Research Institute. These key stakeholders offered valuable perspectives on the sugarcane variety and the growers I would eventually engage with. Although this approach wasn't ideal, it was effective.

After conducting initial interviews with these stakeholders, I entered the field to engage directly with both large-scale and small-scale sugarcane growers through interviews and surveys. These interactions provided a deeper understanding of their daily lives, their challenges as producers, and how they prefer to be engaged and informed about the new genetically modified sugarcane variety.

The fieldwork component of this study involved a two-week trip to KwaZulu-Natal, during which I primarily engaged with large-scale sugarcane growers. I initially relied on extension officers and scientists from SASRI to guide my interactions, unaware that the extension officers mainly specialised in working with large-scale growers. As a result, most of my interviews were conducted with this group, and only a few small-scale growers were included in the study. This imbalance in participant representation was not anticipated and highlighted a limitation in the fieldwork process, as it restricted the breadth of perspectives from the broader sugarcane-growing community.

*Cycle 2: Developing the communication strategy*

The second cycle focused on using the data gathered in the first cycle to develop multimedia guided by journalism practices that would facilitate engagement between sugarcane growers and scientists. This cycle would also involve soliciting the views of multimedia experts on how best to create the multimedia that would be accessible and relevant to sugarcane growers. This phase took place between May and June 2021 and involved the research team collaborating with multimedia specialists to create two animated videos and an information booklet. The materials were developed in multiple languages (English, Afrikaans, and isiZulu) to ensure

*Cycle 3: Implementing the communication strategy*

After developing the media through several iterative consultations with the scientific community involved in creating the genetically modified sugarcane variety, my co-researcher and I returned to KwaZulu-Natal for further fieldwork. The primary objective of this trip was to evaluate the effectiveness of the media in facilitating engagement between the sugarcane growers and scientists. Specifically, I aimed to assess how well the media communicated the scientific aspects of the GM sugarcane variety and to gather growers' feedback on how the media could be improved.

The evaluation process was conducted through focus groups carefully designed to provide a platform for open and constructive dialogue. These focus groups brought together growers and allowed for in-depth discussions about the content and presentation of the media. This approach was chosen to capture a wide range of perspectives, ensuring that the press would be refined to meet the specific needs and concerns of the growers.

The focus groups yielded valuable insights that will be explored in detail in subsequent sections of this thesis. Several critical concerns emerged for the growers, including market access and land ownership issues. These concerns are particularly significant in the context of small-scale growers, who often face systemic barriers that can limit their ability to benefit from new agricultural technologies. Market access remains a challenge, as small-scale growers typically have less bargaining power and fewer opportunities to sell their produce at competitive prices. Land issues, on the other hand, are deeply intertwined with historical and socio-economic factors that affect land tenure security and the equitable distribution of resources.

The insights gained from these focus groups have important implications for the ongoing development and dissemination of the media. By incorporating the growers' feedback, the media can be refined to better address their specific concerns, thereby enhancing its effectiveness in facilitating meaningful engagement between growers and scientists. This iterative process not only strengthens the relevance and impact of the media but also aligns with the principles of participatory action research, ensuring that the growers' voices are central to the research outcomes.

*Cycle 4: Withdrawing for data analysis*

After a weeklong stay in KwaZulu-Natal to test the media in focus groups, the research team withdrew from the field to analyse the findings. The focus groups were a crucial component of the research, designed to assess the effectiveness of the media in communicating the scientific principles behind the genetically modified (GM) sugarcane variety and facilitating dialogue between growers and scientists. This phase of the research provided insights from the growers. It allowed for additional feedback from the scientific community, offering a comprehensive perspective on how the media could be further improved and redeveloped.

Upon returning to Rhodes University, the following research phase involved thoroughly analysing the data collected during these focus groups. This data comprised a range of perspectives from the growers, including their initial reactions to the media, their understanding of the scientific content, and their suggestions for further refinement. To systematically process this information, I employed a thematic analysis, a qualitative method that identifies, analyses, and reports patterns (themes) within the data.

Thematic analysis was chosen for its flexibility and ability to provide a rich, detailed data account. It enabled me to identify key themes that emerged from the growers' feedback, such as the accessibility of the scientific content, the clarity of the media, and specific concerns related to the socio-economic implications of adopting the GM sugarcane variety. This method also organised data into coherent categories, facilitating comparision and contrasting different viewpoints.

The insights gained from this analysis are critical to the next steps in the research process. They informed the redevelopment of the media and contributed to a deeper understanding of the growers' perspectives, ensuring that their voices were central to the research outcomes. This iterative data collection, analysis, and media refinement process was fundamental to the participatory action research approach, emphasising collaboration and continuous feedback to produce relevant and impactful outcomes for the community involved.

*Cycle 5: Reflection and reworking the communication strategy*

Following the withdrawal from the field, a critical reflection phase of the research process began. This reflective practice is integral to participatory action research (PAR), emphasising the cyclical nature of action, reflection, and further action. The researcher engaged in a detailed analysis of both the development of the media and the dynamics of the focus group engagements. This reflection was not merely a retrospective evaluation but a forward-looking exercise aimed at refining the research approach and enhancing the impact of the media interventions.

Iterative consultations with the scientific community and the sugarcane growers' target audience informed the media's development process. The media was developed to bridge the communication gap between scientists and growers, focusing on making complex scientific information accessible and engaging.

The focus group engagements were instrumental in uncovering the growers' perspectives on the genetically modified sugarcane variety and broader socio-economic issues that affect their livelihoods. These sessions highlighted the importance of creating informative and responsive media to the audience's concerns and contexts. These groups' feedback revealed strengths and weaknesses in the media's design and content.

This reflective phase also reinforced the importance of flexibility in PAR, as the research design and interventions must remain adaptable to the insights gained from each cycle of action and reflection. The recommendations made at this stage were thus not only aimed at improving the immediate project outcomes but also at contributing to the broader discourse on effective science communication and engagement.

### 3.3.1. Qualitative Research

The qualitative methodology has been specifically chosen for this study because it aligns with my action research methodology and because this study is exploratory and seeks to understand and learn about the experiences and perceptions of the sugarcane growers. Qualitative methodologies give space for comprehensive understanding of complex situations by allowing people's thoughts, understandings and observations (Creswell & Creswell, 2018). Since this study explores complex engagement between two groups, i.e. scientists and growers, the use of a qualitative methodology would help understand this complexity.

Qualitative approaches enable deep exploration of participant experiences, values, and concerns that quantitative methods alone cannot capture (Creswell & Poth, 2018; Denzin & Lincoln, 2018). The exploratory nature of this research, investigating under-researched questions about science communication in agricultural contexts, further justified the qualitative emphasis.

## 3.4. Research Setting

As we have established, sugarcane is cultivated in Mpumalanga, KwaZulu-Natal, and parts of the Eastern Cape. This study focuses on sugarcane growers in KwaZulu-Natal on the North and South Coast. On the North Coast, which is more inland, I surveyed primarily large-scale sugarcane growers in the Amatikulu region. Where a sugarcane producer yields >1 600 tons of sugarcane in a year, they are classified as a large-scale sugarcane producer. I surveyed small-scale sugarcane growers in the Sezela and Umzimkhulu regions on the South Coast, which is more coastal. A small-scale sugarcane grower producer yields <1 600 tons of sugarcane annually. Two factors determined why this study was situated in these areas. I wanted to include growers who faced different degrees of the two significant challenges that scientists believed might be addressed through the new GM sugarcane. Firstly, different degrees of *Eldana saccharina* Walkerinfestation, and secondly, different degrees of the proliferation of unwanted plants potentially managed by the herbicide.

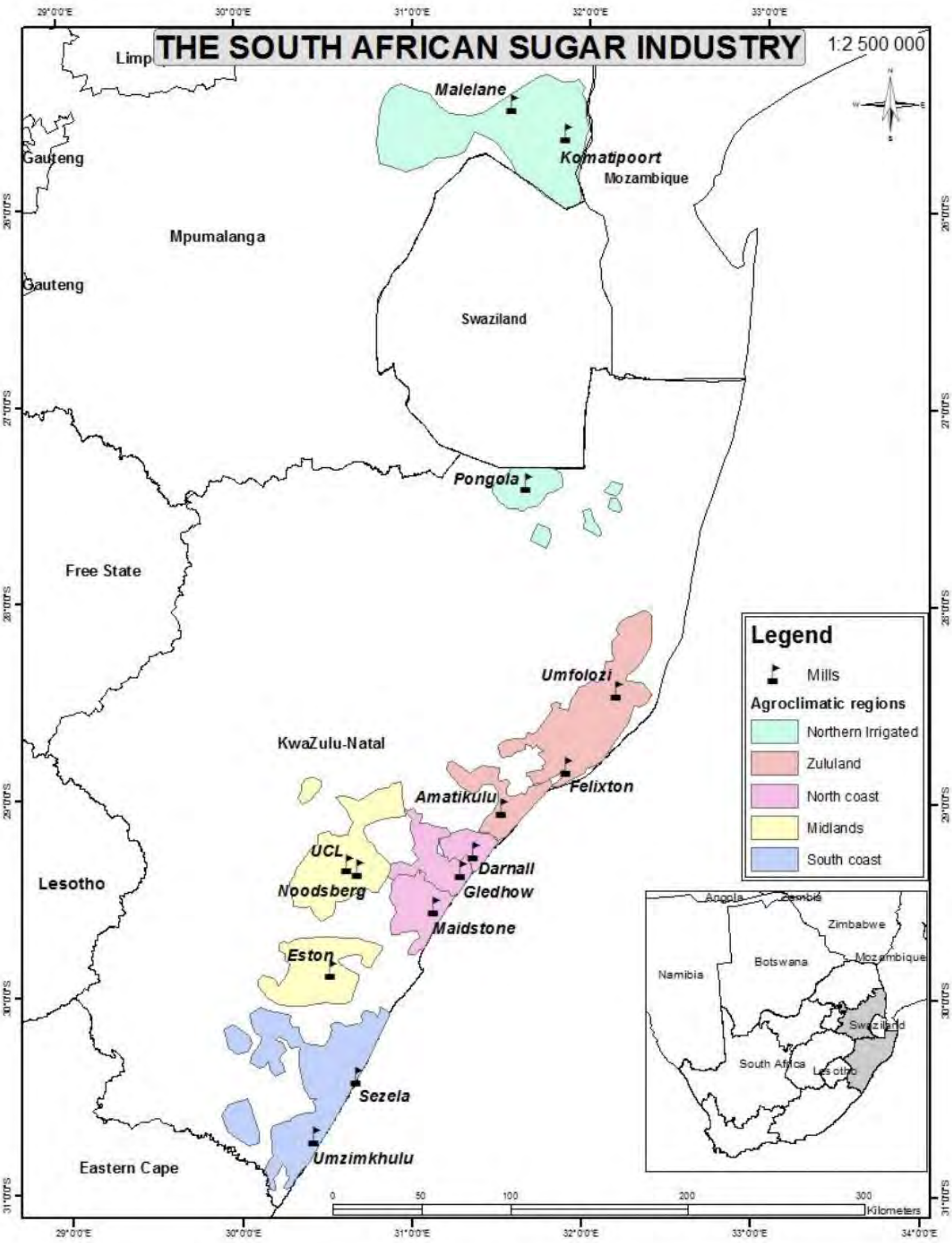



*Figure 2 Figure 2 A map indicating the 14 South African sugar mills in KwaZulu-Natal. (Singels et al. 2019).*

## 3.5. Sampling

This study used a convenience and purposive sampling strategy, selecting participants based on specific criteria relevant to the research objectives. Convenience sampling elements were introduced due to COVID-19 restrictions and reliance on extension officer networks for participant identification. The majority of research participants were identified through the assistance of extension officers from the South African Sugarcane Research Institute (SASRI). Due to COVID-19 restrictions, the extension officers recommended sugarcane growers who could be accessed whilst maintaining all health protocols. This was because the extension officers had direct contact with sugarcane growers and had established relationships with them, which made it easier for me to gain access to participants during these challenging times. It was also convenient for me to access sugarcane growers who were more accessible than other growers. This sampling approach, whilst not randomly representative, was appropriate for the exploratory nature of the research and PAR methodology's emphasis on working with willing participants (Patton, 2015; Palinkas et al., 2015).

In this study, I distinguish between large-scale and small-scale sugarcane growers. For the purpose of this study, large-scale growers will be growers who produce more than 1600 tons of sugarcane and small-scale growers will be growers who produce less than 1600 tons of sugarcane per annum.

The primary sampling framework employed a purposive selection strategy based on four fundamental criteria designed to ensure participant suitability and research validity. Firstly, participants were required to demonstrate active engagement in sugarcane cultivation with a minimum operational threshold of five hectares, establishing a baseline for meaningful agricultural activity and data collection. Secondly, prospective participants needed to possess documented experience managing pest management challenges, specifically those associated with *Eldana saccharina* (sugarcane stem borer) infestations, ensuring relevant expertise and practical knowledge pertinent to the research objectives. Thirdly, participants were required to demonstrate commitment and availability for sustained engagement across multiple research activities throughout the study duration. Finally, the sampling design incorporated geographic stratification to ensure representative distribution across diverse production regions, thereby enhancing the external validity and generalizability of findings across different agro-ecological zones and production contexts.

Study participants were stratified into two distinct categories according to their production capacity and operational scale. Large-scale producers were defined as commercial agricultural entities demonstrating annual production volumes exceeding 1,600 tons, representing established industrial farming operations. Conversely, small-scale producers encompassed agricultural operators with annual production outputs below 1,600 tons, a classification that incorporated both traditional smallholder farmers and land reform beneficiaries who had acquired agricultural properties through government redistribution programs. This binary classification system enabled the research to examine differential patterns and outcomes across varying scales of agricultural production within the study population.

This categorisation reflected industry standards and enabled analysis of how communication preferences and GM attitudes vary across different farming contexts.

## 3.6. Data Collection Methods

This section deals with and motivates the various processes undertaken by the researcher to collect data. Tacchi et al. (2003) state that all the information the research collects is material that will contribute to the research no matter how irrelevant it seems. For this reason, I decided to settle on a mixed approach, primarily qualitative methods but also some quantitative ones. The qualitative techniques I used were focus groups and semi-structured in-depth interviews, and the quantitative methods were electronic surveys.

Focus groups and semi-structured in-depth interviews are well-suited for participatory action research (PAR) because they facilitate deep, interactive discussions and enable participants to express their views in their own words. These qualitative techniques encourage active participation and collaboration, which is essential for PAR's goal of involving participants in the research process. Focus groups promote group dynamics and collective insights, while semi-structured interviews allow for detailed, personal narratives, contributing to a richer understanding of the participants' experiences and perspectives.

On the other hand, electronic surveys complement these qualitative methods by providing a broader quantitative perspective. They allow for collecting data from a larger sample, quantifying trends and patterns that can validate and contextualise the qualitative findings. This mixed-methods approach ensures a comprehensive analysis, combining the depth of qualitative insights with the breadth of quantitative data, which is beneficial in achieving PAR's participatory and evidence-based goals.

### 3.6.1. Semi-structured Interviews

I conducted semi-structured interviews with sugarcane growers. The use of semi-structured interviews allowed me to have a guide to the topics that I wanted to discuss, whilst at the same time allowing flexibility for the participants to share what they think is important (Brinkmann & Kvale, 2015). The interviews were audio-recorded with the participants' permission and each interview lasted about 45 to 75 minutes. A total of 20 interviews were conducted (11 large-scale, 9 small-scale growers), each lasting 45-75 minutes.

The development of the interview guide adhered to established methodological frameworks for exploratory qualitative research, as outlined by Brinkmann and Kvale (2015). The instrument was designed to systematically investigate five primary thematic domains that emerged from the literature review and research objectives. These encompassed participants' existing agricultural methodologies and information-seeking behaviours, their knowledge base and attitudinal orientations toward genetically modified crops, their communication preferences and media consumption patterns, their perceptions and trust levels regarding scientific institutions and agricultural extension services, and their socio-economic constraints and developmental priorities. This multi-dimensional approach ensured comprehensive data collection while maintaining theoretical coherence with the study's exploratory framework, thereby facilitating nuanced understanding of farmer perspectives within their broader socio-economic and technological contexts.

I also conducted semi-structured interviews with three scientists from the South African Sugarcane Research Institute (SASRI). The purpose of these interviews was to understand how the scientists perceive engagement with sugarcane growers and their experience with farmer engagement. All interviews were audio-recorded with participant consent and conducted in participants' preferred language (English, Afrikaans, or isiZulu). For isiZulu interviews, a qualified translator assisted during data collection, and professional translation services were employed for transcription.

### 3.6.2. Questionnaires

I developed questionnaires that were completed by sugarcane growers who participated in the study. The questionnaires were developed to gather important biographical information about the growers, which included, age, race, level of education, size of their farming operations, and the challenges they are experiencing. The questionnaire also aimed at understanding their media consumption habits and their opinions on various statements about scientific knowledge, and genetically modified sugarcane. The questionnaires were administered in different languages, including English, Afrikaans and isiZulu to cater for the different language preferences of the participants. I also collected contact details of the participants who were willing to be contacted for further stages of the research. A total of 67 sugarcane growers completed the questionnaires.

Survey Development and Pilot Testing Process:

The questionnaire was developed through a systematic three-stage process following established best practices for mixed-methods survey design (Dillman et al., 2014; Fowler, 2014):

1. Initial development: Based on literature review and expert consultation
2. Expert review: Feedback from agricultural extension specialists and communication researchers
3. Pilot testing: Administered to commercial and large scale growers in February 2021

The pilot testing phase proved instrumental in identifying methodological challenges that necessitated substantial revisions prior to the commencement of primary data collection. Three principal areas of concern emerged from this preliminary evaluation. Firstly, the initial interview guide exhibited excessive linguistic complexity that posed accessibility barriers for participants with varying literacy competencies, thereby requiring systematic simplification of language whilst preserving conceptual integrity. Secondly, cultural sensitivity issues were identified, particularly regarding the framing of questions pertaining to genetically modified technology, which demanded careful recalibration to ensure cultural appropriateness and minimise potential participant discomfort. Thirdly, the prevalence of technical terminology throughout the instrument was recognised as potentially problematic, necessitating either comprehensive explanation of specialised terms or their replacement with more accessible vernacular equivalents. These refinements ensured that the final interview guide was both methodologically robust and practically viable for implementation across diverse participant demographics, thereby enhancing the validity and reliability of subsequent data collection procedures.

The study encountered a notable sampling bias that requires acknowledgement. Large-scale growers comprised 60% of the final sample, exceeding the intended 50% target outlined in the research design. This over-representation occurred because large-scale operations were more readily accessible through existing extension service networks, which made recruitment straightforward but inadvertently created barriers to reaching smaller farms.

As a result, small-scale growers were under-represented in the sample, which poses a significant limitation for the study’s generalisability. This is particularly concerning given that small-scale and large-scale growers often differ substantially in their farming practices, economic circumstances, and attitudes towards agricultural innovations. The perspectives captured in this research may therefore not fully reflect the broader farming community.

This sampling limitation highlights the practical challenges of conducting agricultural research across diverse farm types. Future studies should consider implementing more targeted recruitment strategies, such as direct outreach to small-scale grower associations or utilising multiple recruitment channels beyond extension services, to achieve more balanced representation across different farming scales.

### 3.6.3. Focus Groups

Focus groups were conducted with sugarcane growers to test the multimedia developed for this research. There were two focus groups, one for large-scale growers and the other for small-scale growers. The first focus group had 8 large-scale growers and was conducted in Amatikulu on the North Coast and the second had 15 participants of which most were small-scale growers and land beneficiaries and was conducted in Sezela on the South Coast. I created separate focus groups to recognise the different interests and dynamics between these two groups. Focus groups enabled observation of social dynamics and peer influences on attitude formation whilst providing direct feedback on communication materials (Krueger & Casey, 2014).

Two focus groups were conducted to capture diverse perspectives across different farming scales and geographical regions. The first group comprised eight large-scale growers from the Amatikulu area on the North Coast, whilst the second included fifteen small-scale growers and land reform beneficiaries from Sezela on the South Coast. Each session lasted between 120 and 135 minutes to allow for comprehensive exploration of key themes whilst maintaining participant engagement.

The sessions followed a structured discussion format that incorporated multimedia presentations to facilitate understanding of complex concepts, followed by systematic feedback collection. All discussions were recorded using both audio and video equipment, with explicit participant consent obtained prior to commencement, to enable detailed post-hoc analysis of both verbal and non-verbal communication patterns.

The decision to conduct separate focus groups for different grower categories was methodologically deliberate. This approach recognised the potential influence of power dynamics and social hierarchies that could inhibit authentic participation if large-scale and small-scale growers were combined in mixed groups (Kitzinger, 2005). Small-scale farmers, particularly those from land reform programmes, might experience intimidation or feel reluctant to express dissenting views in the presence of established commercial producers. By maintaining homogeneous groups, the research design aimed to create more comfortable environments where participants could speak openly about their experiences and perspectives without fear of judgement or social pressure.

## 3.7. A Method for Analysing the data

Thematic analysis was the primary method for data analysis in this study because of its flexibility and compatibility with action research methodology. Braun and Clarke (2006) define thematic analysis as "a method for identifying, analysing and reporting patterns (themes) within data. It minimally organises and describes your data set in (rich) detail".

Thematic analysis was employed as the principal analytical method, drawing upon Braun and Clarke's (2006) six-phase reflexive approach to systematic data interpretation. This analytical framework was considered most appropriate for the study's objectives due to its inherent flexibility in accommodating the diverse data sources generated through the research process, including interview transcripts, focus group recordings, and observational notes.

The method's capacity to handle varied data types whilst maintaining methodological rigour made it particularly well-suited to the participatory action research framework underpinning this study (Braun & Clarke, 2019). Unlike more prescriptive analytical approaches, thematic analysis allowed for the iterative and collaborative elements essential to PAR methodology, enabling ongoing reflection and refinement of themes in consultation with research participants. This alignment between analytical method and overall research philosophy ensured that the data interpretation process remained consistent with the study's commitment to participatory knowledge generation.

### 3.7.1. Detailed thematic analysis process

The analytical process commenced with Phase 1 (March-April 2022), which involved comprehensive familiarisation with the dataset. All interviews and focus weretranscriped, with isiZulu transcripts subjected to back-translation verification to ensure linguistic accuracy. This initial phase required extensive immersion in the data through multiple readings of transcripts whilst simultaneously listening to audio recordings, allowing for capture of nuances that might be lost in written form alone. During this process, preliminary observations were documented, noting emerging patterns, contradictions, and unexpected findings that warranted further investigation.

Phase 2 (April-May 2022) focused on generating initial codes through systematic analysis. An inductive coding approach was adopted, allowing themes to emerge organically from the data rather than imposing predetermined theoretical categories. NVivo 12 software facilitated code organisation and data management throughout this process. Following Braun and Clarke's (2019) guidance on reflexive thematic analysis, inter-coder reliability was not prioritised; instead, analytical transparency was maintained through detailed coding notes.

Phase 3 (May-June 2022) involved searching for themes by grouping codes according to conceptual similarity. This process identified twelve initial themes spanning communication preferences, attitudes towards genetically modified crops, and socio-economic concerns. Thematic mapping exercises were undertaken to visualise relationships between emerging themes and identify potential hierarchical structures.

Phase 4 (June-July 2022) required rigorous theme review to ensure both internal coherence and external distinctiveness. Each theme was examined to verify that coded data formed coherent patterns whilst remaining sufficiently distinct from other themes. This process also involved checking that themes accurately represented the entire dataset, resulting in the condensation of twelve initial themes into six main themes with associated sub-themes.

The fifth phase (July-August 2022) focused on defining and naming themes with precision. Clear definitions were developed for each theme, with explicit boundaries established regarding inclusion and exclusion criteria. This process involved articulating the narrative within each theme to ensure analytical clarity.

Finally, Phase 6 (August-September 2022) involved producing the analytical report. Representative quotations were selected to illustrate each theme, and themes were integrated into a coherent analytical narrative that addressed the research questions. To enhance validity, key findings were shared with selected participants for feedback, maintaining the participatory ethos of the broader research framework.

## 3.8. Ethical Considerations

This study's main ethical concerns are consent, anonymity, confidentiality, and harm. Any researcher must understand that human experiences are central to any research and that human dignity should be respected at all costs. It is the researchers' responsibility to ensure the anonymity of the people who form part of the research by ensuring they are not embarrassed or face retribution. De Vos et al. (2005) state that this is particularly the case with qualitative research, where the researcher can access the information, and interviews are done in person.

Cohen et al. (2000) argue that a participant's privacy could be jeopardised, primarily when the researcher merely uses the participant to achieve the research goals without considering the participants' humanity. In this instance, the researcher acknowledged and respected the participants' privacy in the study. The researcher obtained ethical clearance from the Rhodes University Human Ethics Committee, which indicates the ethical research process to be followed by the researcher.

When conducting the fieldwork, the researcher clarified what the research was for and would be used for. Informed written consent was obtained from the participants, dated, and signed. An invitation letter detailing the study was left with the participants; it also included contact details of the researcher involved, the ethical clearance reference number, confidentiality and privacy of the participants, and outlined potential risks. Participation in the study was entirely voluntary. Respondents were allowed to no longer partake in the study at any point. The ethical principles regarding privacy, anonymity, and confidentiality were maintained throughout the study.

Steyn (2009) states that privacy refers to protecting the identity of research participants, while confidentiality refers to how information is handled. The researcher knew he had an ethical obligation to protect research participants from anything they may not be comfortable with and only to use the information gathered for this study. This moral obligation was not limited to data management but was maintained throughout the research process, from data collection, analysis, discussions, and conclusions. In some instances, complete anonymity could not be accommodated because some participants were photographed and would be used in some of the media produced for this study. For this, a media release form was given to participants where they gave the researcher permission to either use the images or not use them for research purposes. The form allowed them to choose that their media may be used or that I could take photographs but not use them.

Elton (2021) states that research must be conducted in such a manner that it does not cause any harm to the participants in the study. Although the study initially set out to be low risk, Covid-19 posed a severe health risk given that this research took place at the pandemic's peak and pre-roll out of vaccinations. I tried my best to ensure that the research participants and I were safe from potential exposure to Covid-19. The researcher followed the protocol the World Health Organisation (WHO) outlined. I ensured that social distancing of 1,5 metres was observed. All the interviews and focus groups were done either outside or inside. The study was conducted indoors, with the room at 50% capacity, proper ventilation, mask-wearing, and regular sanitising of hands and commonly touched surfaces such as tables. Masks were worn. In some cases where camera interviews were done, masks were not worn as requested by the director. It was also vital for me to monitor my health for possible Covid-19 symptoms.

## 3.9. Limitations of the Study

The study started in 2020. By March 2020, the country entered a national state of disaster in response to the global outbreak of the coronavirus. As mentioned before, one of Selenger's (1997) seven characteristics is that the community of interest should be part of or independently define the problem. However, I could not do this because I did not have access to the community then. Instead, I engaged with sugarcane extension specialists. These specialists have direct access to the sugarcane growers and generally understand these growers' realities as they regularly work with them. I had extensive interviews and meetings with specialists and scientists, and we defined the problem on behalf of the community, which is not ideally what the PAR model suggests. These interviews were necessary because the national lockdown was initially scheduled for two weeks but ended well into June 2020. Other non-essential face-to-face gatherings were prohibited and needed to take place online. Part of the lockdown meant that non-essential travel between provinces was permitted. The researcher for this study is based in the Eastern Cape, and the survey was conducted in KwaZulu-Natal. As a result of these travel restrictions and other limitations, the fieldwork for the study had to be postponed to 2021. While audiovisual conferencing tools were at the researcher's disposal, this would have been a barrier for some growers in rural areas where connectivity might be an issue. They might not be too familiar with the conferencing platforms.

The second limitation of this study was language barriers. A significant portion of the small-scale sugarcane grower is isiZulu speaking, which made engagement with the researcher difficult and posed a challenge for the researcher in conducting the focus group or interviews himself. A native isiZulu speaker offered translation support and managed the interviews where the language was a barrier. While this was a barrier for the researcher, having participants express themselves in a language they were comfortable with was a benefit as they could engage with the material and topic of the study. Some of the audio-visual material used in the focus group was also in isiZulu.

## 3.10. Conclusion

This chapter outlined the research methodology that was used for this research. The methodology predominantly adopted a qualitative approach that is largely qualitative with some quantitative data collected through questionnaires. Participatory action research methodology was used for this research, and the research followed five iterative cycles. The research used thematic analysis as a method for understanding patterns in the data adopting core principles of collaboration, iteration, and participant involvement throughout data collection and analysis phases.

This chapter also highlighted important ethical considerations, particularly the health and safety of research participants during the COVID-19 pandemic. Lastly, the chapter outlined the limitations of the research. The systematic documentation of research activities, participant demographics, and analytical procedures provides transparency about methodological choices whilst identifying areas for improvement in future research. The next chapter will present the data and the analysis for this research.

# Chapter 4: Findings and Discussion

## 4.1. Introduction

This study aimed to develop thought-provoking media to elicit engagement between growers, extension officers, and scientists around a genetically modified sugarcane variety. The researcher produced multimedia productions through an action research process, including animated explainer videos and an information booklet.

The goals of the research included:

- Establishing basic understandings of GM products and concerns of growers through initial interviews.
- Producing media based on these interviews and information from scientists which would elicit engagement around the GM product.
- To test the multimedia products with groups of growers in focus groups.
- Following focus group engagement, modifying the media products.
- To critically reflect on the overall research process.

The study set out to answer the following question: How can conceptual frameworks and media lend themselves to facilitate engagement around a genetically modified sugarcane variety?

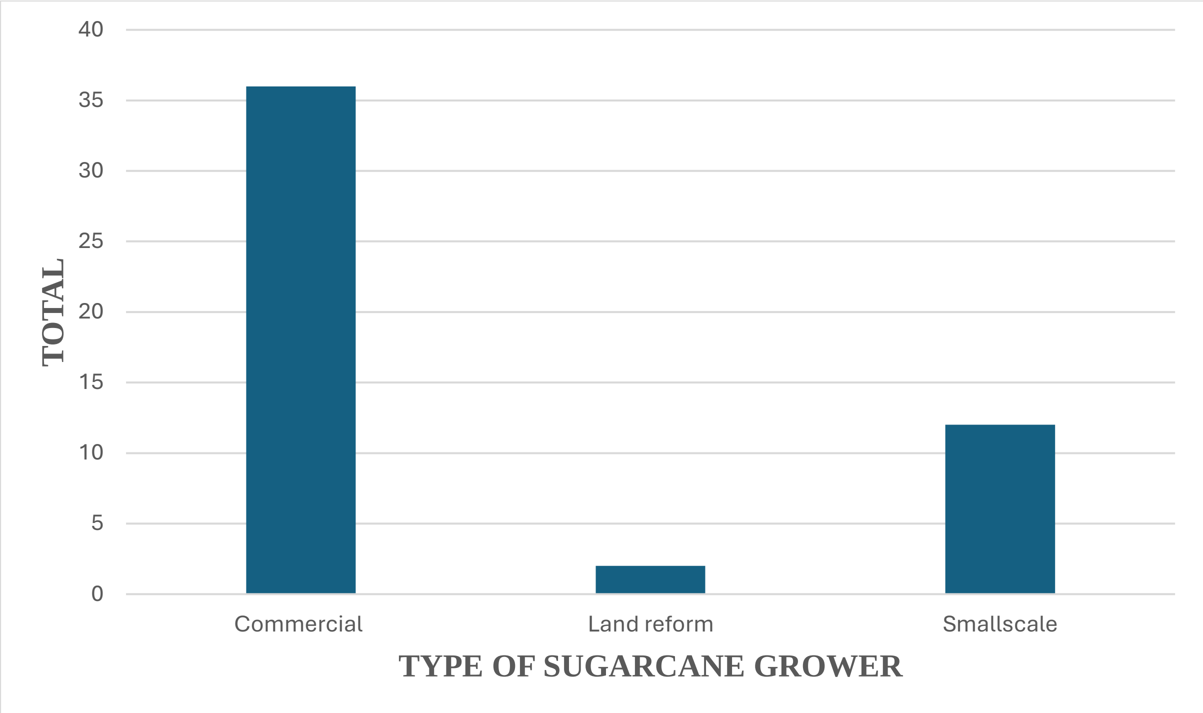
This chapter of the research will outline this thesis's central findings, revisit the study's goals, and critically examine the findings that emerged from the research, and suggestions for further research.

## 4.2. Findings emerging from preliminary fieldwork: Commercial growers and small-scale growers need separate messaging strategies

Whilst in the field and upon returning to Makhanda, the survey data was reviewed, revealing that many respondents were white, male, and large-scale growers. In contrast, small-scale growers, who were predominantly black, were underrepresented. This imbalance poses a critical challenge, particularly in participatory action research (PAR), built on principles of inclusivity and equity and empowering historically marginalised groups (Chevalier & Buckles, 2019).

During the fieldwork, it became evident that the questionnaire was well-suited for interviewing commercial farmers but posed significant challenges when engaging small-scale growers. This insight did not emerge during the subsequent data analysis but during the fieldwork.

Commercial farmers, who generally had higher education and a firm grasp of agricultural science, confidently approached the interviews, focusing on issues such as export regulations and commercial concerns. In contrast, small-scale growers were more challenging to recruit, and those who participated often struggled to relate to the interview questions. Many perceived the process as humiliating, highlighting their limited scientific knowledge. Contributing factors included language barriers, lower levels of formal education, and more modest material circumstances, which made the questionnaire appear less relevant to their lived experiences and farming practices.

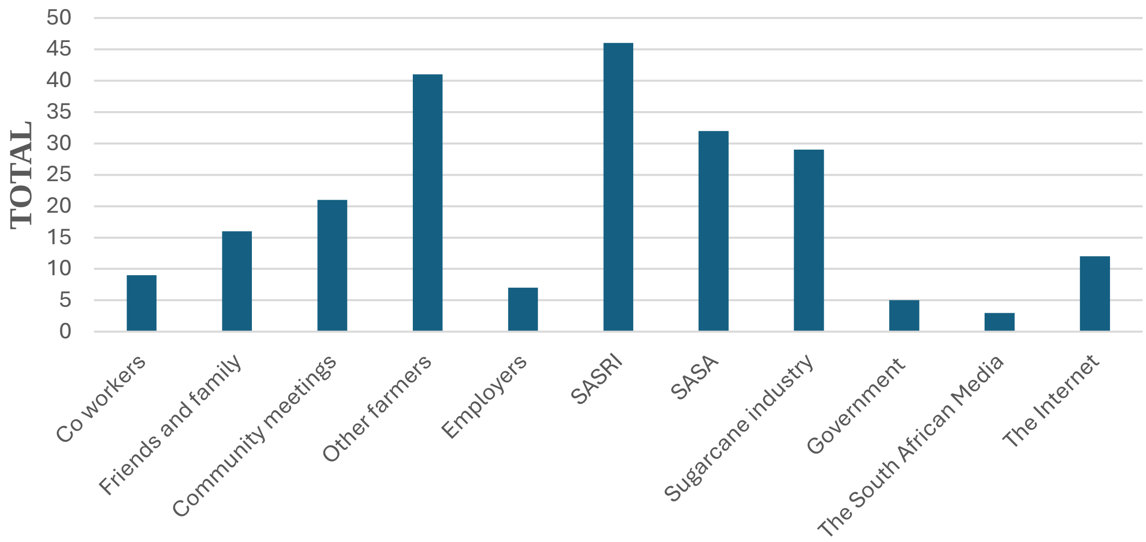



PAR emphasises the importance of involving all stakeholders in the research process, particularly those historically excluded or disadvantaged. In South Africa, agriculture has long been shaped by systemic racial inequities rooted in the legacy of apartheid, which has disproportionately affected black small-scale farmers in terms of land ownership, access to resources, and decision-making power (Cousins, 2015). Representing black, small-scale growers in this study underscores the core principle of PAR, which seeks to amplify the voices of marginalised communities and ensure that their perspectives and experiences inform the research process.

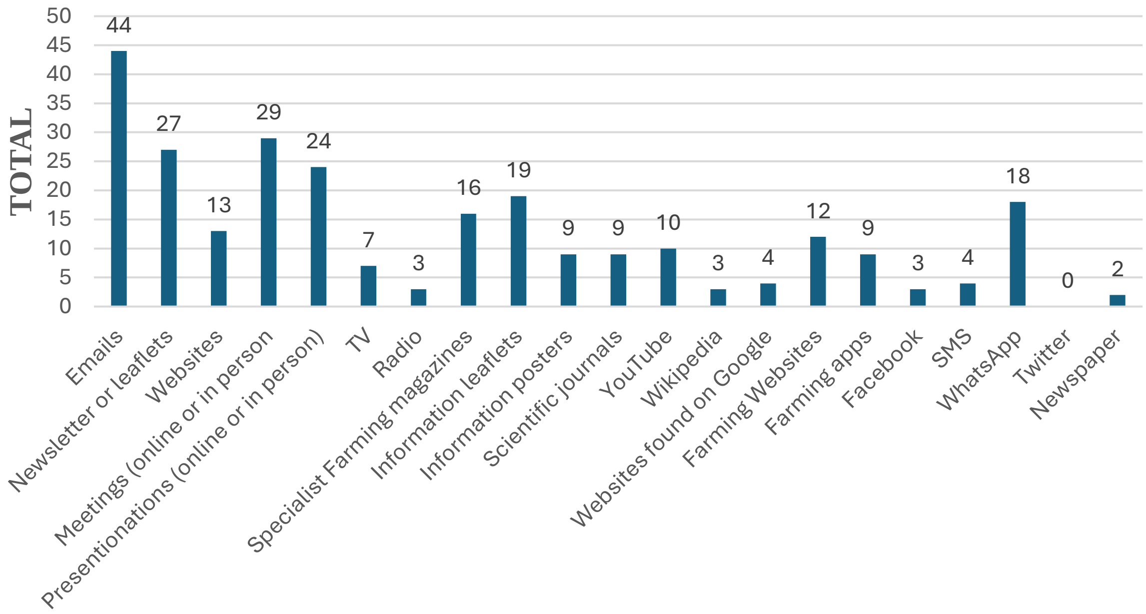
The perspectives of small-scale growers are vital because their realities often differ significantly from those of large-scale growers. Small-scale farmers face unique challenges, such as limited access to credit, infrastructure, and extension services and vulnerability to market fluctuations (Aliber & Hall, 2012). Failing to include their voices would means that the research would risks producing findings skewed toward the experiences and needs of large-scale growers, leading to recommendations that may not be applicable or beneficial to small-scale farmers.

Participatory action research aims to co-create relevant and actionable knowledge for all stakeholders. When certain groups are underrepresented, the research outcomes may lack legitimacy and fail to address the structural barriers that marginalised groups face. For example, the study disproportionately reflects the views of large-scale growers. In that case, developing media products and communication strategies for engaging with GM sugarcane may not resonate with or meet the needs of small-scale growers. This lack of inclusivity could reinforce existing inequalities rather than address them.

PAR is not only about collecting data but also about empowering participants through active engagement and mutual learning. The absence of small-scale growers from the research process limits their ability to contribute to and benefit from the knowledge generated. Without their inclusion, the study misses an opportunity to build capacity among these growers and to foster a sense of ownership and agency in the research outcomes (Herr & Anderson, 2015). Furthermore, the data from the survey indicated that growers, particularly commercial growers, prefer to receive their media in methods that are cost-efficient, easily accessible, durable, and easy to understand. This preference is significant for growers in rural areas of South Africa, where logistical, economic, and time constraints often pose substantial barriers to accessing information.




PRIMARY SOURCES OF GETTING INFORMATION ABOUT SUGARCANE




PREFERRED MODE OF GETTING INFORMATION ABOUT SUGARCANE

Many small-scale farmers in rural South Africa face economic challenges, including limited access to financial resources, which can restrict their ability to invest in expensive or high-tech forms of communication (Aliber & Hall, 2012; de Lanerolle, Walton & Schoon, 2017). Cost-efficient media, such as printed booklets, radio broadcasts, or simple mobile-based information, give growers affordable access to critical information without significantly burdening their limited resources. Using low-cost media is essential for reaching resource-constrained farmers in rural areas, where access to modern technologies may be limited.

In rural areas in the former KwaZulu homelands, small-scale farmers often have limited access to reliable internet connections. They may lack the infrastructure for high-tech solutions like broadband or smartphones. Therefore, media that is easily accessible and does not rely on advanced technology—such as community radio, pamphlets, or local gatherings—becomes crucial in disseminating agricultural knowledge. Accessible media ensures that growers are not excluded from essential information due to infrastructural limitations (Grodsky & Egziabher, 2016). This is especially true in rural areas where farmers often work long hours in the fields and may not have the time or capacity to engage with more complex or digital-based media.

Growers in rural areas need media that can withstand the challenges of a demanding work environment. Printed materials such as booklets and posters are durable and can be kept for future reference, allowing growers to revisit critical information as needed. This media type is practical for farmers who may not always have immediate access to the latest technologies or resources to seek information online (Aliber & Hall, 2012). Durability in media ensures that data is retained over time and can be consulted when necessary, particularly when farmers need ongoing guidance for their agricultural practices.

The importance of readily understandable media cannot be overstated. Many rural growers may not have formal education beyond basic literacy, and straightforward, visually appealing media that uses simple language is more likely to be understood and acted upon. Information that is clear and easy to process, such as visual diagrams or videos with minimal technical jargon, ensures that the knowledge is accessible to a broader audience, including those with lower literacy levels (Rogers, 2003). This is especially important in agricultural extension efforts, where growers must grasp complex concepts, such as the benefits and risks of genetically modified organisms (GMOs), to make informed decisions.

Growers expressed a desire to continue receiving information using the same cost-efficient, accessible, durable, and easy-to-understand methods because these media forms fit well with their daily realities. As rural farmers typically juggle multiple responsibilities, including working long hours in the fields and managing their farms, they often lack the time to engage with more sophisticated or time-consuming forms of media. Information that is concise, accessible, and available at their convenience—such as through radio broadcasts, SMS updates, or printed materials—fits better into their busy lives, allowing them to stay informed without disrupting their agricultural routines.

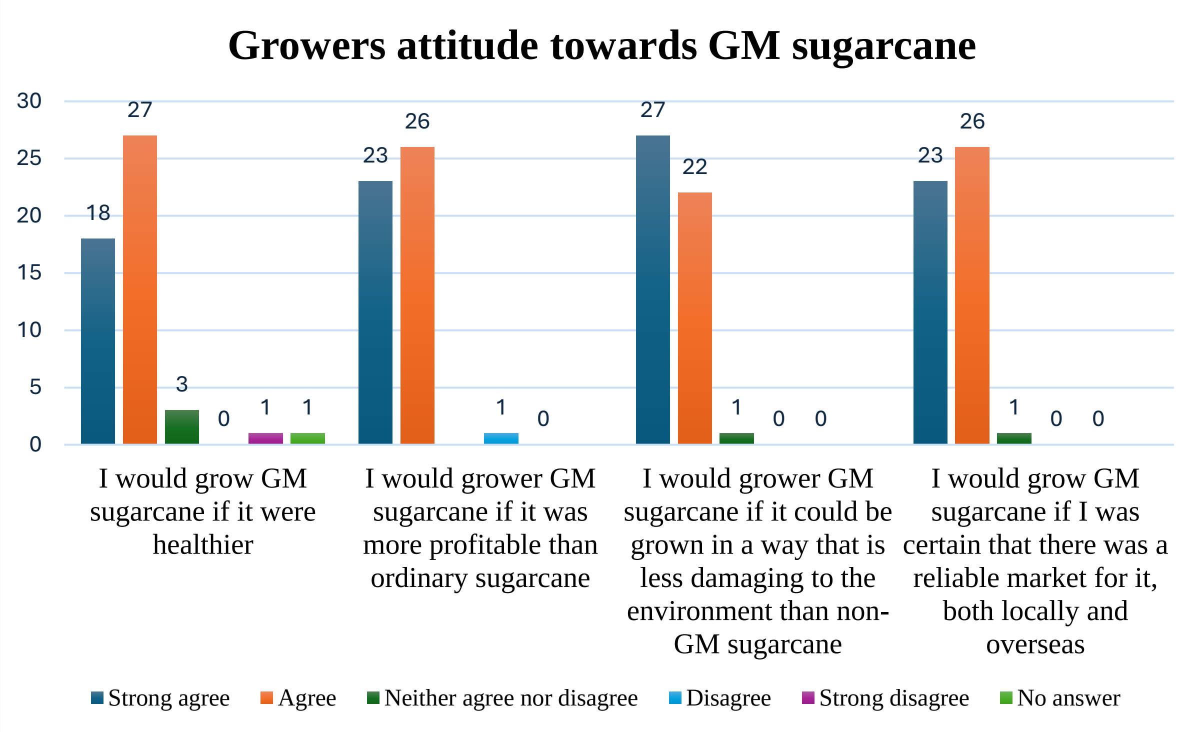
Moreover, the desire for continuity in media preferences also stems from the sense of reliability and familiarity that these methods provide. Growers have likely been exposed to these media types over the years, which means they trust them and understand how to use them effectively. According to Grodsky and Egziabher (2016), continuity in communication methods fosters trust and improves the effectiveness of agricultural extension services. If a new form of media or technology were introduced that required additional learning or infrastructure, it might face resistance due to the perceived inconvenience or extra cost.

Effective communication is a two-way process that requires active listening and crafting messages tailored to the intended audience. When examining the communication strategies necessary for two distinct groups of growers—small-scale and commercial—a differentiated approach becomes evident due to differences in survey responsiveness and media preferences.

The findings from the survey conducted among commercial growers revealed a significant divergence in media preferences compared to what existing research predicts for individuals with similar demographic profiles. While literature suggests that growers within their demographic often engage with traditional media channels, such as radio or community newspapers, the survey highlighted a stronger inclination toward digital platforms, particularly email newsletters, social media, and specialised agricultural forums. This preference indicates a shift towards more modern and industry-specific communication channels, underscoring the importance of understanding media habits rather than relying on generalised demographic assumptions (Brown & Taylor, 2018).

These findings emphasise the need for differentiated communication strategies tailored to each group. For small-scale growers, methods prioritising interpersonal interaction and culturally relevant engagement are critical to ensure effective listening and message delivery. In contrast, commercial growers require strategies that leverage digital tools and industry-specific platforms, which align with their media consumption habits and professional needs.

### 4.4.1. Generally, the survey indicates a positive attitude towards GM crops




The generally positive outlook of South African growers on genetically modified (GM) sugarcane, as reflected in the survey results, though it is important to note that the survey represents only a snapshot of a small demographic of farmers, is compelling. This limited sample size warrants caution when generalising the findings to the broader population of sugarcane growers nationwide. Nevertheless, the optimism expressed by the surveyed growers can be understood within the wider context of South Africa's rural agricultural landscape, where economic challenges, environmental pressures, and limited access to resources drive the search for more sustainable and profitable farming methods.

One of the primary reasons for the positive view of GM sugarcane is its potential to enhance profitability (Masuku, 2013). The ability of GM crops to increase yields while reducing the need for expensive inputs, such as pesticides, is a significant advantage for sugarcane farmers, especially in rural areas where financial resources may be limited (James, 2011). For these growers, achieving better yields without incurring high costs can be crucial in their decision to consider cultivating GM crops. The increased profitability from GM sugarcane may provide farmers with the financial stability needed to sustain their livelihoods and invest in their operations.

In addition to economic benefits, GM sugarcane offers environmental advantages that are particularly relevant to farmers in rural South Africa. Genetically modified varieties can be engineered to withstand pests, diseases, and drought conditions, reducing reliance on chemical pesticides and water usage (Popp, 2019). This is especially important in rural areas, where farmers often face limited access to water resources and may lack the infrastructure to apply chemical treatments effectively. Therefore, the environmental sustainability of GM crops is a key consideration for farmers looking for ways to mitigate the adverse effects of climate change and land degradation, issues that are often more pronounced in rural farming communities.

The reduced use of pesticides associated with GM crops also carries potential health benefits, as it can result in lower levels of chemical residues in food. This factor is particularly significant in rural regions, where access to healthcare may be limited, and the direct relationship between farm practices and public health is a concern. By reducing the use of harmful chemicals, GM sugarcane could offer a safer, healthier alternative for both consumers and farm workers, who are often at greater risk of pesticide exposure (Falck-Zepeda, 2014).

However, the success of GM sugarcane in South Africa depends heavily on establishing a reliable market. As the survey only represents a small demographic of farmers, it is essential to acknowledge that broader market conditions and regulatory frameworks may not fully align with the expectations of all growers. While some may be enthusiastic about GM sugarcane's potential, widespread adoption will depend on market acceptance, consumer demand, and the regulatory environment. In South Africa, the market for GM crops is still developing, and farmers are likely to adopt these technologies only if they are assured of a consistent and profitable market for their products (Ntshingila, 2019).

## 4.5. Developing science communication media requires an iterative process

Action research is characterised by its cyclical process of planning, acting, observing, and reflecting (Hill, 2014). Reflection is an essential stage in this process as it allows researchers to critically assess their actions, the effectiveness of their interventions, and the outcomes of their work. Thus, at this point, the researcher pauses to reflect.

During the initial visit to the research location, it became evident that the extension officer worked primarily with large-scale white growers. This was a significant limitation in ensuring the representation of black and/or small-scale growers, often underrepresented in agricultural research and extension activities, particularly in South Africa. This issue is particularly critical in the context of participatory action research (PAR), which is predicated on inclusivity, ensuring that all stakeholders, especially those from marginalised groups, have a voice in the research process (Chevalier & Buckles, 2019).

My co-researcher, Mchunu (2024), recognised this imbalance and took the necessary steps to remedy the situation by engaging with black and/or small-scale growers. This was important for several reasons. In line with the principles of PAR, it was essential to include the voices of small-scale growers, particularly black farmers, who are often excluded from key discussions and decisions regarding agricultural innovations (Aliber & Hall, 2012). Their perspectives are vital to understanding the diverse needs and challenges within the farming community and ensuring that the research outcomes are relevant to all stakeholders. In South Africa, small-scale and black farmers have historically been excluded from land ownership, access to resources, and agricultural development programmes due to the legacy of apartheid (Cousins, 2015). To promote social equity and justice in agricultural research, it is necessary to make concerted efforts to include these groups, thereby addressing the structural inequalities that persist in the sector. Furthermore, small-scale growers have different experiences, challenges, and knowledge than large-scale commercial growers (Aliber & Hall, 2012).

The study's aim to communicate the GM sugarcane variety and facilitate engagement around it led to the decision to produce media that would be clear, accessible, and tailored to the needs of the growers. Given the preference for cost-effective and easily accessible communication methods expressed by the growers, I decided to develop media products that would align with these preferences. The media consisted of animated videos and a booklet. The videos were chosen because they could visually demonstrate the concepts related to GMOs and the specific GM sugarcane variety, making these more straightforward for growers, including those with limited literacy (Rogers, 2003). The booklet format was chosen because it was a durable, tangible form of media that growers could refer to when needed. Both formats were designed to explain genetically modified organisms, including their development and their scientific principles.

By using these media formats, the study ensured that the information would be available in a format that was consistent with the preferences of the growers. The decision to rely on continuity—using formats already familiar and widely accepted by the target audience—was also based on the previous data indicating that growers preferred easy-to-understand, accessible, and reliable (Maponya et al., 2020).

Developing media content that explains complex topics, such as GM crops, often comes with significant challenges. One of these challenges was learning animation software (Adobe Animator), which was unfamiliar to the researcher. Animation is a powerful tool for simplifying intricate concepts, but mastering the software takes considerable time and effort. According to studies on multimedia learning, the effectiveness of animation in communication depends on how well the creator integrates visual elements with the verbal content (Mayer, 2009).

The iterative nature of the content development process, which involved ongoing consultation with researchers, ensured that the final product was scientifically accurate and accessible to the target audience.

> *These are really great. Can't wait to have the final versions!* **(RR1)**
>
> *Just checking – are we waiting for the Script for video 2?* **(RR2)**

The importance of collaborating with researchers in co-creating content cannot be overstated. GM crops are highly technical and contentious often misunderstood by the public (Gaskell, 2003). For a layperson with no background in Biotechnology, the scientific processes behind GM crop development can seem opaque or even alarming. Therefore, developing media content with expert input ensures that the information is accurate and avoids the pitfalls of oversimplification or misrepresentation. This collaborative approach enhances the media's credibility and allows the content to address common misconceptions or concerns that the public may have.

Effectively communicating information about genetically modified (GM) crops requires breaking down complex scientific concepts into language that is both accessible and understandable. Animation can serve as an effective tool to simplify these ideas and make them more engaging for diverse audiences. However, it is equally important to avoid overly colloquial language, as this presents significant challenges in science communication.

Bucchi (2008) critiques the deficit approach, which frames the communication of scientific knowledge as a unidirectional process from experts to a presumed passive and uninformed public. This approach assumes that simplifying scientific concepts—often by employing overly colloquial language—will improve public understanding. However, Bucchi argues that such oversimplification can distort the nuances of scientific knowledge and alienate audiences by undermining their capacity to engage with the material critically and in the case of GM crops, reducing the complexity of the science to overly conversational terms risks reinforcing the perception that the public is incapable of grappling with the intricacies of the topic. This perpetuates the power imbalance between experts and the public and limits opportunities for meaningful dialogue and co-production of knowledge.

Bucchi's (2008) assertion that oversimplification can distort scientific knowledge and alienate audiences raises significant concerns about the balance between accessibility and science communication. However, it is essential to differentiate between oversimplification, which strips away nuance, and strategic simplification, which transforms complex concepts into accessible and empowering formats while retaining scientific integrity. In the case of GM crops, introducing refugia planting requirements and developing educational materials for growers demonstrates how simplification, when thoughtfully executed, can facilitate understanding, foster critical engagement, and enable meaningful participation.

Bucchi's (2008) critique rightly highlights the risks of reductive communication, particularly when it reinforces perceptions of public incapacity to engage with complex topics. Yet, this perspective underestimates the potential of visual and iterative learning tools to bridge knowledge gaps. For example, the poster explaining refugia for GM crops empowered small-scale growers by demystifying a scientific concept through visuals demonstrating how pest populations could evolve without refugia. This approach did not merely reduce the complexity of the subject. Instead, it restructured it into a form that aligned with the growers' existing knowledge and contexts—doing so equipped them with the understanding needed to actively participate in discussions about the practical and economic implications of refugia planting.

The process of developing the poster further underscores the value of strategic simplification. As someone with a similar educational background to many small-scale growers, I grappled with the scientific intricacies before creating several drafts that scientists and the research team rigorously reviewed. This iterative process ensured the material maintained scientific accuracy while being accessible to its intended audience. Bucchi's concerns about oversimplification leading to alienation overlook this collaborative process, which exemplifies the co-production of knowledge between experts and intermediaries who share cultural or experiential proximity to the audience (Irwin & Wynne, 1996).

Rather than perpetuating power imbalances, strategic simplification, in this case, reduced barriers to understanding, enabling growers to engage with the science on their terms. This aligns with Freire's (1970) concept of education as a dialogic process, where learning is a collaborative endeavour that fosters critical consciousness. By clearly explaining why refugia were necessary through iterative revisions and audience-informed visuals, the poster facilitated growers' capacity to question, discuss, and apply the science in ways that resonated with their lived experiences. Far from alienating the audience, this method empowered them to engage with the material and articulate their concerns actively, fostering a sense of ownership over the knowledge produced.

Furthermore, Bucchi's (1998) argument risks conflating accessibility with oversimplification, which could perpetuate exclusivity in scientific discourse. Scientific communication, particularly in contexts involving historically marginalised communities, must acknowledge the structural barriers –such as disparities in education and access to resources—that often exclude these groups from meaningful participation (Leach et al., 2005). Simplifying scientific concepts to align with small-scale growers' cultural and practical realities is not a concession to public incapacity but an ethical imperative to ensure inclusivity and equity in knowledge dissemination.

This case also challenges the notion that scientific nuances are incompatible with accessible communication. The iterative refinement of the poster demonstrated that complexity can be conveyed through creative formats, such as time-lapse visuals, which allow audiences to grasp dynamic processes without needing prior technical expertise. Such approaches respect the audience's intelligence and demonstrate a commitment to ensuring that scientific knowledge serves the needs of diverse stakeholders.

It is crucial to align the media with the learner's cognitive processes when presenting technical information, especially in a visual format. The cognitive theory of multimedia learning suggests that visual and verbal channels can optimise learning and retention (Mayer, 2005). Through animations, a layperson can better grasp how GM crops are developed and why they might be beneficial, reducing the perceived gap between the scientific community and the general public.

The development of the media was both iterative and consultative. The findings from the questionnaire, alongside insights gathered from one-on-one interviews, informed the media's type and content. The primary aim was to ensure the media was engaging and reflective of the growers. It is important to note that the press was not in its final form. Drawing on the principles of participatory action research (PAR) and journalism theories such as engaged and public journalism, the media was designed to undergo further modifications. These modifications were planned to occur after conducting focus groups. The focus groups adopted a two-tiered approach: first, to gather feedback for improving the media, and second, to gauge participants' understanding of the genetically modified (GM) sugarcane variety and assess how the media could enhance engagement.

Within the framework of PAR, the iterative refinement of media is essential to ensure that the content remains contextually relevant and resonates with the intended audience. PAR emphasises collaboration and reflexivity, requiring researchers to adapt their approaches based on ongoing input from participants (Kemmis & McTaggart, 2014). In this context, allowing the media to undergo modifications ensures that the growers' voices and lived experiences are heard and central to the communicative process. Such an approach fosters co-creation, enhancing the legitimacy and effectiveness of the media while promoting more profound engagement with the subject matter.

Media development aimed at farmers who would like to cultivate GM sugarcane took place over a few months. The media included three animated explainer videos, a poster on refugia, and an information booklet. These materials were developed based on data collected from interviews and questionnaires. The media and its characters needed to be reflective of the growers. The press features diverse characters that look like farmers, ensuring reliability and engagement. This approach was grounded in the understanding that farmers are more likely to trust information presented by figures that resemble themselves (Bandura, 2001).

A deliberate effort was made to avoid complex scientific jargon in the media. Instead, straightforward language and metaphors were used to explain scientific concepts. For instance, metaphors helped simplify complex ideas. However, this approach was met with challenges. Some scientists who were consulted and are involved in the research of the GM sugarcane variety felt that the use of metaphors oversimplified the science.

The media was translated into isiZulu to ensure accessibility for growers. This translation process was challenging because some scientific terminology did not exist in isiZulu. To address this, workshops were held with the assistance of science graduates to devise new terminology. This iterative process ensured the media was scientifically accurate and linguistically accessible to the target audience.

### 4.5.1. The data suggests peer teaching might be a helpful science communication tool

As mentioned, Mchunu (2024) went back into the field to speak with small-scale growers, gathering valuable insights from those directly involved in the cultivation of GM sugarcane. Upon her return, my co-researcher provided insights that deepened my understanding of the small-scale farming community. Notably, she discovered that several small-scale farmers in KwaZulu-Natal had completed their schooling and possessed university-level qualifications. This challenged the common perception, as Kirsten and Van Zyl (1998) argue, of small-scale farmers as subsistence growers, revealing instead that many are engaged in farming for commercial purposes and actively seek engagement and support. These findings underscore the need for a more nuanced approach to agricultural extension and support services, recognising that small-scale farmers are not a monolithic group. Many may be educated and entrepreneurial, with aspirations and needs that align more closely with commercial growers' aspirations.

Some of these small-scale growers desired to engage with scientists developing the (GM) sugarcane variety. This desire emphasised their interest in participating in and benefiting from agricultural advancements. This type of science engagement offers several benefits. Firstly, it ensures that the research addresses the actual needs and concerns of the growers, leading to more relevant and applicable innovations (Lotz-Sisitka, Limson & Le Grange, 2024). Secondly, it fosters a sense of ownership and empowerment among growers, who become active participants in the research process rather than passive recipients of technology (Stilgoe et al., 2014). Lastly, such engagement can enhance the adoption and acceptance of GM crops, as growers involved in the development process are more likely to trust and utilise the resulting technologies (Wynne et al., 2009).

The presence of educated small-scale growers within agricultural communities presents a unique opportunity to employ peer education as a communication strategy. As Hess et al. (2016) argued, community mapping highlights the importance of identifying individuals who possess bridging and bonding capital within their communities. These individuals are critical in connecting their communities to external resources (bridging capital) and fostering more substantial, meaningful conversations within the community (bonding capital). In small-scale farming, educated growers can serve as both connectors to external scientific knowledge and facilitators of culturally and contextually relevant dialogue.

Peer education leverages the shared experiences and trust within a community to facilitate learning. Backett-Milburn and Wilson (2002) argue that peer educators, by their shared social or cultural identity with the target group, are uniquely positioned to deliver information in a way that resonates with their audience. Highly educated small-scale growers in agricultural communities are ideally suited to this role. Their experiences as small-scale growers allow them to understand their peers' practical challenges and cultural nuances. At the same time, their education equips them with the knowledge needed to communicate complex scientific concepts, such as the importance of refugia in GM crop management.

Trust is a cornerstone of effective communication, and peer education capitalises on trust within peer networks. As Shiner (1999) notes, peer educators are often seen as more approachable and credible than formal authorities, such as scientists or government officials. This credibility can lead to more critical and robust conversations, as growers may feel more comfortable questioning and discussing ideas with someone they perceive as an equal. The informal and iterative nature of these interactions allows for the co-creation of knowledge, where both the educator and the learners contribute to a shared understanding of the topic.

Moreover, peer education aligns with the principles of participatory action research (PAR), emphasising inclusivity, collaboration, and the empowerment of marginalised groups. By involving educated growers as peer educators, this approach not only disseminates knowledge but also builds the capacity of the broader community to engage with scientific ideas and advocate for their needs. This is particularly important in contexts like South Africa, where historical inequities have excluded many small-scale growers from formal decision-making processes (Leach *et al*., 2005).

The dual role of these growers—as recipients of scientific knowledge and as facilitators of peer education—addresses the critique of oversimplification raised by Bucchi (2008). Rather than relying on externally developed materials that risk alienating their audience, peer education allows for the contextualisation of information in ways that are both accessible and meaningful. For instance, an educated grower might use locally relevant metaphors or real-world examples to explain the science behind refugia, fostering a more profound understanding among their peers.

The process evaluation insights from Backett-Milburn and Wilson (2002) further underscore the adaptability of peer education to specific community needs. In small-scale farming communities, this adaptability could involve tailoring communication to address issues such as language barriers, varying levels of formal education, and differing media preferences. For example, an educated grower could facilitate discussions during community gatherings or demonstrate best practices in the field, ensuring the knowledge shared is immediately applicable and relevant.

The existence of highly educated small-scale growers within agricultural communities represents an untapped resource for fostering peer education as a communication strategy. By leveraging their bridging and bonding capital, these individuals can facilitate the dissemination of scientific knowledge in trustworthy and empowering ways. This approach enhances the inclusivity and effectiveness of agricultural extension efforts and fosters a sense of ownership and agency within the community, contributing to more equitable and sustainable outcomes.

In this context, the concept of public journalism becomes highly relevant. As Ferrucci et al. (2020) articulated, public journalism prioritises the voices and concerns of the public in the media narrative. It shifts the role of journalism from merely reporting events to actively engaging with the community, facilitating public discourse, and fostering a sense of participation and empowerment among the populace. This paradigm is crucial in the agricultural sector, where disseminating knowledge and including farmer perspectives can significantly impact policy and practice.

Ferrucci et al. (2020) posit that public journalism can bridge the gap between communities and the entities that serve them, ensuring that the narratives and solutions generated reflect the actual needs and conditions of the people. Therefore, the insights gained by my co-researcher highlight the importance of recognising the diverse profiles and aspirations of small-scale farmers. This recognition should inform the design and implementation of inclusive engagement strategies that are responsive to their needs, leveraging the principles of public journalism to facilitate meaningful dialogue and collaboration.

One small-scale grower with a degree in science emphasised the importance of including sugarcane producers in the field tests of genetically modified (GM) sugarcane varieties.

> *In anything they are working on or trying to improve, I would like them to involve us in their process. Whatever seed you develop, it definitely has to be tested by the farmers. So I would like to be involved in the actual process.* **(SG1)**

This inclusion of participants can yield several significant benefits. Firstly, it ensures that the testing conditions reflect the real-world environments where the crops will be grown, leading to more accurate and applicable results. Secondly, involving producers can enhance the credibility and acceptance of GM varieties among the broader farming community, as peer experiences can be more persuasive than external endorsements (Bonny, 2016). Lastly, this collaborative approach can facilitate the identification of practical challenges and opportunities from the outset, leading to more robust and adaptive innovations.

The introduction of a genetically modified (GM) sugarcane variety resistant to *Eldana saccharina Walker* represents a proactive measure to combat a pest that threatens sugarcane crops. However, discussions with small-scale growers suggest that *Eldana saccharina* Walkeris not currently their most pressing concern, raising questions about the immediate relevance of this invention.

> *We do not have a lot of the Eldana pest here in Ogwini. Years ago, however, in the 1990's we had it, but it was not too bad.* **(SG2)**

Projections indicate that *Eldana saccharina* Walker infestations will become more prevalent in new areas due to climate change, as increasing temperatures create more favourable conditions for the pest's spread (Vuuren & John, 2016). Despite this, growers' current perceptions reflect the present reality, not the anticipated future risks. This gap between present concerns and future threats underlines a weakness in existing communication strategies. Without clear and compelling messaging around how climate change will likely alter pest dynamics, growers may struggle to see the value of adopting preventive measures, such as planting GM sugarcane.

Communicating the changing patterns of *Eldana saccharina* Walker infestations requires a shift in framing. Messages must connect growers' current experiences with a scientifically informed narrative about the future. Visualisations, for instance, could illustrate how rising temperatures and shifting ecosystems will likely lead to increased *Eldana* infestations over time, as Badullovich, Grant, and Colvin (2020) suggested. Such approaches help contextualise the threat within the broader climate change framework, making abstract predictions more tangible and relatable.

However, framing future threats poses unique challenges. Norgaard (2009) notes that individuals often experience cognitive and behavioural resistance to engaging with future-oriented risks, mainly when these risks are complex or distant. Growers may prioritise addressing immediate, visible problems over preparing for issues they have not yet encountered. This resistance underscores the importance of crafting messages that balance urgency with practicality. For example, communication could emphasise how proactive measures such as planting *Eldana saccharina* Walker-resistant sugarcane reduce future risks, protect livelihoods, and ensure long-term sustainability.

Current communication strategies around *Eldana saccharina* Walker-resistant GM sugarcane must evolve to address the complexities of climate change and future pest dynamics. By incorporating visualisations and reframing the narrative to emphasise climate-driven changes, these messages can better resonate with growers, ensuring they understand the long-term value of adopting preventive solutions. This approach not only strengthens the relevance of GM sugarcane but also supports growers in preparing for a climate-altered future.

With smaller yields due to small parcels of land, small-scale growers face higher per-unit costs for inputs like seeds, fertilisers, and labour. Additionally, their reduced output often forces them to sell their products at local markets or to intermediaries who do not offer competitive prices, further eroding their profit margins. This financial strain perpetuates a vicious cycle of poverty, making it exceedingly challenging to invest in improvements or expansions that could enhance their productivity and profitability.

> *Because of our small fields, it is very difficult to make profit. This means that you are unable to maintain your sugarcane appropriately. It is because it is difficult to buy fertiliser and herbicides. Herbicides are very expensive. Labour is also very expensive. At some point the RV price dropped drastically and that really hit us hard, as small-scale farmers because our cane died during that time since it is not maintained well enough for it to give us a decent profit.* **(SG3)**

As previously mentioned in this chapter, the limited size of their land holdings directly impacts the financial viability of small-scale growers. The economic logic is straightforward: small parcels of land constrain the yield that can be cultivated. Consequently, these growers often need help to achieve the economies of scale enjoyed by their commercial counterparts.

> *If we had access to a big plot of land, we could plant other crops there so we can sell them to make money so by the time the sugar cane makes profit, you have been able to put bread on the table. It is a big struggle, because I really*

> *like farming, not just cane, but other crops too. It is a bit impossible because my land is small. I have about two hectares of sugarcane, but I wish I had at least ten hectares.* **(SG4)**

While these growers are willing to plant a GM sugarcane variety, SASRI stipulates that they must also plant refugia on their land. Refugia are areas where non-GM crops are grown to prevent pest populations from developing resistance to genetically modified traits. According to Van Wyk (2001), refugia are essential in resistance management strategies as they help maintain a population of pests that remain susceptible to the GM crop's protective traits, thereby slowing down the overall development of resistance.

For small-scale farmers who already operate on limited land parcels, the requirement to dedicate a portion of their land to refugia poses a significant challenge. This requirement means that a fraction of their already limited land must be allocated to non-GM sugarcane, effectively reducing the area available for planting the potentially more profitable GM varieties. Consequently, the land constraint further exacerbates their financial difficulties, as it limits their ability to fully utilise their land for maximum profit. While scientifically justified, this policy places an additional burden on small-scale growers.

Small-scale growers were excited and eager to collaborate with scientists developing the GM sugarcane variety. However, they had significant issues and concerns, primarily related to profitability and market access. These concerns were intricately tied to the problem of land availability and ownership. One grower expressed his desire to access more land. Like many others, this individual likely suffers from the lingering effects of South Africa's historical farming background.

South Africa's agricultural landscape has been profoundly shaped by its colonial and apartheid history. During these periods, large parcels of land were systematically taken from Black farmers and redistributed to White settlers, resulting in a racially skewed pattern of land ownership that persists today (Daile, 2012). The 1913 Natives Land Act, for instance, prohibited Black South Africans from owning or renting land outside designated reserves, which constituted a mere 7% of the country's land. This legislation laid the foundation for a racially discriminatory land tenure system that marginalised Black farmers, depriving them of productive land and resources.

This grower's desire for more land highlights the ongoing struggle for land reform and equitable access in post-apartheid South Africa. Despite enjoying farming, he lacked the necessary land to expand and improve his agricultural practices, a plight shared by many small-scale growers who were dispossessed during the colonial and apartheid eras. This historical context is crucial for understanding the barriers faced by small-scale farmers today and their impact on agricultural development and sustainability.

Development communication plays a critical role in addressing these challenges. It involves strategic communication to support social development and foster positive change (Servaes, 2008). In this context, development communication can facilitate dialogue between small-scale growers, scientists, policymakers, and other stakeholders. By amplifying the voices of marginalised farmers and ensuring their concerns are heard, development communication can help drive policies that address land inequities and promote more inclusive agricultural development. This approach not only supports the adoption of innovative technologies like GM sugarcane but also ensures that the benefits of such advancements are equitably distributed, contributing to the overall socio-economic development of the farming community.

## 4.6. Themes that emerged from the focus groups

With the help of a thematic analysis, this section aims to illustrate the themes that emerged during the focus groups where media surrounding the GM sugarcane variety were tested with small-scale and commercial growers. Thematic analysis is a method for identifying, analysing, and reporting themes within data (Braun & Clarke, 2006). It organises and describes the data set in detail. The value of thematic analysis lies in its flexibility and ability to provide a detailed and nuanced data account (Nowell et al., 2017). By applying thematic analysis to the focus groups, we can systematically explore and highlight the key themes and patterns that emerged, offering valuable insights into the perceptions and experiences of both small-scale and commercial growers regarding the tested media.

The development of the media was based on the insights from growers through the structured questionnaire and interviews. This initial phase ensured that the media content aligned with the perspectives and needs expressed by the growers themselves. Subsequently, the media was utilised within focus groups, and the data presented below is derived from these focus group sessions.

The primary objective of the focus groups was to elicit growers' opinions on the media. However, the discussions evolved and revealed broader topics and concerns among the participants, as set out below. This unexpected shift in conversation highlighted underlying issues and provided a richer context for understanding growers' perspectives.

However, some of the data suggested that the media required further refinement. Specifically, there was an identified need for a more detailed explanation of GMOs and GM crops. Participants indicated that a more profound and precise explanation of GMOs would enhance the media's effectiveness and relevance, ensuring the content is informative and accessible to growers with varying prior knowledge. My limited understanding of GMOs also influenced this need for refinement.

These five themes, which emerged from the focus groups, will be critically discussed concerning relevant literature:

- Effectiveness of the media on GM sugarcane
- Land as a limited commodity
- Communication and engagement
- Skepticism and acceptance of GM sugarcane
- Environmental and ecological impacts

### 4.6.1. Effectiveness of the Media on GM sugarcane

The use of clear and straightforward visuals in educational materials, particularly in complex topics such as genetically modified (GM) processes, has been widely acknowledged as an effective strategy for enhancing comprehension. According to Mayer's Cognitive Theory of Multimedia Learning, the human brain processes visual and verbal information separately, which allows for a more comprehensive understanding when both types of information are presented in tandem (Mayer, 2005). Visuals such as illustrations and images help bridge the gap between abstract or complex ideas and the learner's prior knowledge, thus promoting more effective learning (Clark & Paivio, 1991).

The positive reception of visuals by growers in the study aligns with Sweller's Cognitive Load Theory, which suggests that instructional materials should be designed to minimise unnecessary cognitive load. When materials are clear and well-structured, learners can focus their mental resources on the key concepts being taught rather than struggling to decode complicated or unclear information (Sweller, 1988). The use of simple and accessible images, therefore, can serve to reduce cognitive overload and facilitate a deeper understanding of intricate subjects like GM processes.

Furthermore, studies have shown that incorporating visuals can improve information retention and recall. Tversky (2001) argues that visualisation aids in organising and structuring knowledge, making it easier for learners to retain and recall complex information. In this regard, the growers' appreciation of clear visuals suggests that such materials help understand the GM process and reinforce and maintain the knowledge imparted.

> *Yes, I think they were—lovely illustrations, pretty simple*. **(CG1)**

The effectiveness of simple illustrations in conveying information is well-documented in educational research, where simplicity is recognised as a key factor in enhancing comprehension and retention. Gagné (1985) highlights the importance of clarity and simplicity in instructional design, suggesting that complex concepts can be made more accessible when the visuals are uncomplicated and direct. This aligns with the perspective that simplicity in design allows learners to focus on core concepts without being distracted by unnecessary details.

Moreover, as Paivio (1986) argues, cognitive theories argue that information presented in a straightforward visual format allows learners to process the material through visual and verbal channels. The resulting learning experience is more effective when these two channels work harmoniously. The simplicity of the illustrations thus not only makes the information accessible but enhances the likelihood of retaining the information for later use, as learners can easily integrate visual and verbal elements into their cognitive framework.

Tufte (2001) further reinforces that good design, characterised by simplicity and clarity, significantly enhances understanding. His work on the principles of data visualisation suggests that visuals should present only essential information, with minimal distraction from irrelevant elements. When applied to educational materials, such as booklets and videos, this principle ensures learners focus on the key concepts communicated, leading to a more effective learning experience.

The growers’ positive reaction to the simplicity of the illustrations can, therefore, be seen as consistent with these established educational theories, which suggest that simplicity aids in initial understanding and long-term retention.

> *I think they are very appropriate to get a conversation started.* **(CG2)**
>
> *Well, those plants there don’t terribly look much like sugarcane to me.* **(CG2)**
>
> *The image of the farmers on the front of the book: Do they look like farmers, or do they look like beggars on the street?* **(SG5)**
>
> *This is a person; however, this person does not have any eyes. They are wearing glasses.* **(SG6)**

The three quotes highlight critical challenges in the design and reception of visual media used for communication with stakeholders, particularly in contexts where cultural relevance, representation, and clarity are paramount. These responses suggest that visual elements in media, such as photographs, illustrations, or graphics, must be carefully designed to avoid misinterpretation and ensure alignment with the audience’s expectations, experiences, and cultural norms.

CG2’s comment, “Well, those plants there don’t terribly look much like sugarcane to me,” illustrates the importance of accurate and recognisable representations in scientific or agricultural media. Visual inaccuracies or distortions can undermine the credibility of the material as they fail to align with the audience’s lived experiences or knowledge. According to Jewitt and Oyama (2001), visuals play a crucial role in conveying meaning, particularly in scientific communication, where they often supplement or even replace textual explanations. Misrepresenting a key element, such as sugarcane, could alienate the audience or diminish their trust in the material’s validity. Therefore, media design must prioritise visual accuracy to ensure relevance and resonance with the intended audience.

SG5’s critique of the image on the book cover, “Do they look like farmers, or do they look like beggars on the street?” highlights the power of visual representations in shaping perceptions of identity and agency. Inappropriate or demeaning imagery risks reinforcing harmful stereotypes or undermining the individuals’ dignity. This aligns with Hall’s (1997) theory of representation, which argues that media representations do not merely reflect reality but actively construct it. For agricultural stakeholders, imagery that portrays farmers in an undignified or marginalised manner can have significant implications, potentially reinforcing societal hierarchies or perpetuating misperceptions about rural communities. To avoid this, designers must ensure that visual representations are empowering, contextually appropriate, and respectful of the depicted subjects.

SG6's observation, "This is a person; however, this person does not have any eyes. They are wearing glasses," underscores the critical need for visual clarity and detail in media design. Ambiguity or lack of clarity in visuals can lead to confusion, making it difficult for audiences to engage with or trust the material. Kress and van Leeuwen (2006) note that visual semiotics play an essential role in communication, as audiences derive meaning from textual content and visual cues. When these cues are unclear or poorly designed, they can hinder the effectiveness of the message and disengage the audience. Visual elements must be unambiguous for science communication and media in agricultural contexts and align with the audience's interpretative frameworks.

The design of visuals must prioritise accuracy, empowerment, and clarity to ensure that the material resonates with its audience and supports meaningful engagement. By aligning with principles of representation and semiotics, communicators can create materials that are not only informative but also respectful and relevant to their stakeholders.

The effectiveness of visual representations in initiating discussions, particularly in educational settings, relies on their ability to engage audiences and stimulate critical thinking. According to Bruner (1966), visuals are powerful tools in the learning process because they can prompt cognitive engagement and encourage a more profound exploration of the subject matter. Visual stimuli often act as cognitive triggers, sparking conversation and promoting understanding as they engage the learner's emotional and intellectual aspects.

However, the concern raised by some growers about the accuracy of the visuals underscores an essential point in the design of educational materials: the need for visual accuracy and realism. Visual representations can undermine their reliability and impact when they fail to depict the subject matter accurately. This aligns with the ideas of Mayer (2005), who discusses the importance of honesty in multimedia learning, where accurate and clear visuals are essential for learners to form correct mental models of the information presented. If the visuals do not reflect the reality of the subject matter, learners may be misled, which could hinder their ability to grasp the concepts being discussed fully.

Furthermore, Tufte (2001) argues that visual representations must strive for accuracy and simplicity to ensure that they effectively communicate the intended message. Inaccurate or misleading visuals, even if simple, may cause confusion and misinterpretation, thereby reducing the effectiveness of the learning process.

While using visuals to initiate conversations is beneficial, as noted by CG2, the potential drawbacks of inaccurate representation highlight the importance of ensuring that educational materials are engaging and factually correct. This balance between engagement and accuracy is essential for the effectiveness of visual aids in academic contexts.

> *I personally think it's fine as it is, but I take a point that CG1 made about having more balanced information if you are going to promote GM cane.* **(CG2)**

Providing balanced and accessible information in educational materials is widely recognised as essential for enhancing credibility and promoting informed decision-making. CG2's comment about the need for balanced information reflects a broader educational principle, stated by Gagné (1985), who argues that effective instructional materials should provide both sides of an argument to allow audiences to evaluate the subject matter critically. In promoting genetically modified (GM) sugarcane, presenting a balanced perspective supports the audience's autonomy and fosters trust in the materials, as learners are more likely to engage with content perceived as objective and well-rounded.

Moreover, the preference for videos over booklets highlights the growing recognition of multimedia learning as an effective method for engaging audiences. Mayer (2005) emphasises that multimedia presentations, especially those incorporating both visual and auditory elements, cater to different learning styles and can increase motivation and engagement. Videos, as dynamic and interactive formats, allow for more practical demonstrations and can present complex information more easily. This supports the growers' preference for videos, allowing them to connect with the material more immediately and practically.

The power of video as a medium for education is further reinforced by the work of Clark and Mayer (2016), who suggest that videos are particularly effective when they include narration alongside visuals, as this combination helps reduce cognitive overload and enhances comprehension. Videos also have the potential to demonstrate processes in action, which is particularly useful for topics such as GM cane, where visualising the process can provide a clearer understanding.

The growers' preference for videos and the need for balanced information reflects an essential principle in educational design: materials should be engaging and informative. By combining an accessible, balanced presentation of information with the engaging nature of multimedia formats, educational initiatives can better meet the needs of their audience.

> *The videos are also easy to engage with.* **(CG2)**

The effectiveness of video in holding an audience's attention can be attributed to several psychological and cognitive factors. Videos, as a multimodal form of communication, engage both visual and auditory channels, making them more likely to capture and sustain attention than other media forms (Mayer, 2005). Cognitive load theory supports the idea that videos reduce the burden on the viewer by presenting information in a more intuitive and less effortful way to process (Sweller, 2010). This makes them particularly effective for audiences struggling to maintain focus, such as growers juggling various tasks while consuming content.

Moreover, the dynamic nature of video content—combining visuals, sound, and movement—has been shown to enhance emotional engagement, improving memory retention and comprehension (Moreno & Mayer, 2007). Using storytelling, visuals, and contextual cues in the video can also increase motivation to engage with the material, as it feels more relatable and engaging compared to static forms of media (Rosen, 2010). In the context of training or educational videos for growers, these features contribute to a higher likelihood of sustained attention and a deeper understanding of the content.

> *I don't think that I would use this booklet. People would much rather have conversations than carry a booklet, but they definitely would use the videos.* **(CG3)**

CG3's comment underscores a growing preference for dynamic and interactive forms of communication, which are more engaging and accessible than static resources like booklets. This preference is well-supported by cognitive and educational theories that emphasise the importance of active engagement in learning. According to Dewey (1938), education thrives on direct experience and interaction, which aligns with CG3's suggestion that conversations and videos are more effective than passive reading materials. These formats foster active participation, crucial for deeper understanding and retention.

Furthermore, the desire for balanced information, including diverse perspectives, is key to how individuals process and internalise information. Fostering critical thinking requires presenting multiple viewpoints instead of offering one-sided narratives, a principle championed by scholars such as Giroux (2001). In the context of commercial growers, the demand for comprehensive and nuanced explanations, particularly regarding contentious issues like genetically modified (GM) cane, suggests a preference for media that not only presents information but also invites dialogue and offers diverse viewpoints for critical examination. This approach is grounded in the theory of constructivist learning, which emphasises the importance of learners constructing their understanding through interaction with others and the environment (Vygotsky, 1978).

Thus, the preference for videos and conversations over static materials reflects an evolving approach to education and communication, where engagement and critical thinking are prioritised.

> *I take a point that CG1 made about having more balanced information if you are going to promote GM cane.* **(CG2)**

CG2's point about the importance of balanced information when promoting GM cane resonates with key principles in communication. The inclusion of diverse viewpoints is essential for fostering credibility and promoting informed decision-making, as it allows audiences to evaluate different perspectives and come to their conclusions critically. According to Habermas (1984), deliberative democracy relies on the free and open exchange of ideas, where diverse viewpoints are presented and critically discussed. This ensures that the audience can engage with the material in an inclusive and intellectually rigorous way.

Moreover, when discussing controversial topics like GM cane, it is essential to acknowledge multiple perspectives to avoid biased representation. Nussbaum (1997) noted that fostering an environment where differing opinions are considered and respected is fundamental for developing a robust, democratic discourse. This approach enhances the credibility of the information and encourages a more holistic understanding of the topic at hand. In agricultural practices, including opposition viewpoints can mitigate potential resistance and allow stakeholders to form a more comprehensive and informed opinion.

> *Perhaps go into more detail about how refugia works. This suggests that while the current level of detail is adequate, there is a need for more in-depth explanations on certain topics.* **(CG1)**

CG1's observation highlights the importance of providing in-depth explanations for complex topics, such as refugia and the implications of genetically modified (GM) sugarcane. Refugia, in the context of GM crops, refer to areas where non-GM crops are planted to prevent the development of resistance to pests that may evolve due to the widespread use of GM crops. This concept is integral to integrated pest management (IPM) strategies, as it ensures that a population of pests is not exposed to the GM crop's genetic modifications, maintaining the efficacy of pest control measures (James, 2011).

The need for clarity on such topics is particularly crucial for small-scale growers, who may lack access to technical resources and expertise. For these growers, understanding the science behind genetic modifications and mechanisms like refugia is essential for effective crop management and making informed decisions about the adoption of GM crops. The complexity of genetically modified organisms (GMOs) means that evident, accessible explanations are necessary to avoid misconceptions and ensure that growers are fully aware of both the benefits and potential risks of using GM cane (Bawa & Anwar, 2015).

Moreover, providing detailed information on GM sugarcane's broader environmental and economic implications is critical. This involves explaining the long-term effects of GM crops on biodiversity, soil health, pest management, and the financial impact on local farming practices. Educational resources that delve deeper into these subjects would empower growers with the knowledge needed to make informed choices and enhance the credibility of the material being presented.

The discussion highlights concerns about the practical utility of the booklet, including how well it explains the concepts and whether it is a valuable reference for the growers. The importance of having records and certificates for farming activities is also emphasised.

> *We want to start the culture of asking questions, keeping records, and stop the culture of being silent.* **(SG7)**

SG7's statement about fostering a culture of asking questions and keeping records addresses a crucial shift towards transparency and open communication, particularly regarding complex topics such as genetically modified (GM) sugarcane. Encouraging growers to engage with the material critically and ask questions is vital for empowering them to make informed decisions. The culture of silence or passive acceptance, as opposed to active inquiry, often leads to misconceptions and a lack of understanding. As Freire (1970) asserts, education should be a process of dialogue and questioning that promotes critical thinking, allowing individuals to challenge existing narratives and develop a deeper understanding of the issues at hand.

In the case of GM sugarcane, growers' mixed feelings are not unusual, as the benefits—such as pest resistance and reduced chemical use—are often overshadowed by concerns about long-term environmental impacts, safety, and economic implications. Providing accessible and detailed information is essential to bridge this gap. According to Wilson (2002), effective communication, particularly in agricultural biotechnology, requires explicit, understandable explanations addressing the technology's scientific aspects and broader societal consequences. This dual focus ensures that growers are aware of the potential advantages and able to assess the risks and challenges associated with GM crops critically.

Moreover, creating opportunities for open dialogue, where questions are welcomed, and records are kept for future reference, can help dispel uncertainties. Maintaining records can also promote a sense of ownership and responsibility among growers, empowering them to track their own experiences and outcomes, which is crucial for the continued adaptation of new agricultural technologies (McGuire & Popkin, 1991). This approach aligns with participatory learning principles, where learners actively engage with and shape the content they are being taught.

Ultimately, SG7's advocacy for questioning and record-keeping reflects a commitment to fostering a more informed and proactive approach to adopting GM sugarcane, ensuring that growers feel confident in their understanding of the technology and its implications.

### 4.6.2. Land as a Limited Commodity

The central theme that recurred during the focus groups on the media about GM sugarcane is the discussion of the limited land available to small-scale farmers. This constraint is highlighted in several comments, emphasising how the scarcity of land affects farmers' ability to adopt new farming practices and technologies. As argued by Pretty (2008), the issue of land availability is a significant challenge for small-scale farmers, particularly in developing countries, where land is often fragmented and productivity per hectare is already under pressure. This scarcity limits the capacity of farmers to implement new technologies, especially those that require the allocation of additional land for specific purposes, such as planting refugia for pest management in the case of GM sugarcane.

The challenge of land scarcity is further argued by Scoones (2009), who claims that small-scale farmers often operate within highly constrained environments where decisions about agricultural practices are heavily influenced by the availability of resources, particularly land. The limited land base forces farmers to prioritise practices that offer immediate economic benefits, often leaving little room for experimenting with or adopting new technologies that require additional investment in both land and resources. As such, the potential benefits of GM crops, such as increased yields or reduced pesticide use, may be undermined by the practical reality of land limitations.

Furthermore, the difficulty in adopting new agricultural technologies due to land constraints reflects broader socio-economic dynamics, as Ellis (2000) stated. Small-scale farmers are typically resource-poor and face high risk when adopting new technologies. Their decisions are often shaped by the need to ensure short-term food security and income rather than long-term investment in unfamiliar farming practices. This limited capacity for risk-taking further complicates the potential for GM crops to gain traction among small-scale farmers, who must carefully assess whether the potential benefits outweigh the initial costs and the risk of failure.

Thus, the land limitations faced by small-scale farmers represent a significant barrier to adopting GM sugarcane and other agricultural innovations. These constraints must be addressed through targeted policy interventions that consider the realities of small-scale farming, ensuring that new technologies are accessible and feasible within these farmers' resource constraints.

> *Our land is not big enough; we barely have a hectare per farmer, and very few people have more than a hectare of land. If we were to adopt GM sugarcane, who amongst us would be willing to plant a different type/breed of sugarcane to accommodate insects?* **(SG4)**

The argument highlights the critical issue of land availability in adopting genetically modified (GM) sugarcane, particularly for small-scale farmers. Reserving land for non-modified sugarcane varieties, known as refugia, is a strategy to delay pest resistance to GM crops. However, this requirement imposes substantial challenges for small-scale farmers who operate on limited landholdings. For such farmers, allocating portions of their already constrained land to refugia is often neither practical nor economically viable. This issue underscores a broader barrier to adopting agricultural technologies that rely on land-intensive pest management strategies. Glover et al. (2018) noted that small-scale farmers frequently face significant difficulties in integrating such technologies due to resource constraints, which diminishes their potential benefits and sustainability in these contexts. The emphasis on planting specific varieties for pest management raises critical questions about the equity and inclusivity of such measures, particularly for resource-poor farming communities.

> *We were excited when you said that this new method of planting would be helpful to us farmers, but now we are disappointed to learn that we will need to use some part of the land to plant the usual sugarcane just to accommodate insects. By doing that, will we not be encouraging the spread of these insects? Are we not making a hive for them to produce and spread?* **(SG2)**

This quote illustrates the farmers' apprehension about potentially exacerbating pest problems through new planting methods. The suggestion to allocate part of their limited land to plant non-GM sugarcane varieties for pest management raises fears about inadvertently fostering pest populations.

The economic implications of land use were a central concern for the farmers, highlighting the tension between maximising financial returns from limited landholdings and the costs associated with adopting new farming practices. Small-scale farmers, often working with minimal resources, face considerable economic pressures when integrating resource-intensive technologies. This balancing act becomes incredibly challenging when practices like refugia require farmers to dedicate portions of their land to non-GM varieties for pest management. This reduces the land's productive capacity in the short term despite the potential for longer-term benefits. As Ellis (2000) argued, small-scale adoption of new technologies often hinges on their ability to manage the immediate costs and risks involved, which can act as significant barriers to adopting innovative agricultural methods.

> *When watching the video, I realised that the economic side of this is that we as farmers will be able to save because this method of sugar cane farming does not require us to spend much on insect control and weed control, that will save us a lot of money.* **(SG8)**

The potential for economic savings through reduced pest and weed control costs is undoubtedly appealing to farmers, particularly those working on small-scale operations where resource constraints are prevalent. The introduction of genetically modified (GM) crops, such as GM sugarcane, promises significant reductions in pest management costs, which could increase overall profitability. However, the requirement for allocating land to different sugarcane varieties to achieve these benefits introduces a critical limitation. Small-scale farmers, often constrained by limited landholdings, may struggle to allocate enough space for non-GM refugia, compromising the technology's practicality. The broader issue of opportunity costs compounds this concern. As noted by Pretty (2008), the economic viability of new agricultural technologies is highly dependent on the ability to integrate them into existing farming systems without unduly sacrificing other productive activities. For small-scale farmers, who often engage in multiple agricultural activities to ensure food security and income diversification, the requirement to allocate land for refugia could mean foregoing other potentially more profitable crops. Consequently, the economic incentive of reduced pest control costs may not outweigh the opportunity costs associated with land reallocation.

Nevertheless, the discussion also highlighted farmers' willingness to explore adaptive strategies. Despite the challenges, there is a strong interest in innovative approaches that could be more beneficial and feasible for small-scale operations. According to Sumberg et al. (2012), small scales often demonstrate resilience and adaptability in the face of new technologies, seeking alternative solutions that align with their needs and resource constraints. Such adaptive strategies might include integrating pest management techniques with other low-cost innovations, which could enhance their operations' sustainability and profitability.

> *As you proceed with your research, you could help us find a way to improve the sugar cane we already have to make more insect-resistant before introducing GMSC as an alternativ*e. **(SG9)**

This sentiment reflects a pragmatic approach, suggesting a preference for improving existing sugarcane varieties to enhance their pest resistance rather than adopting entirely new varieties that require additional resources and adjustments. For small-scale farmers, particularly those operating on limited land, introducing new varieties can often be seen as risky and resource-intensive. Adopting genetically modified (GM) crops, for example, may involve substantial upfront costs for seeds, technology, and infrastructure, which can be prohibitive for farmers with constrained resources. As Ellis (2000) argues, small-scale farmers are generally more inclined towards strategies that build upon existing systems, as they can more easily integrate incremental changes into their operations without disrupting established practices.

Moreover, enhancing the pest resistance of current crop varieties offers a more feasible and cost-effective alternative to large-scale changes in farming practices. This approach allows for the retention of familiar cultivation techniques, reducing the need for farmers to adapt to entirely new production systems. According to Chambers and Conway (1992), improving local agricultural systems through low-cost innovations is often more effective for small-scale farmers, as it fosters resilience and enhances productivity without necessitating extensive external inputs. This preference for incremental improvements reflects a broader tendency for small scales to focus on adaptations that ensure sustainability and minimise risk rather than investing in disruptive, high-cost technological solutions.

### 4.6.3. Communication and Engagement

Effective communication and engagement are crucial to the successful adoption and broader acceptance of GM sugarcane. A transparent information-sharing approach, robust educational initiatives, and consistent stakeholder engagement are essential for addressing concerns and facilitating informed decision-making among key actors. Growers, in particular, require access to reliable and scientifically grounded information from credible sources to make informed decisions about adopting GM sugarcane. This aligns with the findings of numerous studies on agricultural biotechnology, which argue that farmers' trust in the sources of information significantly impacts their willingness to adopt new technologies (Van der Walt et al., 2013; Glover et al., 2010).

Educational campaigns targeting both growers and consumers are pivotal in shifting public perceptions and fostering acceptance. Fisher et al. (2015) noted that such campaigns can demystify genetically modified organisms (GMOs) and provide the necessary context to address public apprehension. Moreover, stakeholder engagement is a tool for information dissemination and a means of building a dialogue that can help mitigate resistance through active participation and response to concerns (Pray et al., 2005).

Farmers rely on more than just scientific data to make decisions. They also value the socio-political context in which such information is presented (Conway & Pretty, 2013). In the case of GM sugarcane, tailored, locally relevant information can reduce perceived risks and provide a more comprehensive understanding of the benefits and challenges associated with GM crops.

Thus, as highlighted by numerous scholars, for GM sugarcane to be successfully adopted, stakeholders must receive continuous education, transparent communication, and opportunities for open dialogue to overcome concerns and ensure that adoption is based on well-rounded, trusted knowledge.

> *So we're talking about a huge educational drive here. First, within our industry, we need to get everybody on board; the other is where we are marketing it*. **(CG2)**

CG2's call for an extensive educational drive underscores the necessity for comprehensive and targeted information dissemination to ensure that all stakeholders are well-informed about the benefits and risks of GM sugarcane. This approach aligns with the broader understanding that effective communication and engagement are foundational to adopting agricultural innovations, particularly when they involve controversial technologies like genetic modification. For example, Glover et al. (2010) emphasised the critical role of transparent information in promoting informed decision-making among farmers, particularly when new technologies are perceived as risky or complex.

Furthermore, participants highlighted the importance of an inclusive and transparent debate involving all stakeholders. This approach is supported by scholars who argue that agricultural biotechnology's success depends on providing scientific information and creating spaces for public dialogue and engagement (Fisher et al., 2015). A transparent discussion that involves diverse viewpoints and fosters trust can significantly influence the acceptance of GM crops, as it allows stakeholders to voice concerns and seek clarification on various issues. According to Van der Walt et al. (2013), such engagement is pivotal in addressing scepticism and building trust, especially in the context of new agricultural technologies.

The importance of introducing GM sugarcane within the industry and to the broader public cannot be overstated. Conway and Pretty (2013) note that how information is framed and communicated plays a crucial role in shaping public perceptions and overcoming resistance. By employing a strategy that prioritises clarity, transparency, and inclusivity, stakeholders are more likely to understand the potential benefits, such as increased yield and environmental sustainability, while acknowledging and addressing the associated risks.

Thus, there is a need for a comprehensive educational campaign, as CG2 suggests, to inform industry stakeholders and engage in broader societal conversations that contribute to the successful integration of GM sugarcane. A well-executed educational strategy ensures stakeholders can make balanced and informed decisions.

> *But I think this question needs to be put out there for the whole industry to answer. But almost having a small group of people like us to say whether it's right or wrong, I think you've got to do it naturally; you've got to do it with everybody.* **(CG4)**

CG4's comment advocating an inclusive, industry-wide debate reflects the need for a democratic process in which all voices are heard and considered. Such an approach is essential for building consensus and ensuring that decisions represent the collective interests and concerns of all stakeholders within the industry. This concept of inclusive decision-making has been widely advocated, and it is recognised that engaging a broad spectrum of participants—from farmers to policymakers—is vital to addressing the complexity of biotechnology adoption (Conway & Pretty, 2013).

The idea of a transparent, inclusive debate also resonates with the principles of participatory governance, which emphasise the importance of involving all relevant stakeholders in decision-making processes to ensure equitable and sustainable decisions. Fisher et al. (2015) argue that stakeholder engagement is central to fostering a sense of ownership and trust, which can enhance the legitimacy of decisions and facilitate smoother implementation of new technologies. This inclusivity helps to address the potential risks of exclusion, where a narrow group of decision-makers might overlook the concerns of a wider audience, leading to resistance and discontent.

Additionally, this type of democratic process can help balance competing interests and highlight the diverse perspectives that exist within the industry. According to Glover et al. (2010), such broad-based engagement ensures that decisions regarding GM crops reflect scientific knowledge and social, ethical, and economic considerations, which are critical to their acceptance. The idea is to create a platform where dialogue and debate can occur openly, ensuring that decisions are made with full awareness of the implications for all involved.

Thus, as CG4 suggests, a democratic and inclusive approach is essential for achieving consensus and ensuring that decisions about GM sugarcane reflect the industry's diverse views and needs. This approach strengthens decision-making and fosters a more cohesive and cooperative environment for future developments.

> *Scientifically, it might be proven that it doesn't have harmful effects, but the perception is it's the housewife buying the product.* **(CG1)**

CG1's comment underscores the crucial need to balance scientific evidence with public perception and market sentiment in the GM sugarcane debate. While scientific studies may currently demonstrate that GM crops do not pose harmful effects, public perception—particularly among consumers—often plays a significant role in shaping the market dynamics and acceptance of such innovations. Conway and Pretty (2013) noted that public attitudes toward biotechnology can be influenced by various factors, including perceived risks, trust in the entities promoting the technology, and broader socio-cultural values. Even when not grounded in scientific facts, these perceptions can significantly affect consumer choices, market behaviour, and, ultimately, the success of new agricultural technologies.

Moreover, addressing public opinion is not just about countering misinformation but also about recognising the role of social context in shaping perceptions. Fisher et al. (2015) argue that understanding public concerns is essential for formulating effective communication strategies that bridge the gap between scientific knowledge and consumer sentiment. This is particularly true for GM crops, where fears about safety, environmental impact, and corporate control often dominate public discourse. Therefore, in the case of GM sugarcane, transparent and consistent information sharing is necessary to reassure consumers and empower them to make informed decisions based on evidence.

Furthermore, as highlighted by growers, ongoing updates and support from research institutions, such as SASRI, are crucial for maintaining informed decision-making within the industry. Glover et al. (2010) emphasise that continuous communication from trusted research bodies is vital for ensuring stakeholders, particularly farmers, are equipped with the latest data and insights to guide their decisions. This constant flow of information helps to reduce uncertainties and enables growers to make timely, educated choices about adopting new crop varieties, such as GM sugarcane. The anticipation expressed by growers regarding updates also highlights the value placed on reliable, timely information, which can help to build confidence in the technology and its benefits.

Thus, while scientific evidence provides the foundation for understanding the safety and efficacy of GM sugarcane, addressing consumer perceptions and ensuring that growers have access to ongoing updates are key components in fostering broader acceptance and successful adoption of this technology.

> *I think it is healthy for all growers to know that there is a GM study, where it is, and what decisions they need to take and when.* **(CG4)**

CG4's comment highlights the essential role of continuous information dissemination to keep growers well-informed and actively engaged in the decision-making process regarding GM sugarcane. In the context of agricultural innovation, particularly with genetically modified crops, providing growers with timely and accessible information is crucial for enabling them to make educated choices about adoption. Glover et al. (2010) have argued that access to up-to-date, precise information helps farmers understand the potential benefits and risks associated with new technologies, ensuring that they can make decisions based on reliable evidence rather than speculation or misinformation.

The need for ongoing updates also speaks to the broader principle of participatory decision-making in agriculture. Conway and Pretty (2013) emphasise that for new agricultural technologies to be successfully adopted, researchers, growers, and other stakeholders must have a continuous dialogue. This dialogue ensures that growers are aware of the latest developments in GM research and allows them to voice their concerns, ask questions, and adapt their practices as necessary. By keeping growers engaged in this way, they are more likely to feel a sense of ownership over the process, increasing the likelihood of successful adoption.

Moreover, Fisher et al. (2015) highlight the importance of clarity in communicating scientific findings and policy decisions. If growers are provided with clear timelines, expectations, and decisions about GM sugarcane, it can reduce uncertainty and help them plan accordingly. The sense of empowerment that comes from being well-informed can also improve their confidence in adopting GM technologies and engaging in broader industry discussions.

Thus, as CG4 suggests, ensuring that all growers are kept up-to-date on the progress of GM studies, the decisions they must make, and when is vital for fostering informed, proactive involvement in adopting GM sugarcane.

> *In general meetings, everyone talked about Eldana figures, and they wanted to know when GM cane is coming*. **(CG3)**

CG3's observation highlights the urgency and anticipation surrounding the introduction of GM sugarcane as a solution to significant agricultural challenges, such as *Eldana* control. This underscores the critical role that biotechnology can play in addressing specific pest and disease issues, which can directly impact the productivity and sustainability of crops. Glover et al. (2010) noted that the adoption of GM crops often stems from the perceived need to address pressing agricultural problems, with farmers keen to embrace new technologies that offer solutions to long-standing issues, such as pest infestations.

The anticipation expressed by stakeholders reflects a broader trend in agricultural innovation, where farmers and other industry players are eager for technological advancements that promise to improve crop yields and reduce pest-related losses. Conway and Pretty (2013) argue that such enthusiasm is often driven by the tangible benefits of new technologies, particularly in pest and disease management. In the case of GM sugarcane, the potential to address the threat posed by pests like Eldana can drive significant interest from growers looking for more effective and sustainable solutions.

Moreover, Fisher et al. (2015) emphasise managing expectations while introducing new technologies. While growers may be eager for the arrival of GM sugarcane, the timeline for its introduction must be communicated clearly, along with the necessary support systems to ensure successful implementation. This aligns with the need for transparency and regular updates discussed earlier to keep stakeholders informed and engaged throughout the adoption process.

### 4.6.4. Scepticism and Acceptance of GM Sugarcane

After viewing the multimedia, the sugarcane growers expressed that attitudes toward genetically modified (GM) sugarcane vary significantly. A significant theme that emerged from the focus group discussion with commercial sugarcane growers was concern about the market acceptance of GM sugarcane. Participants voiced uncertainty about whether consumers would be willing to accept products labelled as GM, reflecting broader apprehensions within the agricultural sector about the potential rejection of GM products in key markets. As Gastrow et al. (2012) notes, the public's perception of genetically modified crops is shaped by a complex interplay of economic, cultural, and environmental factors, which can significantly influence market dynamics and consumer behaviour. In the context of sugarcane, these concerns are particularly relevant, as growers depend heavily on consumer preferences and demand within local and international markets.

Due to fears of market rejection, the hesitancy to adopt GM sugarcane aligns with findings from other agricultural sectors, where consumer acceptance is often a key barrier to the widespread adoption of genetically modified crops. As argued by Anderson (2009), market perceptions of GM products can be influenced by factors such as consumer education, environmental concerns, and trust in regulatory bodies, all of which can affect the willingness of both producers and consumers to embrace these technologies. This uncertainty surrounding market acceptance highlights the need for effective communication strategies to address consumer concerns and build trust in GM products, particularly in markets where consumers may be more sceptical or less informed about biotechnology.

> *I think there's a whole element missing out here because we all know what GM does, and you all know that many people are very sceptical of it. So, there's one final question you need to answer. I mean, is it acceptable?* **(CG4)**

The comment mentioned above reflects the core issue of whether the market is ready to accept GM products. This concern is paramount because it directly impacts the commercial viability of GM sugarcane. The willingness of consumers to embrace genetically modified (GM) crops is a critical determinant of market success, especially for products like sugarcane, which is both a staple crop and a major commodity in international markets. As argued by Thayer (2003) and Gastrow (2018), public acceptance of GM crops is influenced by a combination of cultural, ethical, and economic factors, all of which must be carefully navigated to ensure the commercial success of such products. This concern is particularly significant for agricultural industries, where market dynamics can rapidly shift in response to changing consumer preferences or regulatory measures.

The economic viability of GM crops hinges not only on their productivity benefits but also on their marketability. As stated by the Food and Agriculture Organization (FAO) (2004), the integration of biotechnology in agriculture must be matched by strategies addressing consumer concerns and regulatory frameworks facilitating trade. Without broad consumer acceptance, the potential economic gains from GM sugarcane may be undermined by market resistance, limiting the crop's commercial success. The challenge for growers, therefore, lies in balancing the technological advantages of GM crops with the need for market-driven acceptance. This tension has been evident in various agricultural sectors where GM crops have been introduced.

> *It would be nice to hear what the miller has to say because they were in touch with the markets...if we've got to put GMO on the back of our labels, it's going to have an effect.* **(CG1)**

CG1's statement highlights the importance of understanding market dynamics and consumer perceptions, particularly from the perspective of millers directly engaged with the market. As intermediaries between producers and consumers, millers play a crucial role in determining the acceptance of new agricultural technologies, such as genetically modified (GM) crops. According to a report by the World Bank (2007), market acceptance of GM crops is heavily influenced by consumer trust, which is shaped by factors like transparency in labelling and the perceived risks or benefits associated with GM products. Millers, therefore, not only process the crop but also bear the burden of consumer sentiment, which can significantly affect their willingness to adopt or promote GM sugarcane.

Labelling was also identified as a critical factor that could influence consumer acceptance. The need for transparency in labelling and the potential negative impact on sales was emphasised in various studies, particularly in markets with significant consumer resistance to GM foods. McHughen (2000) argued that clear and transparent labelling is essential for building consumer confidence, as it allows individuals to make informed choices based on their preferences and values. Conversely, the lack of transparency can lead to consumer distrust and, in some cases, market rejection. This issue has been particularly pronounced in European markets, where consumer opposition to GM crops has led to significant challenges in their acceptance. The potential for a negative impact on sales, therefore, underscores the importance of understanding not only the technological advantages of GM sugarcane but also the broader social and economic context in which these products are introduced.

> *...that labelling is a big thing. You just put GM on the bottom of that label; there are a whole lot of people who will not buy your product.* **(CG4)**

CG4 highlights a significant concern that labelling GM products could deter consumers, particularly those sceptical or opposed to GM foods. The impact of labelling on consumer behaviour has been a focal point of many academic discussions, with concerns that labels indicating genetically modified ingredients can reinforce negative perceptions about the safety of GM foods. Gaskell et al. (2006) argue that consumer acceptance of GM foods is deeply influenced by how information is presented, with labelling acting as a potential signal that either reassures or heightens consumer fears. In regions where public opinion is already wary of biotechnology, a GM label may be a reminder of perceived risks rather than a neutral or educational tool.

Other participants echoed this sentiment, reinforcing the importance of transparent and honest labelling practices. Transparency in labelling has long been regarded as a key strategy in building trust and enabling informed consumer choices. However, as Frewer et al. (2004) argue, the mere inclusion of a GM label does not guarantee consumer understanding or acceptance; instead, it must be coupled with educational initiatives to address underlying concerns and explain GM technologies' benefits and safety. The impact of labelling on market acceptance, as argued by Lusk and McCluskey (2006), suggests that the effectiveness of such measures depends not only on the presence of a label but also on consumer education and the broader socio-political context in which the products are sold.

#### 4.6.5. Environmental and Ecological Impacts

This theme addresses environmental and ecological considerations associated with the cultivation of GM sugarcane. After watching the media during the focus groups, commercial growers indicated that they were apprehensive about the long-term ecological impacts of GM sugarcane, particularly concerning pest resistance and the broader environmental effects. As highlighted by Altieri (2005), concerns about the ecological consequences of GM crops often revolve around the potential for unintended environmental changes, such as the development of resistant pests or the disruption of local biodiversity. These fears are not unfounded, as research has shown that genetically modified crops while offering benefits such as pest resistance, can also lead to the emergence of pest populations that are less susceptible to the genetic modifications over time (Snow et al., 2005). This evolutionary arms race can increase the ecological burden, potentially requiring more chemical interventions in the future, thus negating the environmental benefits initially promised by GM technology.

Additionally, the environmental concerns expressed by the growers reflect broader apprehensions within the agricultural community about the sustainability of GM crop systems. As Pretty (2008) argues, the ecological risks of GM crops must be carefully balanced with their potential benefits, and farmers must be adequately informed about these long-term impacts.

*It will kill Eldana, but it will kill many other pests. And I mean, there's knock-on effects to all these things...Who knows what the long-term consequences are?* **(CG4)**

*Even in the video you all saw, this genetically modified sugarcane has been taken from a small pest called bacteria.* **(SG1)**

*The genetically modified sugarcane is not harmful to people nor other plants, nor does it change the characteristics of the sugarcane, e.g., reduce the sugar.* **(SG5)**

These quotes capture GM crops' uncertainty and potential risks, such as unintended consequences on non-target species and the environment. On one hand, proponents of GM technology argue that genetically modified crops offer significant advantages, particularly enhanced pest resistance and increased agricultural productivity. As Beddington et al. (2012) noted, GM crops can reduce the need for chemical pesticides, thereby decreasing environmental pollution and promoting more sustainable farming practices. Introducing pest-resistant crops, for instance, can lead to lower pesticide use, which benefits non-target species and preserves the ecological balance of agricultural ecosystems. Moreover, GM crops can contribute to food security by increasing yields, reducing losses to pests, and enabling agriculture to thrive in regions with challenging growing conditions.

On the other hand, there are concerns about the unintended ecological consequences of GM crops, particularly about their impact on non-target species and the environment. As Altieri (2005) argues, introducing genetically modified organisms into ecosystems can disrupt local biodiversity significantly if the crops inadvertently affect beneficial insects or soil organisms. These changes could lead to unintended environmental consequences, such as the emergence of pesticide-resistant pests or a decrease in beneficial species, which could undermine the long-term sustainability of agricultural systems. Snow et al. (2005) further emphasise that the long-term ecological risks of GM crops remain poorly understood, and there is a potential for gene flow between GM and non-GM crops, which could contaminate native varieties and reduce agricultural diversity. Therefore, introducing GM crops poses a risk of unforeseen ecological impacts, making it crucial to monitor their environmental effects over time carefully.

In addition, while GM crops could improve food security and agricultural sustainability, their long-term effects must be evaluated within the broader context of ecosystem health and resilience. As McHughen (2000) suggests, GM crops are not inherently harmful, but their environmental impact depends on how they are managed and regulated. The potential benefits of GM technology should be weighed against the risks, and policies should aim to maximise the benefits of GM crops while minimising their potential ecological drawbacks. The debate, therefore, is not simply about whether GM crops are good or bad but about how they can be integrated into agricultural systems to maximise both their benefits and sustainability.

> *I worry that you might sort out Eldana, but what about smuts? Will that make the cane more susceptible to smuts, pests, or disease?* **(CG3)**

CG3's concern about the potential for GM sugarcane to become more susceptible to other pests or diseases if certain pests are targeted highlights the complexity of ecological interactions and the need for comprehensive risk assessments. One of the key arguments in favour of genetically modified crops, such as Bacillus thuringiensis (*Bt*) toxin-producing sugarcane, is the targeted control of specific pests, such as *Eldana saccharina* (the African sugarcane borer). McHughen (2000) argued that *Bt* toxin is a highly selective pesticide, effective against specific pests like *Eldana* while posing minimal risk to beneficial insects, wildlife, and humans. The ability of *Bt* crops to reduce pesticide use and protect crops from damaging pests offers significant advantages in terms of both economic and environmental sustainability, as it can help farmers reduce costs while promoting environmentally friendly farming practices.

However, CG3's concern raises an important ecological consideration regarding the broader effects of introducing GM crops that produce *Bt* toxin. As highlighted by Altieri (2005), while *Bt* toxin is effective against *Eldana*, the widespread use of *Bt* crops may have unintended consequences, such as the potential for pest resistance to develop over time. Furthermore, introducing *Bt* crops could have cascading effects on non-target species and the broader ecosystem. For example, although *Bt* toxin targets *Eldana*, it may indirectly affect other pest populations or the ecological dynamics that govern pest control. The introduction of GM crops that produce *Bt* toxin could lead to shifts in pest populations, potentially making crops more vulnerable to other pests or diseases, such as smuts or fungal pathogens, that may thrive in the absence of their natural predators or competitors (Snow et al., 2005).

In addition, the risk of pest resistance and the potential for ecological disruption underscores the importance of comprehensive risk assessments before adopting GM crops. As Beddington et al. (2012) suggest, the long-term sustainability of GM crops depends on their careful management and the monitoring of ecological impacts over time. A failure to account for the potential environmental risks, such as increased susceptibility to other pests or diseases, could undermine the benefits of adopting GM technology. Therefore, CG3's concern reflects a broader need for precautionary measures and comprehensive risk assessments to ensure that GM crops like *Bt* sugarcane do not lead to unintended ecological consequences that could affect crop yields and environmental sustainability.

## 4.7. Conclusion

The study focused on developing media content to introduce and facilitate engagement around genetically modified (GM) sugarcane among small-scale and commercial growers. The materials included two animated explainer videos, a poster on refugia, and an information booklet on the new GM sugarcane variety. These media were created using insights from interviews and questionnaires with the growers. The following analysis delves into the key themes from the focus group discussions where these media were tested, offering insights into the growers' perspectives and concerns.

A recurrent theme during the focus groups was the limited availability of land for small-scale farmers, which presents a significant barrier to adopting GM sugarcane. Refugia, areas where non-GM crops are grown alongside GM crops to manage pest resistance, are crucial in this context. However, for small-scale farmers who operate on minimal land, allocating space for refugia is impractical and could limit their ability to maximise their crop yield.

SG4, one of the participants, highlighted this issue by stating, "Our land is not big enough; we barely have a hectare per farmer, and very few people have more than a hectare of land. If we were to adopt GM sugarcane, who amongst us would be willing to plant a different type/breed of sugarcane to accommodate insects?" This sentiment reflects the challenge of balancing the need for innovative agricultural practices with the harsh reality of land scarcity. While theoretically sound, the requirement to dedicate land to non-GM crops as part of pest management strategies is not feasible for farmers with limited resources.

The economic implications of land use were also a primary concern for the farmers. SG8, a small-scale farmer, expressed an interest in the potential cost savings through reduced pest and weed control, but this benefit was tempered by the concern about allocating land for non-GM crops. SG9's suggestion to improve existing sugarcane varieties for better pest resistance before introducing GM varieties reflects a pragmatic approach, emphasising the need for practical solutions that align with the farmers' existing constraints.

The growers' attitudes towards GM sugarcane varied, with significant concerns about market acceptance and consumer perception. Commercial growers, in particular, expressed uncertainty about whether consumers would be willing to accept GM-labelled products. CG4, one of the participants, encapsulated this concern by questioning, "Is it acceptable?" This uncertainty directly impacts the commercial viability of GM sugarcane, as market acceptance is crucial for its success.

The issue of labelling GM products was also identified as a potential barrier to consumer acceptance. CG4 noted that labelling products as GM could deter specific consumers, reflecting a broader scepticism towards GM foods. CG1's comment about the importance of hearing from millers who are in touch with the markets underscores the need for transparent communication between all stakeholders in the supply chain.

The growers' scepticism towards GM sugarcane concerns its potential market reception and the broader implications for consumer trust. This scepticism is not unfounded, as public perception of GM foods remains contentious, influenced by various factors, including ethical considerations, environmental concerns, and the general public's understanding of biotechnology (Gastrow, 2018).

Environmental and ecological considerations around GM sugarcane were also a significant concern among the growers. After watching the media, commercial growers expressed apprehension about the long-term ecological impacts, particularly regarding pest resistance and broader environmental effects. CG4's comment, "...it will kill eldana, but it will kill many other pests. And I mean, there are knock-on effects to all these things...Who knows what the long-term consequences are?" reflects the uncertainty surrounding the ecological implications of GM crops.

CG3, one of the commercial farmers' concerns about the potential for GM sugarcane to become more susceptible to other pests or diseases if certain pests are targeted, highlights the complexity of ecological interactions. This apprehension underscores the need for comprehensive risk assessments and a deeper understanding of the potential knock-on effects of introducing GM crops into existing ecosystems.

The growers' concerns about the environmental impacts of GM sugarcane suggest a need for a cautious approach to its adoption. While GM crops offer potential benefits regarding pest control and yield improvement, these must be weighed against biodiversity and ecosystem health risks. Addressing these concerns through transparent and thorough research will be crucial in gaining the growers' trust and support.

Effective communication and engagement emerged as vital components for the successful adoption of GM sugarcane. The growers emphasised the need for reliable information from trusted sources and the importance of educational initiatives to inform both growers and consumers about GM sugarcane. CG2 suggested an extensive educational drive to ensure stakeholders are well-informed about the benefits and risks associated with GM sugarcane, highlighting the importance of transparent information sharing.

Participants also emphasised the need for an inclusive and transparent debate involving all stakeholders before making decisions about GM sugarcane. CG4's suggestion for an industry-wide discussion indicates a desire for a democratic process where all voices are heard and considered. This approach is crucial for building consensus and ensuring that any decision reflects the collective will of the industry.

The growers' need for ongoing updates and support from research institutes like the South African Sugarcane Research Institute (SASRI) was also highlighted. CG4's comment about the importance of keeping growers informed about the progress of GM sugarcane research underscores the need for continuous engagement and communication. This ongoing dialogue is essential for addressing concerns, updating research developments, and building trust among growers.

The growers appreciated the media's effectiveness in conveying information about GM sugarcane, with simple language and clear visuals being key factors. CG1 noted the usefulness of the illustrations and images in the booklets and videos for understanding the GM process, indicating that straightforward and accessible visuals effectively convey complex concepts. However, some participants suggested that more detailed information and balanced perspectives would enhance the media's effectiveness.

Despite the initial preference for booklets, there was a notable shift towards videos as the preferred medium for conveying information. Videos were seen as more engaging and practical for educational purposes, reflecting a broader trend towards dynamic, visually engaging content in educational and informational media. CG3's comment about the preference for videos over booklets underscores the need for media that is not only informative but also engaging and accessible.

The feedback on the media also highlighted the importance of accurate and relatable representations in the visuals. CG2's comment about the visual representations not accurately depicting sugarcane suggests a need for more precise and contextually relevant visuals to enhance the media's relatability and usefulness. The growers' preference for video content and the need for balanced and detailed information suggest that future media development should prioritise these elements to ensure effective communication and engagement with the target audience.

The thematic analysis of the focus group discussions reveals several key insights and challenges for developing media to introduce GM sugarcane to farmers. The limited availability of land, scepticism towards GM crops, concerns about environmental impacts, and the importance of effective communication and engagement are all critical factors that must be considered in future media development and communication strategies.

The shift in preference towards video content highlights the need for dynamic and visually engaging media that can effectively convey complex information to farmers. The growers' feedback emphasises the importance of accurate and relatable representations, balanced information, and continuous engagement to build trust and support the successful adoption of GM sugarcane.

As the research progresses, it will be crucial to refine the media and communication strategies to address the concerns and preferences of the growers. By prioritising transparency, inclusivity, and ongoing engagement, the media can effectively support the adoption of GM sugarcane and contribute to the sustainable development of the sugarcane industry.

# Chapter 5: Conclusion

## 5.1. Introduction

The relationship between science and society is vital to addressing global challenges, yet it remains fraught with complexities. This thesis, titled *'Engaged Science: Multimedia as a Tool for Engagement Between Researchers and Growers on GM Sugarcane'*, sought to investigate how multimedia can enhance communication and understanding between researchers and sugarcane growers in the context of genetically modified (GM) sugarcane. By focusing on this case study, the research has highlighted the importance of creating accessible and participatory platforms to address scientific and agricultural concerns collaboratively.

This concluding chapter begins by revisiting the research objectives and questions centred on exploring how multimedia tools can bridge the divide between scientific knowledge and the practical realities that growers face. The chapter reflects on how multimedia used to make scientific information about GM sugarcane more accessible, understandable, and engaging, with particular attention to the opportunities it created for growers to voice their perspectives.

The research has underscored the need for an engaged science approach that fosters two-way communication rather than relying solely on traditional methods of information dissemination. By integrating visual, auditory, and interactive elements, multimedia offers a unique capacity to break down complex topics like GM sugarcane in ways that resonate with diverse audiences.

Beyond its practical implications, this study contributes to the broader discourse on science communication and agricultural innovation. It positions multimedia as a communication tool and a means of cultivating trust and mutual understanding between researchers and growers, particularly when addressing controversial or technically intricate subjects.

## 5. 2. Revisiting Research Objectives and Questions

At the core of this study was the aim to explore how multimedia can facilitate meaningful engagement between researchers and growers regarding genetically modified (GM) sugarcane. To achieve this, five key objectives guided the research process.

The first objective was to establish a foundational understanding of GM products and the specific concerns of growers. This was achieved through initial interviews that provided critical insights into growers' perceptions, knowledge gaps, and priorities, laying the groundwork for developing targeted multimedia materials.

The second objective focused on producing multimedia content. This step was pivotal in ensuring the materials were scientifically accurate and relevant to growers' lived experiences and concerns. The resulting multimedia products were designed to elicit engagement by presenting complex scientific information in accessible, relatable, and engaging formats.

The third objective involved testing the multimedia products with groups of growers through focus groups. This stage enabled the research to assess the effectiveness of the materials in fostering understanding, engagement, and dialogue.

Following the focus group engagement, the fourth objective was modifying the multimedia products. Based on the feedback from growers, the materials were refined to enhance their clarity, relevance, and impact.

Finally, the fifth objective was critically reflecting on the overall research process. This involved evaluating the strengths and limitations of the approach, the challenges encountered, and the broader implications of the findings.

These objectives collectively framed the study, enabling a comprehensive exploration of how multimedia can bridge the gap between researchers and growers in the context of GM sugarcane while contributing to the broader discourse on participatory and inclusive approaches in science communication.

## 5.3. Summary of Key Findings

The findings of this study provide significant insights into the role of multimedia in facilitating engagement between researchers and growers regarding genetically modified (GM) crops, particularly sugarcane. Through the iterative process of media creation, testing, and refinement, three key findings emerged: that media can effectively generate informed discussions about scientific innovations; that hypothetical future threats are challenging to communicate effectively; and that science communication targeting small-scale growers must prioritise their most pressing concern – land.

The research demonstrated that multimedia tools can effectively stimulate informed discussions among growers about scientific innovations, such as GM crops. By incorporating growers' perspectives and presenting information in accessible formats, the media products were able to bridge knowledge gaps, foster curiosity, and promote meaningful dialogue. The findings from the focus group discussions revealed that growers engaged with the content not only to understand GM sugarcane but also to critically evaluate its potential benefits and risks in their own contexts.

This result underscores the transformative potential of multimedia in science communication. Unlike traditional methods of one-way information dissemination, multimedia encourages active participation by combining visuals, audio, and storytelling techniques. By humanising complex scientific concepts, such as the genetic modification of crops, multimedia can demystify these innovations and make them more relatable to growers' lived experiences.

However, while the ability of multimedia to generate discussion is evident, the depth of these discussions varied. Some growers engaged deeply with the scientific aspects of GM sugarcane, while others were more focused on immediate practical concerns, such as yield improvements and market access. This highlights a limitation: while multimedia can open up discussions, its effectiveness depends on the relevance of the content to the audience's priorities. In this regard, customisation of content is critical. Science communicators must understand the audience's context to ensure the media resonates with their needs and values.

The second key finding is the difficulty of communicating scientific concepts related to hypothetical future threats, such as pest outbreaks or climate resilience, particularly in GM sugarcane. While growers acknowledged the potential risks that GM crops might mitigate, their immediate concerns—such as access to land and resources—often overshadowed their engagement with these future-oriented scenarios.

This finding reflects a broader challenge in science communication: audiences often struggle prioritising hypothetical or long-term risks over immediate, tangible concerns. For small-scale growers, whose livelihoods are usually precarious, the urgency of addressing daily challenges can render abstract future threats less compelling.

In the context of engaged science, this poses a significant challenge. Communicating hypothetical risks requires clarity and framing strategies that connect these risks to the audience's immediate priorities. For example, while future pest outbreaks may seem abstract, they could be reframed as threats to current yields or income. Similarly, climate resilience might be positioned as a strategy for protecting land and securing livelihoods.

Another challenge in communicating future threats is the inherent uncertainty of scientific predictions. Growers in the focus groups expressed scepticism towards the speculative nature of some claims, particularly when clear, evidence-based explanations did not accompany them.

This suggests that science communicators must balance honesty about uncertainty with efforts to build trust and credibility.

The final and perhaps most significant finding is that any science communication aimed at small-scale growers must address their most pressing concern: land. Throughout the research, land consistently emerged as the central issue shaping growers' decisions, priorities, and engagement with innovations. For many participants, land was not merely a resource but a foundation for livelihood, identity, and intergenerational stability.

This finding has profound implications for the design of science communication strategies. Efforts to engage small-scale growers with innovations such as GM crops must start by acknowledging the land's social, economic, and cultural importance. Messages that fail to address land-related concerns—such as land tenure, access, or soil fertility—risk being perceived as irrelevant or disconnected from growers' realities.

For example, while the media products tested in this study focused on the potential benefits of GM sugarcane, growers frequently redirected discussions to how these innovations might impact their land. Questions such as "Will this crop damage my soil?" or "Will this technology require me to change my farming practices?" reflected the centrality of land in their decision-making processes. This suggests that effective science communication must go beyond presenting scientific benefits; it must actively engage with growers' concerns and provide clear, evidence-based answers to their questions.

Moreover, the focus on land highlights the need for a participatory approach to science communication. Rather than imposing top-down narratives about the benefits of GM crops, researchers and communicators should involve growers in co-creating messages that resonate with their experiences and address their priorities. This ensures that the content is relevant and fosters a sense of ownership and trust, which are critical for successful engagement.

From a critical perspective, these findings suggest that science communication is not merely translating scientific knowledge into accessible formats. It is a dynamic, iterative process that requires communicators to listen, adapt, and respond to the needs of their audience. This challenges traditional models of science communication, which often prioritise the dissemination of information over genuine dialogue and collaboration.

However, the study also highlights certain limitations. While multimedia effectively sparks discussions, it is not a panacea for all communication challenges. Structural issues, such as limited digital access and low formal education, remain significant barriers for many small-scale growers. Addressing these barriers requires broader systemic efforts, including rural infrastructure and education investments.

This study demonstrates that multimedia can play a decisive role in fostering engagement between researchers and growers, particularly around complex and contested innovations like GM crops. However, its effectiveness depends on how well the content aligns with growers' immediate concerns and priorities, particularly land-related ones. To overcome challenges such as communicating hypothetical threats, science communicators must adopt strategies that frame future risks in ways relevant to their audience's present realities.

## 5.4. Limitations of the Study

This study explored the potential of multimedia to facilitate engagement between researchers and growers about genetically modified (GM) sugarcane, offering valuable insights into the intersection of science communication, agricultural innovation, and participatory engagement. However, like any research project, this study was subject to several limitations that affected its scope, methodology, and findings.

The COVID-19 pandemic significantly hindered the progress of this study. The restrictions on movement, social interaction, and public gatherings implemented during the pandemic affected every stage of the research process. Initial interviews with growers and researchers had to be delayed, and in some cases, alternative methods, such as virtual interviews or phone calls, were used. These methods, while helpful, limited the depth and richness of interactions that in-person interviews typically allow.

Furthermore, the focus group sessions, central to testing the multimedia products, were conducted under challenging circumstances. COVID-19 protocols required smaller groups, social distancing, and limited discussion time, which may have restricted the quality and quantity of feedback collected. Some growers, particularly those from remote areas with limited digital literacy, could not participate due to a lack of access to technology or reliable internet connections. These disruptions highlight the challenges of conducting participatory research during a global health crisis, particularly in rural settings where infrastructure and resources are already constrained.

Another significant limitation was the small size of the research group. While the small group allowed for more in-depth engagement with participants, it limited the generalisability of the findings. The perspectives gathered may not fully represent the diverse experiences and concerns of growers across different regions, particularly those in areas with varying levels of access to resources, technology, and education.

The limited sample size also restricted the study's ability to explore potential differences in engagement across demographic groups, such as age, gender, or farming experience. For instance, younger growers with greater exposure to technology may have engaged differently with multimedia products compared to older growers with limited digital literacy.

As the primary researcher, my knowledge gaps also presented a limitation to the study. While I made concerted efforts to familiarise myself with the technical aspects of GM sugarcane and the principles of multimedia production, I am neither a specialist in genetic modification nor a professional media producer.

The multimedia products, while carefully designed to balance scientific accuracy and accessibility, may not have fully captured the nuances of the science behind GM crops or the complexity of growers' concerns. Additionally, my limited experience in participatory research may have influenced the dynamics of engagement with participants.

Digital literacy and accessibility were significant barriers for some participants, particularly those in remote rural areas. While multimedia was chosen as a tool for its potential to make scientific information more accessible, the effectiveness of this approach was limited by participants' varying levels of familiarity with digital technologies. Some growers struggled to engage with multimedia products due to a lack of exposure to similar tools. In contrast, others were hindered by limited access to devices or reliable electricity and internet connections. These challenges highlight the digital divide in rural agricultural communities, limiting their ability to benefit from innovative communication tools.

The time frame of the study was another limitation. The research was conducted over a relatively short period, restricting the ability to explore the long-term impacts of multimedia engagement. For example, while the focus groups provided immediate feedback on the multimedia products, assessing whether these tools had a lasting impact on growers' understanding, attitudes, or decision-making regarding GM sugarcane was impossible.

The complexity of the research topic also posed a limitation. Genetic modification is a highly technical subject that requires careful communication to avoid misunderstandings or oversimplifications. Balancing scientific accuracy with accessibility was a constant challenge, particularly given the diversity of the audience. Some participants found certain aspects of the multimedia products too technical, while others felt that the information lacked depth or failed to address their specific concerns. This highlights the difficulty of designing communication tools that effectively cater to diverse audiences with varying prior knowledge and interest levels.

Social and cultural factors also influenced the study's findings in ways that were difficult to control. For example, growers' engagement with multimedia products was shaped by the content itself and their existing beliefs, values, and experiences with science and technology. Some participants expressed scepticism towards GM crops due to broader societal debates about their safety and ethical implications, which may have influenced their willingness to engage with the materials.

Additionally, cultural norms around hierarchy and communication may have affected the dynamics of focus group discussions. In some cases, participants may have hesitated to voice their opinions openly, notably if they differed from those in the group or the facilitator.

## 5.5. Recommendations and Future Research Directions

While this study highlighted the potential of multimedia to facilitate dialogue between researchers and growers, it also revealed areas requiring further exploration to enhance both the effectiveness of communication tools and the inclusivity of participatory science.

Future research should involve a more extensive and diverse sample of growers, ensuring representation across different demographics, regions, and farming contexts. Such diversity is essential to understanding how growers with varying levels of digital literacy, access to resources, and familiarity with scientific innovations receive multimedia tools.

Diversity in participants would also enable a more nuanced analysis of the factors influencing engagement. For example, future research could investigate whether younger growers with greater technological exposure respond differently to multimedia tools than older growers with limited digital experience. Similarly, exploring gendered perspectives on science communication could reveal insights into how women growers, who may face unique challenges in accessing agricultural innovations, engage with multimedia content.

The short time frame of this study limited its ability to assess the long-term impact of multimedia tools on growers' understanding, attitudes, and decision-making processes. To address this, future research should adopt a longitudinal approach, tracking participants over extended periods to evaluate whether multimedia engagement leads to sustained changes.

Longitudinal studies could assess, for instance, whether growers exposed to multimedia tools are more likely to adopt GM crops or other scientific innovations over time. Research could also explore how engagement evolves as participants encounter new information, technological developments, or shifting socio-economic conditions. Additionally, follow-up interactions could reveal whether initial scepticism towards GM crops diminishes as growers gain familiarity with the underlying science and its practical applications.

While this study demonstrated the potential of multimedia to generate discussions about GM crops, it also highlighted the challenges of designing content that balances scientific accuracy with accessibility.

Research could compare the effectiveness of multimedia formats, such as videos, infographics, or interactive apps, in conveying complex scientific concepts. For example, studies could investigate whether growers respond better to narrative-driven content, which humanises scientific innovations, or to data-driven content, which emphasises empirical evidence. Testing multimedia tools in various contexts and with diverse audiences would help refine their design and maximise their impact.

Additionally, future research should consider the role of co-creation in multimedia design. Involving growers in content development could ensure that the tools reflect their priorities, concerns, and cultural contexts. By adopting a participatory approach, researchers could create multimedia products that are both scientifically accurate and deeply resonant with the target audience.

While multimedia proved effective in this study, it is not the only tool for science communication. Comparative studies examining the strengths and limitations of different communication methods could provide valuable insights into how best to reach and engage diverse audiences. For example, research could investigate whether face-to-face interactions, such as workshops or field demonstrations, are more effective than digital tools in building trust and facilitating dialogue.

Possibly the key finding of this study was the centrality of land-related concerns for small-scale growers. Future research should build on this by investigating other context-specific concerns that may shape growers' engagement with scientific innovations. For example, studies could explore how water scarcity, market access, or labour availability influence growers' priorities and decision-making processes.

By tailoring science communication to address these context-specific concerns, researchers can create more relevant and impactful messages. Understanding the broader socio-economic and cultural factors that shape growers' perspectives is essential for designing communication tools that resonate with their realities.

Finally, future research must address the broader structural issues that limit small-scale growers' ability to engage with scientific innovations. While communication tools play an important role, their impact is constrained by systemic barriers such as limited access to education, infrastructure, and resources.

## 5.6. Concluding Reflections

This chapter has synthesised the findings and implications of this study, demonstrating how multimedia can act as a transformative tool in fostering engagement between researchers and growers in the context of genetically modified (GM) sugarcane. While the findings underscore the value of multimedia in translating complex scientific concepts into accessible formats, they also point to the challenges of inclusivity, particularly in addressing digital literacy and access barriers in rural farming communities.

The research suggests that engaged science requires more than the mere application of digital tools; it demands an iterative, participatory process that prioritises the voices and experiences of all parties involved. By doing so, multimedia becomes a medium of information delivery and a platform for cultivating trust, collaboration, and mutual understanding.

It is evident that multimedia has a unique capacity to transform the way scientific knowledge is communicated and received, particularly in contentious fields like GM crops. The study positions multimedia as a cornerstone of engaged science, one that can encourage participatory approaches and empower stakeholders to make informed decisions. Achieving this vision requires ongoing commitment to inclusivity, transparency, and adaptability in research and communication practices.

Looking forward, this research lays the groundwork for further exploration into the role of multimedia in other areas of agricultural innovation and contested scientific topics. Future efforts should focus on refining multimedia strategies, addressing technological disparities, and evaluating long-term outcomes of engagement initiatives.

In conclusion, this thesis has illustrated the promise and challenges of multimedia as a tool for engagement, offering practical insights and contributing to the evolving discourse on science communication. As agricultural innovation becomes increasingly critical in addressing global challenges, approaches prioritising inclusivity and collaboration, like those explored here, will play a vital role in shaping a more sustainable and connected future.

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# Appendices

## Appendix 1: Guide to the semi-structured interviews

1. Basic personal details. These will be kept confidential.
2. Are you a small-scale or commercial sugarcane grower? Please elaborate on this,
3. How long have you been in the agricultural sector?
4. What are the crops that you farm with?
5. What does farming mean to you? Has it been in your family for generations? Or is this something you have recently started?
6. Do you own a farm? What role do you fulfil on the farm?
7. Tell me about your relationship with the land. What does it mean to you?
8. What are your aspirations as a farmer?
9. Where is your farm located?
10. Tell me about your daily routine on the farm.
11. What are some of the biggest challenges you face on the farm and as a farmer?
12. What are some of your biggest challenges in farming operations? How do you try and address these challenges?
13. Tell me about your relationship with your extension officer. How often do you meet with them? What do you discuss?
14. Please share some of the ways you get information from your grower association. Do you get them in booklets, leaflets, or videos? Email or SMS?
15. What kind of information do you get from your grower association? How often do you get information, and how easily accessible is this information?
16. Tell me about your media consumption.
17. What is your knowledge about biotechnology?
18. What does the term genetically modified organism mean to you?
19. The South African Sugarcane Research Institute is developing a genetically modified sugarcane variety. What do you know about this research?
20. Would you grow genetically modified sugarcane? Comment why you would or would not.
21. How would you like to receive communication on genetically modified sugarcane? How often would you like to receive it?
22. If you have questions about the genetically modified sugarcane variety, who would you like to ask, raise concerns, comment, or share suggestions? How often would you like to do this?
23. What are some of your questions on genetically modified sugarcane?

## Appendix 2: Electronic survey

**Communicating information on GMO sugarcane to sugarcane growers in KwaZulu-Natal Study**

***We wish to collect some biographical information***

1. Are you a sugarcane grower or involved in sugarcane farming? If yes, continue interview.

□Yes

□No

2. Are you over 18? If yes, continue interview.

□Yes

□No

3. Age category: *(Please tick the appropriate box)*

□ 15-24 □ 25-34 □ 35-44

□ 45-54 □ 55-64 □ 65+

4. How would you best describe your race?

□ Black African □ Coloured □ White

□ Indian □ Other_____________ □ Prefer not to say

5. Gender: *(Please tick the appropriate box)*

□ Male □ Female

□Non-binary □ Prefer not to say

6. What language do you speak/ read/ write? Tick all that applies.

| | Speak | Read | Write |
|---|---|---|---|
| IsiZulu | | | |
| Afrikaans | | | |

| | | | |
|---|---|---|---|
| English | | | |
| Other (specify) | | | |

7. Do you consider yourself as belonging to any religion?

□Yes

□No

8. If yes, please state which denomination:

_______________________________________________

9. Highest Education level: *(Please tick the appropriate box)*

□ No schooling □ Primary school □ Some Secondary school

□ Matric □ Diploma □ Degree

□ Post-grad degree □ Masters □ Doctorate

10. How would you best describe your employment status? *(Please tick the appropriate box)*

□ Unemployed

□ Self-Employed with employees

□ Self-employed without employees

□ Employed

□ Working for your own family's sugarcane farm

*11.* Residential area *(Please tick the appropriate box)*

□ Village area □ Farming area □ Informal settlement

□ City/Town □ Other

12. Describe your employment at the sugarcane farming operation? (Please tick any that applies)

□ Management Board

□ Farm owner

□ Farm manager

□ Farm labourer

□ Other (specify):

13. How would you describe yourself as a grower? (Tick all that apply)

□ Commercial farmer

□ Land reform grower

□ Small-scale grower

14. List any other crops besides sugarcane that are grown on the farm.

_______________________________________________

15. Where is the geographical location where you are growing sugarcane?

_______________________________________________

16. How do you obtain your sugarcane plants?

□ Propagation from my existing crops ("seedcane production")

□ Exchanging plants with other farmers

□ Buying sugarcane plants from other farmers

□ Buying sugarcane plants from nurseries/industry suppliers

□ Other (please state which)

□ Don't know

17. What are the key features that you consider to be a successful sugarcane crop? (Please tick all that applies)

□ High yield (tonnage)

□ High sugar percentage

□ Thick and easy to cut

□ Low levels of insecticide/herbicide/fungicide

□ Other (please specify)

18. What is your greatest worry as a farmer/grower?

___________________________________________________

19. What are the main factors which lead to low sugarcane crop yields? *(Please tick all that apply)*

□ Drought

□ Insect infestation

□ Weeds and alien plants

□ Plant diseases

□ Other (please specify)

20. What are the other factors which lead to low quality sugarcane crops?

___________________________________________________

21. Which methods do you use to enhance the productivity (quality or yield) of your crops? (Record all responses)

___________________________________________________

22. Are there any other methods that you wish to use to enhance the productivity of your crops but do not have access to?

___________________________________________________

23. Are there any methods that you would not use to enhance the productivity of your crops?

___________________________________________________

24. Do you use traditional farming methods (such as growing crops using the traditional knowledge of your community)? If yes, please elaborate on methods

___________________________________________________

25. Do you use any of the following? *(Please tick all that apply and specify which ones)*

□ Pesticides

□ Herbicides

□ Fungicides

26. Pesticides, herbicides and fungicides are frequently used in farming. Please answer the following:

| | Strongly agree | Agree | Neither agree nor disagree | Disagree | Strongly disagree | Do not know |
|---|---|---|---|---|---|---|
| I am concerned about the safety of pesticides, herbicides and fungicides in my sugarcane farming | | | | | | |
| I am concerned about the cost of using pesticides, herbicides and fungicides in my sugarcane farming | | | | | | |

27. Where do you get your information from about sugarcane farming? ( Please Tick all that applies)

□ Co-workers

□ Friends and family

□ Church/faith community

□ Community meetings

□ Other farmers

□ Employers

□ South African Research Institute

□ South African Sugar Association

□ Sugarcane industry

□ Government

□ The South African media

□The Internet

28. In what ways or formats do you prefer to get your information about sugarcane farming? Tick all that applies

Sugarcane Industry

□ Emails

□ Newsletters or leaflets

□ Websites

□ Meetings (online or in person)

□ Presentations (online or in person)

Media

□ TV

□ Radio

□ Newspapers

□ Specialist farming magazines

□ Information leaflets

□ Information posters

□ Scientific journals

Internet

□ YouTube

□ Wikipedia

□ Websites found via Google

□ Farming website (please specify)

□ Farming app (please specify)

Social Media

□ Facebook

□ SMS

□ WhatsApp

□ Twitter

□ Other ____________________

29. What type of internet media usage best describes you?

□ I am connected all the time and often stream video or audio

□ I am connected most of the time and share lots of photos on social media but can't afford to watch too many videos

□ I am only connected some of the time and mainly use text on WhatsApp, occasionally sharing photos

□ I can't really afford data but I use my phone as a media player, sharing media using Bluetooth or ShareIt

□ I do not have a smartphone or other media player

30. How do you access the internet? Please tick all that apply.

□ Computer at home

□ Computer at work

□ Internet café

□ My mobile device

□ I don't have access to the internet

***<u>We now wish to move to questions about Science and Biotechnology.</u>***

31. Overall, would you say you are very knowledgeable, somewhat knowledgeable, not very knowledgeable or not at all knowledgeable about science? Tick whichever applies.

| | |
|---|---|
| Very knowledgeable | |
| Somewhat knowledgeable | |
| Not very knowledgeable | |

| | |
|---|---|
| Not at all knowledgeable | |
| (Do not know) | |

32. Overall, would you say you are very knowledgeable, somewhat knowledgeable, not very knowledgeable or not at all knowledgeable about biotechnology? Tick whichever applies.

| | |
|---|---|
| Very knowledgeable | |
| Somewhat knowledgeable | |
| Not very knowledgeable | |
| Not at all knowledgeable | |
| (Do not know) | |

33. How familiar are you with the following terms?

| | Have not heard of it | Have heard of it, but know very little or nothing about it | Know enough about it to explain it to a friend | (Do not know) |
|---|---|---|---|---|
| DNA | | | | |
| Genes | | | | |
| Biotechnology | | | | |

| | | | | |
|---|---|---|---|---|
| Genetic modification | | | | |
| Genetically modified food or GM food | | | | |

34. Genetically Modified (GM) food is derived from crops that have been genetically modified.

As far as you know, are genetically modified crops allowed to be grown in South Africa?

□ Yes

□ No

□ Don't know

35. Do you know any farmers growing GM crops?

□ Yes

□ No

□ Don't know

36. To what extent do you agree or disagree with the following statements about eating genetically modified food as a consumer?

| | Strongly agree | Agree | Neither agree nor disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| I would eat GM food if it were healthier | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| I would eat GM food if it costs less than ordinary food | | | | | |
| I would eat GM food if it were grown in a way that was less damaging to the environment compared to non-GM food crops. | | | | | |

37. Have you ever eaten GM crops? **[If no, skip to 41]**

□ Yes

□ No

□ Don't know

38. If yes, was there any difference in the way that the GM food tasted compared to non-GM crops? Elaborate.

____________________________________________

39. If yes, was there any difference in the way that the GM food looked compared to non-GM crops? Elaborate.

____________________________________________

40. Have you ever grown GM crops? **[If no skip to 46]**

□ Yes

□ No

□ Don't know

41. If yes, state which crop(s).

____________________________________________________

42. Was there any difference in the way that the GM crop looked compared to non-GM crops? Elaborate.

____________________________________________________

43. Was there any difference in the way that the GM crop grew compared to non-GM crops? Elaborate.

____________________________________________________

44. Were there any additional challenges to farming the crop compared to non-GM crops? Elaborate.

____________________________________________________

45. Please assess the following statements, indicating whether you agree strongly, agree, disagree, or disagree strongly.

| | Strongly agree | Agree | Neither agree nor disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| The genetic modification of food leads to higher crop yields | | | | | |
| The GM of food limits the use of pesticides/herbicides | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| The GM of food could result in more drought tolerant crops. | | | | | |
| The GM of food could result in more nutritious food | | | | | |
| The genetic modification of food is interfering in God’s plan | | | | | |
| The genetic modification of food is wrong | | | | | |
| GM foods are safe to eat | | | | | |
| Glyphosates used on GM crops are not safe | | | | | |
| The long-term health effects of eating GM food are unknown | | | | | |
| GM foods benefit large-scale farmers | | | | | |
| GM foods benefit small-scale subsistence farmers | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Overall GM foods provide more benefits than risks for society | | | | | |

46. Are you aware of research being conducted in South Africa to use genetic modification of crops to enhance the performance of sugarcane crops? Elaborate.

_______________________________________________________________

47. To what extent do you agree or disagree with the following statements about growing genetically modified sugarcane as a farmer

| | Strongly agree | Agree | Neither agree nor disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| I would grow GM sugarcane if it were healthier | | | | | |
| I would grow GM sugarcane if it was more profitable than ordinary sugarcane to grow | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| I would grow GM sugarcane if it could be grown in a way that was less damaging to the environment compared to non-GM sugarcane. | | | | | |
| I would grow GM sugarcane if I was certain that there was a reliable market for it, both locally and overseas. | | | | | |

48. General questions

1. State what benefits you believe the GM sugarcane crops will bring

___

2. State what drawbacks you believe the GM sugarcane crops will bring.

___

3. What questions do you have about the GM sugarcane?

___

4. In which ways would you prefer to get more information about the GM sugarcane?

___

***END OF SURVEY***

**<u>For office use only:</u>**

Location: [ ] *South Coast – **SC**; North Coast - **NC***

Interviewer code: [ ] *Kyran* – ***KB;*** *Nontokozo* – ***NM;*** *Extension Officer* **-** ***EO***

Interviewee code: [ ] Numbered consecutively

Interview date and time: [ ]

Language of Interview: [ ] *English* **-** ***E****, Zulu* – ***Z****; Xhosa* – ***X****; Afrikaans* **-** ***A***

Type of farmer: [ ] *Commercial* – ***C****; Small-scale* – ***SM****; Land reform grower* **-** ***LRG***

**Thank you for your efforts in participating in this study.**

## Appendix 3: Guide to the focus groups

**<u>Cognitive:</u>**

1. Have the media products answered all of you questions about the GM sugarcane product? Prompt: What makes you say that?

2. Are there bits of the video/brochure that are confusing or that you don't understand? Please point them out for us so we can look at revising that bit so all growers will understand this.

3. Is the language clear? Please comment. Or do you think we must use plainer less technical English or maybe isiZulu or Afrikaans?

4. Did the pictures help you understand the explanations? Explain how we could improve the pictures in the brochure and the animations to clarify the meaning.

5. Do you think of yourself as someone who uses media products like these to engage with science and scientists? What makes you say that?

**<u>Affective:</u>**

1. How did the media make you feel?

2. Did the video feel right, or was it too casual or formal? Prompt: What makes you say that?

3. Did the media feel like it was aimed at you as a sugarcane farmer and the challenges you experience daily? Did you feel recognized and respected? Prompt: What makes you say that?

4. Did you relate to the type of media that was shown, or do you feel other media will be more appropriate for people like yourself?

Can you comment on the little guy in the video and how he made you feel? What about the images in the brochure and other aspects of the look and feel of the brochure like the colours, the kind of text etc?

**<u>Social:</u>**

1. Do you feel connected with the people and the research that is being undertaken about GM sugarcane? Who do the SASRI scientists work for? Do you see SASRI scientists as there to come up with solutions for growers like you?

2. Scientists need knowledge, and to understand you and your field, they would need knowledge from you. What types of knowledge would be important for you to share with each other to help make GM sugarcane research relevant for your

fields? Prompt: Eldana infestation, herbicide usage, ability to plant refugia and manage fields, broader problems and challenges such as land or finances…

3. To make this research and testing work for eveyone, what should your relationship be like?

**Motivation:**

4. What prompted you to attend this focus group today?

5. After watching these videos and studying the booklet, did the material meet your expectations? Prompt: Please explain.

6. Do the media products motivate you to think about planting GM sugarcane and to talk to your fellow growers, your extension officer and the SASRI scientists about GM sugarcane? Why?

**7.** Can you picture your extension officer being comfortable showing this media to other growers?

**Behavioral:**

8. Before watching this video, how would you describe your attitudes and perception of GM sugarcane?

9. Do you think participating in this focus group and seeing the media has changed the way you see yourself as someone who feels confident to ask questions about GM sugarcane, and share your suggestions and views of GM sugarcane with SASRI scientists and extension officers? How can we adapt the material so people are more motivated to engage with SASRI after viewing it? Prompt: Why do you say that?

# Appendix 4: Ethics approval letter

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**Rhodes University Human Ethics Committee**
PO Box 94, Makhanda, 6140, South Africa
t: +27 (0) 46 603 7727
f: +27 (0) 46 603 8822
e: s.manqele@ru.ac.za
**NHREC Registration number: RC-241114-045**

https://www.ru.ac.za/researchgateway/ethics/

10/02/2021

Prod Janice Limson

Email: J.Limson@ru.ac.za

Review Reference: 2021-1374-5939

Dear Prof Janice Limson

**Title:** Communicating information on GMO sugarcane to sugarcane growers in KwaZulu Natal

Principal Investigator: Prof Janice Limson

Collaborators: Dr. Alette Schoon, Ms. Nontokozo Mchunu, Mr. Kyran Blauuw

This letter confirms that the above research proposal has been reviewed and **APPROVED** by the Rhodes University Human Ethics Committee (RU-HEC). Your Approval number is: 2021-1374-5939

Approval has been granted for 1 year. An annual progress report will be required in order to renew approval for an additional period. You will receive an email notifying when the annual report is due.

Please ensure that the ethical standards committee is notified should any substantive change(s) be made, for whatever reason, during the research process. This includes changes in investigators. Please also ensure that a brief report is submitted to the ethics committee on the completion of the research. The purpose of this report is to indicate whether the research was conducted successfully, if any aspects could not be completed, or if any problems arose that the ethical standards committee should be aware of. If a thesis or dissertation arising from this research is submitted to the library's electronic theses and dissertations (ETD) repository, please notify the committee of the date of submission and/or any reference or cataloging number allocated.

Sincerely,

Arthur Webb

**Prof Arthur Webb**

**Chair: Rhodes University Human Ethics Committee, RU-HEC**

cc: Mr. Siyanda Manqele - Ethics Coordinator

Page 1 of 1

# Appendix 5: Consent invitation form

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**PARTICIPANT INFORMED CONSENT**

**INFORMED CONSENT DECLARATION**

**(Participant)**

Project Title: **Communicating information on GMO sugarcane to sugarcane growers in KwaZulu Natal**

*Kyran Blaauw/ Nontokozo Mchunu/Dr Alette Schoon/Prof Janice Limson* from the Biotechnology Innovation Centre and School of Journalism, Rhodes University has requested my permission to participate in the above-mentioned research project.

The nature and the purpose of the research project and of this informed consent declaration have been explained to me in a language that I understand.

I am aware that:

1. The purpose of the research project is to study how information on genetically modified (GM) sugarcane may be effectively communicated to sugarcane growers in KwaZulu Natal.

2. The Rhodes University has given ethical clearance to this research project ***(Ethics Approval Number 2021-1374-5939)*** and I have seen/may request to see the clearance certificate by contacting Mr Siyanda Manqele (s.manqele@ru.ac.za).

3. By participating in this research project I will be contributing towards developing a set of communication tools that will allow researchers to better understand the queries and questions of sugarcane growers and to allow sugarcane growers a better understanding of the GM sugarcane product.

4. I will participate in the project by *Kyran Blaauw/ Nontokozo Mchunu/Dr Alette Schoon/Prof Janice Limson by* ***answering questionnaires or being involved in group discussions about the project.***

5. My participation is entirely voluntary and should I at any stage wish to withdraw from participating further, I may do so without any negative consequences.

6. I will not be compensated for participating in the research.

7. There are no known risks associated with my participation in this project. If I wish to hide my identity if filmed I will have the opportunity to have my face obscured or voice altered.

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8. The Principal Investigator intends publishing the research results in the form of journal articles, conference presentations and in the form of a documentary. However, confidentiality and anonymity of records will be maintained and my name and identity will not be revealed to anyone who has not been involved in the conducting of the research, ***unless I indicate to the contrary/recognize that as a public figure my identity will inevitably be/become known. (Agree/Accept loss of confidentiality)***

9. I will not receive feedback/will receive feedback in the form of small group discussions or written communication regarding the results obtained during the study.

10. I agree/disagree to the Principal Investigator's request to take photographs, or videoing me as part of this research project. If videoed, I agree/disagree to have my face visible. I agree/disagree to have my voice altered.

11. I agree/disagree to the Principal Investigator's use of voice recording of my comments and opinions during interviews.

12. Any further questions that I might have concerning the research, or my participation will be answered by Prof Janice Limson, 046 603 8792, j.limson@ru.ac.za

13. By signing this informed consent declaration, I am not waiving any legal claims, rights or remedies.

14. A copy of this informed consent declaration will be given to me, and the original will be kept on record.

I, ……………………………………………………………………………., have read the above information / confirm that the above information has been explained to me in a language that I understand and I am aware of this document's contents. I have asked all questions that I wished to ask and these have been answered to my satisfaction. I fully understand what is expected of me during the research.

I have not been pressurised in any way and I voluntarily agree to participate in the above-mentioned project.

| …………………………………… | …………………………… |
|---|---|
| **Participants signature** | **Date** |

Rhodes University, Research Office, Ethics
Ethics Coordinator: ethics-commitee@ru.ac.za
t: +27 (0) 46 603 7727 f: +27 (0) 86 616 7707
Room 220, Main Admin Building, Drostdy Road, Makhanda, 6139

# Appendix 6: Study invitation

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**Invitation letter: Sugarcane Growers, Extension Officers and SASRI Scientists**

**Communicating information on GMO sugarcane to sugarcane growers in KwaZulu Natal Study**

**General Information:**

Dear Participant

At Rhodes University's Biotechnology Innovation Centre and School of Journalism and Media Studies we are studying ways in which to communicate information about a genetically modified sugarcane plant that will be launched in South Africa within the next ten years by the South African Sugarcane Research Institute (SASRI). Our study is funded by the Technology Innovation Agency of South Africa, through the Department of Science & Innovation. Working with the School of Journalism at Rhodes University, we recognise the need for engagement between communities and scientists, in order to better understand each other's perspectives. In this study, Journalism and Media Studies Masters students, together with their research supervisors, will be engaging with each of the different groups to develop a set of different communication approaches that will best serve to communicate information about the sugarcane crop.

In order to develop and package information that would be valuable to sugarcane growers we invite you to be a part of this study and to answer questions in either an online format, in telephonic or in face to face interviews. You will be given an opportunity to ask questions and raise any concerns.

Data will be gathered from you in the form of questionnaires or interviews conducted either in writing (online), telephonic of face to face questionnaires. Dates and times of any follow up discussion will be negotiated with you and will be communicated ahead of time. If necessary, we may also invite you to individual or group follow-up interviews. Some of these discussions will be filmed for a video documentary, if you provide your consent for this.

The purpose of this letter is to inform you of your rights, should you decide to participate in this study. Please note that an ethical clearance for this project was obtained from Rhodes University, Number 2021-1374-5939

We formally invite you to participate in the research. Please see the attached consent form which we shall ask you to sign should you agree to participate. Please do not hesitate to ask us any further questions regarding this project.

***Can you participate?***

Yes, if you are:

- 18 years and above
- Able to give consent voluntarily
- A sugarcane grower, a scientist working at SASRI or a SASRI extension officer

***What is expected of you?***

Once you have fully understood the consent form and signed it, you are a participant of this research project.

All discussions will be conducted in English or in isiZulu. You are welcome to withdraw from the group discussion at any point. When logistics details of the interactive sessions are confirmed, this information will be passed on to you.

***Why will your participation be of value?***

Your input will be of value in evaluating the best communication approaches around a sugarcane GMO that will be launched within the next ten years in South Africa by SASRI.

***Is your participation compulsory?***

No, participation is completely voluntary. Even though you may have completed a consent form, should you wish to withdraw from the group discussion or the project, at any point, you are most welcome to do so. Please be aware that this research is not an assessment of your performance and your decision to participate (or not participate) will in no way affect your relationship with Rhodes University or any other party.

***Will your role in this study be kept confidential?***

Please note that any information you share with the researcher/s will not be shared with others involved. In addition, your name will not appear on any written reports and no identifying features will be provided, in order to protect your identity. All of the data collected will be stored in a secure place, and only the researchers involved in this project will have access to it. In order for us to protect your data we will provide each of you with a reference number at registration which you will be required to use when you complete your questionnaires. You can also use this reference number if you wish to withdraw from the study. Your names and email addresses will be collected at the time of completing the first questionnaire. A list linking your name to your reference number will be located in a secure place. This information will be used to remind you of your reference number in case you misplace it. Your contact information will be used to contact you to inform you of dates and times for the follow up meetings.

Your contact information, the data collected either in writing, video or through an audio recording, will be stored in password protected laptops.

A video documentary will be made. If you agree to be videoed, you can elect for your face to be obscured and/or voice altered if you appear in this video documentary.

***What are the risks involved?***

There are no known risks.

**Privacy and disclosure of information:**

All gathered information will only be accessible to the staff members and postgraduate students involved. Signing the consent form gives them permission to publish the analysed results in academic journals, theses, grant reports and in formal presentations for academic purposes such as conferences. Participants name or any specific personal details relating to the participants will not be mentioned in any publication, report or results.

**Further information:**

If you require any further assistance, encounter any problems or wish to enquire further about this research, you may contact:
Prof Janice Limson
j.limson@ru.ac.za 046 603 8263 or Dr Alette Schoon a.schoon@ru.ac.za 046 603 7115

Masters students involved in this study are:
Nontokozo Mchunu and Kyran Blaauw who will oversee the interviews. They can be contacted at Nontokozo Mchunu m.mchunu@ru.ac.za, 0738544295 or Kyran Blaauw k.blaauw@ru.ac.za, 0733657823

**Thank you for your time**

## Appendix 7: Media release form

School of Journalism & Media Studies
Rhodes University, South Africa

RHODES UNIVERSITY
Grahamstown 6140 South Africa

# Media Release form

I ……………………………………………………………………………………………

of ……………………………………………………………………………………………

agree to the use of this media product, provisionally titled

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

produced by students of the School of Journalism & Media Studies at Rhodes University.

I agree that the product may be shown, exhibited or exploited in any media or territory as required by the producers.

I understand that no fee is payable for this participation and that I have no further claim on the producers or any other person associated with this production. I understand that my appearance in the final media product is not guaranteed.

The production and dissemination of this product is subject to the School of Journalism & Media Studies' Ethical Guidelines for the Practice of Journalism (see overleaf).

Signed:…………………………………………… Date:……………………………

Witness:…………………………………………..

Witness:……………………………………………

School of Journalism & Media Studies, Rhodes University, Grahamstown, South Africa
PHONE 046 603 7100 FAX 046 603 7101 EMAIL journqueries@ru.ac.za

## School of Journalism & Media Studies' Ethical Guidelines for the Practice of Journalism

**Self-disclosure**

- Journalists should always be honest about their identity as media workers and the purposes for which they are collecting information.
- They also should be contactable by their sources.

**Public interest vs personal rights**

- It is in the public interest to have the most up-to-date and accurate information about the society we are part of.
- The right to privacy is inalienable, except in circumstances that strongly promote the public interest or in which a person decides to make public their own private details.
- Negotiating informed consent and the unintended outcomes of publication/broadcast must constitute part of the process of reporting.

**Accuracy**

- Be accurate and comprehensive in the representation of subjects and issues, providing context and sensitivity.
- Do not intentionally contribute to, alter, or seek to alter or influence events. This principle should not be confused with the right of journalists to take editorial or activist positions in their analysis of these events.
- Do not manipulate language, images and documents or add to or alter sound in any way that can mislead the public or misrepresent subjects and issues.
- Resist being manipulated by staged media opportunities.
- Do not exploit your duties for the principal purpose of acquiring prestige or personal influence.
- Ethnocentric bias in journalism, whether it is based on racial, ethnic, cultural, class, gender or religious grounds, needs to be transparent. It is recognised that a complete lack of bias, whilst valuable for accuracy and fairness, is unattainable in practice.
- Be aware of, and transparent with, your own bias.
- Journalists should publish correct ions of any information found to be harmfully and/or substantially inaccurate.
- Plagiarism is not allowed. Declare the sources you have used as background and research material.

**Sources and subjects**

1. Trust between journalists and the public, and between journalists and their sources is of paramount value.
2. Treat all subjects with respect and dignity.
3. Everyone has the right to reply.
4. Minimise harm to your sources.
5. Respect off-the-record (and similar) arrangements.
6. Avoid the use of anonymous sources unless there is no other way to place very important information in the public domain. Corroborate such information.
7. Avoid chequebook journalism where informants are paid.
8. Give special consideration to vulnerable subjects (such as children and those unable to give informed consent) and be compassionate to victims of crime or tragedy. Intrude on private moments of grief only when it is strongly in the public interest.
9. Do not identify children who have been victims of abuse or exploitation, or have been charged with or convicted of a crime. If there is any chance that coverage might cause harm of any kind to a child, he or she should not be interviewed, photographed or identified unless a parent or guardian consents or a public interest is overwhelmingly evident. We do however recognise that children also have the right to freedom of expression.

**Criminal cases**

- The legal presumption of innocence, in particular in cases that are still sub judice, must be respected.
- Information that prejudices the outcome of a court case must be withheld.

**Audience**

- Exercise care and responsibility with regard to the presentation of brutality, violence and atrocities.
- In situations of conflict consider the role news journalism can play in heightening tensions and seek ways of encouraging understanding, tolerance and trust between the various parties.

**Online**

- All these ethical principles and considerations apply to the online environment.
- Journalists have a right to engage online as journalists and citizens.
- Because the online social world is so pervasive it will touch and affect professional work, so private opinion needs to be ethical and take cognizance of the borderless nature of the internet.
- Verify information and sources in the same way as you do for analogue media.
- Assume the entire public can see everything you publish online .