Gordon Institute of Business Science
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Changing youth perceptions: Exploring enablers of diffusion and adoption of agricultural innovations in South Africa

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ABSTRACT

The purpose of this research is to explore the enablers of diffusion and adoption of agricultural innovations in South Africa with the objective of changing youth perceptions about agriculture. Twelve semi-structured interviews were conducted with professionals participating in the agricultural value chain either as an employee or an agribusiness owner.

Family, agricultural studies and upbringing influenced individuals to pursue careers in agriculture. Adoption is enabled by innovation attributes that increase productivity, mitigate adverse climatic conditions and improves adaptability of farming operations. Affordability is a major barrier to adoption of innovations. Lack of skills capacity to manage the innovations reduces the effectiveness of technology transfer. Education, role models, mentoring, public-private collaboration, ICT development, participatory infrastructure development, policies that promote research and enterprise development and institutions that facilitate effective extension, financial, technical and research support services enable innovation diffusion and adoption. Skills-mismatch, inadequate funding for research, lack of agricultural youth program policies and institutions working in silos restrict innovation diffusion and adoption.

This study provides recommendations for developing positive agricultural learning experiences for young people to be able to draw positive and successful narratives about modern agriculture.

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KEYWORDS

Innovation, Diffusion, Attributes, Adoption, Transformation

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DECLARATION

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

13 March 2019

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CHAPTER 1: INTRODUCTION TO THE RESEARCH PROBLEM

1.1 INTRODUCTION

Most young people have the perception that agriculture is time consuming (Ahaibwe, Mbowa and Lwanga, 2013; Anyidoho, Leavy and Asenso-Okyere, 2012; Leavy and Hossain, 2014; Ivanic and Martin, 2018; Naamwintome and Bagson, 2013). They perceive agriculture as a labour-intensive industry (Chinsinga and Chasukwa, 2018; Eissler and Brennan, 2015; Naamwintome and Bagson, 2013) that produces little return in terms of money (Abdullah and Sulaiman, 2013; Chinsinga and Chasukwa, 2018; Leavy and Hossain, 2014).

Young people perceive agriculture as an activity for old people and those that have failed in life (Abdullah and Sulaiman, 2013; Chinsinga and Chasukwa, 2018; Njeru, Gichimu, Lopokoiyit and Mwangi, 2015). They perceive agriculture as a haven for uneducated individuals who do not require any proper training (Jones, Williams and Gill, 2016; Naamwintome and Bagson, 2013). This is why most young people view agriculture as a last resort option in choosing careers. For most, agriculture is an option to resort to if every other business endeavour or career option has failed (Anyidoho, Leavy and Asenso-Okyere, 2012; Proctor and Lucchesi, 2012).

The perceptions of youth on agriculture are as a result of lack of knowledge on agricultural value chains (Abdullah and Sulaiman, 2013; Douglas, Singh and Zvenyika, 2017). There is a knowledge gap between the innovations being used by players in the various agricultural value chains and what young people are seeing in their communities as well as in the schools (Abdullah and Sulaiman, 2013). Most young people have little knowledge of career opportunities in agricultural value chains and therefore choose careers in tertiary sectors.

Some of the perceptions that the youth have about agriculture stem from stereotypes that are reinforced by the media as well as cultural beliefs (Kusis, Miltovica,and Feldmane, 2014). White (2012) cites education curricula as one of the reasons for youth turning away from agriculture. He reports that the curriculum for secondary school education tends to neglect agricultural sciences and farming as a career path is downgraded. Schools that teach agriculture as a subject or as part of other subjects

depict agriculture as labour intensive, with traditional methods of farming, lacking modern technology and innovations that have harnessed the digital way of doing things (Eissler and Brennan, 2015). In some countries, schools have used agricultural tasks as punishment for pupils that misbehave (Chinsinga and Chasukwa, 2018). Such an experience will deter individuals from considering agriculture as a career choice.

1.2 BACKGROUND

The agricultural sector in South Africa is regarded as one of the sectors earmarked to promote inclusive economic growth in South Africa. Agriculture is a relevant sector in SA as it produces food for the nation and raw materials required in non-agriculture sectors. In South Africa, more than 70% of a household's food budget is spent on agricultural commodities like vegetables, meat, bread, cereals, milk, cheese and eggs and raw materials required in non-agriculture sector (Greyling, 2015).

South Africa is a net exporter of agricultural commodities by value. (Greyling, 2015). Agriculture contributes to foreign currency earnings through export of agricultural commodities. The trade of agricultural commodities on the international market contributes about $6.2 billion towards foreign currency earnings. Of the total SA population employed, 5.59% are employed in agriculture (General manager, n.d). The sector grew by about 21.9 per cent in 2017 contributing about 0.5 percentage points to overall gross domestic product (GDP) growth (Gumede and Schneeweiss, 2018). The agricultural sector contributes about 2.5% annually to GDP directly from agricultural commodities traded on the market. A further 12% is contributed to the GDP through value added products from related manufacturing and agribusinesses (Gumede and Schneeweiss, 2018).

Historically, the sector was dominated by white commercial farmers. Black people were employed on farms as farm labourers. The agricultural sector lacks social inclusivity. Most farming activities take place in rural areas and on the periphery of urban areas. Most young people emulate urban living conditions and cannot wait to complete their studies so as to emigrate to urban areas (Noorani, 2015).

There are not many young successful farmers in these communities and this gives the picture that agriculture is meant for individuals that have failed to get employment in white collar jobs. Most young people in South Africa do not consider entrepreneurship in

agriculture because of among other things, the lack of role models in communities they grow up in. The methods of production used in agriculture in are traditional methods that have lost relevance to today's youths.

Current discussions in the country pertaining to agriculture seek to address access to factors of production such as land, capital and labour. Land reform policies are geared towards expropriation of land as a means of addressing land ownership imbalances dating back to the apartheid era. Within the same discussions, the national development plan vision 2030 (NDP) has identified agriculture as one of the sectors that can accelerate inclusive growth through the creation of meaningful employment (Department of Planning, Monitoring and Evaluation, 2018)

As part of the National Development Plan 2030, South Africa aims to reduce poverty and inequality through the creation of decent employment, rural community development and land reform employment (Department of Planning, Monitoring and Evaluation, 2018). Currently, participation in the agricultural sector is skewed towards established commercial farmers.

Most of the commercial farmers active in the agriculture sector are old. The average age of a farmer in South Africa is 62 years old (Sihlobo, 2015). This could lead to a succession gap in agriculture. The value of the tacit knowledge will be lost. Low involvement of youths might result in a decrease in production levels yet the population is increasing.

Global trends on population increase estimate that the world population will increase to nine billion by 2050 (Griggs, Stafford-Smith, Gaffney, Rockström, Öhman, Shyamsundar, and Noble, 2013). Therefore, the question of food security arises as to whether there is still going to be enough food to feed generations to come. In the face of increasing population growth, new strategies are required to increase food productivity so as to ensure food safety (Tiraieyari and Krauss, 2018). The demographic structure of sub-Saharan Africa shows a youth bulge with a median age of 18 years old. It is estimated that the population of 15 to 24-year-old age group will increase on an annual basis by about six million for the next ten years. Such a youth profile has the potential to contribute towards high economic growth (Betsherman and Khan, 2018).

Given the current state of agriculture in South Africa and the global trends of increasing population, the agriculture sector needs to invest in productivity-increasing infrastructure such as energy saving and water saving management technologies to maintain its international competitiveness and remain with a positive trade balance (Greyling, 2015). Furthermore, to harness demographic dividend of the youth bulge, there is need to attract young people to participate in the agricultural value chain.

To address the perceptions of young people towards agriculture, there is need to transform the agricultural sector into a more modern industry. One of the ways of transforming the agricultural sector is by aiding new technologies being used in the commercial farming sub-sector to diffuse into subsistence farming sub-sector, rural communities as well as schools. As highlighted by the Solow Model, applying technology is one way to increase productivity of land, labour and capital (Ivanic and Martin, 2018). Therefore, in addition to increasing access to land, labour and markets, entrepreneurship can be promoted by enabling the transfer and diffusion of technology in agricultural value chains.

One of the roles of the government is to create decent jobs. This is in line with the objectives of the National Development Plan, to provide decent employment through inclusive growth. The government is currently running programs designed to enhance agriculture value chains by developing clusters around producing areas. Examples include the Comprehensive Agricultural Support Program (CASP), Operation Phakisa, Black Producer Commercialisation Program, Agriculture Policy Action Plan and the Revitalisation of Agriculture (APAPRA) and Agro-processing value chains policy (Department of Agriculture, 2019)

1.3 RESEARCH SCOPE

Past research revealed findings that point towards young people's perceptions about the industry being time consuming (Anyidoho et al., 2012; Ahaibwe et al.,2013; Naamwintome and Bagson, 2013; Leavy and Hossain, 2014; Ivanic and Martin, 2018). Some youth perceive agriculture jobs as physical and back-breaking (Naamwintome and Bagson, 2013; Eissler and Brennan, 2015; Chinsinga and Chasukwa, 2018). Other young people view agriculture careers as financially unrewarding (Abdullah and Sulaiman, 2013; Leavy and Hossain, 2014; Chinsinga and Chasukwa, 2018).

Past studies have established that the agricultural sector is unattractive to young people because of the traditional farming methods used, the stereotypical image portrayed by media, and the outdated education curriculum in learning institutions that offer agricultural science courses (Chinsinga and Chasukwa, 2018; Eissler and Brennan, 2015; Kusis, Miltovica, and Feldmane, 2014; White, 2012).

Researchers have recommended the need for policies that promote investment in modern technologies that reduce drudgery and increase agricultural productivity (Tiraieyari and Krauss, 2018). Leavy and Hossain (2014) suggested that providing training that matches the skills demanded in the job market will improve the image of the sector. Douglas, Singh, and Zvenyika (2017) recommended policy makers to promote extensive use of modern technology and infrastructure in agriculture so as to make the sector attractive to young people.

These past studies identified the problems restricting the agriculture sector from attracting youth involvement in agriculture. Recommendations were made to invest in technology to modernize agriculture so as to attract youth participation. The idea that young people will consider agricultural careers if the sector uses modern technology was not substantiated by research studies. The mechanisms of transfer and diffusion are highlighted in innovation diffusion literature (Bozeman 2000; Dearing 2009; Orr 2018). The mechanism of transfer and diffusion of agricultural innovations had not been substantiated by research. This means there is a gap in literature on the determinants that;

a) influence the youth to consider pursuing careers in agriculture
b) enable or restrict the effective transfer, diffusion and adoption of agricultural innovations.

This study helped fill that gap.

Given the perceptions of youth towards agriculture and literature proposing modernizing agriculture as a means to attract youth engagement in agriculture, the scope of this research is to explore key strategies and policy options that can be applied to create an enabling environment that can facilitate the effective transfer of technologies in agriculture. This is in line with promoting transformation of the agricultural sector so as to attract youth participation in the agricultural value chain.

The study is limited to people who have professional careers in agriculture as well as agri-business owners. This study will recommend policies and interventions derived from literature review and insights from the participants that can promote youth involvement in the agricultural sector.

1.4 RESEARCH MOTIVATION

One of the reasons why young people perceive agriculture as a less attractive sector is the use of traditional farming methods. Whilst Lwoga, Ngulube and Stilwell (2010) believe in the perpetuation of indigenous knowledge as a means to sustainably develop the agriculture sector there is vast literature supporting the role of technology in revolutionising industry sectors (Gollin, 2014). In his study on knowledge management practices, Lwoga et al (2010) report that farmers assimilate knowledge gained from tacit sources better than that gained from explicit sources such as information communication technology (ICT) and print sources. However, the study recommends that knowledge intermediaries such as research and extension services engage with local farmers in documenting most of the tacit indigenous knowledge so as to factor in new innovations and disseminate it to other users of such knowledge.

Research and development have come a long way in developing technology that shifts production away from labour intensive traditional methods of farming. Examples include labour-saving technologies in irrigation, mechanization, automation as well as land-augmenting technologies that seek to increase productivity such as products of plant breeding (Bustos, Caprettini and Ponticelli, 2016).

Technology transfer is a key driver in improving agricultural economies especially through development of value-addition and agro-processing value chains. Such industries are essential for competitiveness and economic prosperity (Tchamyou, 2017). To transform agriculture, producers must adopt technology that increase production efficiencies in the production cycle (Babu and Jayachandran, 2017).

Babu and Jayachandran, (2017) cite knowledge inequality as one of the factors slowing down the process of agricultural transformation. The authors report on policy, institutional and market interventions critical for reducing knowledge inequality. Institutions are necessary for developing capacity needed to address knowledge gaps at all levels. However, when a mismatch of policy and institutional intervention exist, knowledge

distortion occurs further widening the knowledge gap. The authors recommend social entrepreneurship as a vehicle to create knowledge sharing platforms as well as knowledge sharing ecosystems. This helps address the issue of lack of role models who are successfully engaged in agriculture.

In their research on assessing the role of innovation in developing tourism, Carisle, Jones, Kunc and Tiffin (2013) found that institutions play a critical role in networking and transfer of knowledge. Institutions facilitate the development and preservation of best practices needed to increase productivity. This is echoed by Orr (2018) in his study where he reports on the critical role of markets, policies and institutions in enabling diffusion of innovations.

Based on this literature, this research seeks to explore how attributes of the innovation, the demand environment, policies and institutions are facilitating diffusion of agricultural innovations with the objective of transforming agricultural value chains in South Africa. Key components of this study are set out in table 1 below.

Table 1: Components of the study

Construct	Dimension	Scholar
Technology Transfer	Innovation diffusion and Adoption	Dearing, (2009) Bozeman, Rimes and Youtie (2015)
	Institutions, markets and Policies	Röling,Jiggins, Hounkonnou, and Van Huis, (2014). Orr, (2018)
Transformation	Dual economy	Gollin, (2014)
	Youth Perceptions	Eissler and Brennan (2015), Swarts and Aliber (2013)
	Knowledge economy	Tchamyou (2017)
	Modernizing agriculture	Mellor (2017)

Source: Researcher's own

This research will contribute to academic theory by adding to the body of social cognitive career theory literature on determinants of career choice in agricultural professions. Furthermore, this research will contribute to literature on innovation diffusion and adoption. The research study will examine the characteristic of institutions, innovations,

policies and demand environment that effectively facilitate diffusion of agricultural innovations. The findings will build on the existing agricultural adoption and innovation diffusion literature and can be used to inform future actions. The findings of this study can assist the business fraternity in developing policies and interventions that can promote youth involvement in the agricultural sector thereby improving the economic competitiveness of the sector.

1.5 RESEARCH PROBLEM AND OBJECTIVES

The youth are already predisposed to technology through increasing internet access and the high penetration of smartphones. The agricultural industry stands a chance in taking advantage of technology to align agricultural activities with current trends in the digital world.

In as much as surveys by various researchers have indicated the negative perceptions of the youth towards agriculture, there are still some young people that have taken up professional careers in agriculture while others have taken the entrepreneurial route within agriculture. Therefore, despite the negative connotations attached to this sector, there are certain factors that have contributed to some people making career decisions to become knowledge workers and entrepreneurs in the agricultural sector.

If the youth view agriculture as a dull and unattractive field because of the perceived traditional labour-intensive methods of production, what are the key strategies and policy options that can be applied to promote diffusion of agricultural innovations so that the agricultural sector can be transformed and attract youth involvement?

This study sought to explore the enablers of transfer and diffusion of agricultural innovations. The objective of the research is;

- To unveil determinants that have influenced individuals to participate in the agriculture value chain either as entrepreneurs or as knowledge workers.
- To examine factors of institutions, demand environment, innovation attributes and policies that enable or restrict the transfer, diffusion and adoption of agricultural innovations.
- To use the identified enablers and barriers to derive a recommendation for creating an institutional environment that facilitates the transfer, diffusion and adoption of agricultural innovations

The researcher developed a conceptual model of construct interactions that assisted in establishing links between the constructs under study. The conceptual model of construct interactions, presented as Figure 1 in chapter two, is developed from the premise that the youths' perception of agriculture being dull, labour intensive and using traditional methods of farming, can be changed by transforming the agricultural industry through innovation diffusion. Transforming the agricultural sector is driven by agricultural innovations using markets and institutions as enablers of innovation diffusion.

Chapter two presents literature review on key dimensions of transfer and diffusion of agricultural innovations as well as enablers of transformation of agriculture.

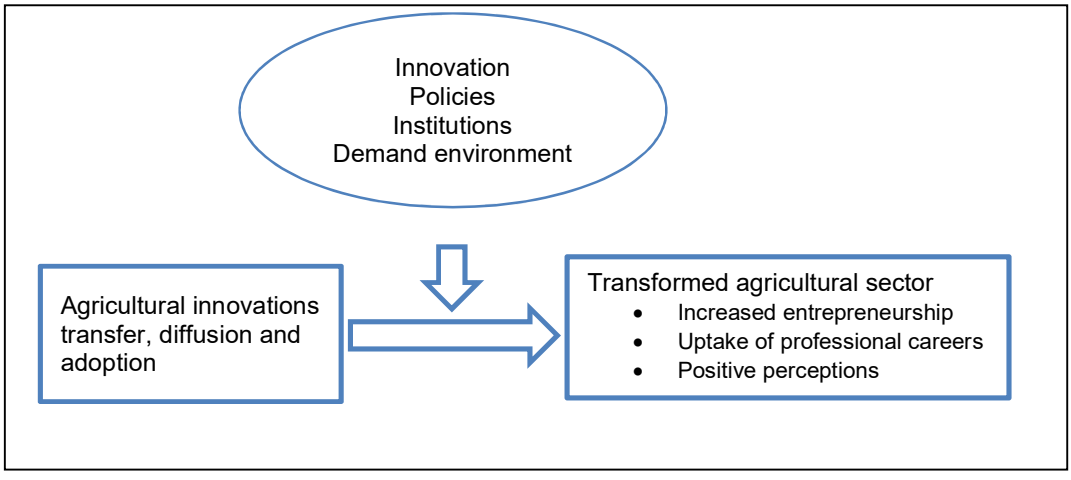
CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

The literature review explores into each of the major themes related to this research study namely agricultural transformation, technology transfer and innovation. In building up the literature review, definitions of key words will be given in this section. The study seeks to examine enablers of transforming the agriculture sector to promote youth involvement. In this report the term "Youth" takes the statistical definition of anyone between 15 to 35 years old. For the agriculture context, "Youth involvement" refers to meaningful and sustained participation within the agricultural value chain (Oboh, and Adeleke, 2016). For this study, youth involvement refers to participation either as an entrepreneur in agriculture or as an individual with a professional career in agriculture.

A conceptual model of construct interactions is presented in **Figure 1** below. The conceptual model postulates that investments and interactions among innovation, policies, institutions and the demand environment are imperative for creating positive perceptions about the agriculture sector thereby promoting uptake of professional careers in agriculture as well enhancing the involvement of young people in starting businesses in agriculture. The ultimate outcome will be a transformed agricultural sector where knowledge is created, transferred, diffused and adopted effectively to boost the efficiency of agricultural value chains.

Figure 1: Conceptual model of construct interactions



Source: Researcher's own

2.2 THEORETICAL UNDERPINNING

The scope of this research is to explore key strategies and policy options that can be applied to promote transformation of the agricultural sector so as to attract youth participation in the agricultural value chain. The agriculture sector is perceived in a negative manner. However, there are still some young people that have taken up professional careers in agriculture. Others have started business ventures in agriculture. Therefore, despite the negative perceptions attached to this sector, there are certain factors that have contributed to some people making career decisions to become knowledge workers and entrepreneurs in the agricultural sector.

This study drew on social cognitive career theory posited by Lent, Brown and Hackett (1994), to explore the factors that influenced some people to pursue agriculture as a career choice. According to the social cognitive career theory, career and academic interest is determined by self-efficacy and outcome expectations. Self-efficacy relates to how much an individual believes in their ability to perform and complete tasks under various contexts. This makes up their perceived abilities. Outcome expectations relate to what will come out of one's decisions. This makes up their expected outcomes. Learning experiences have an impact on an individual's self-efficacy and outcome expectations thereby influencing their career choice. Learning experiences can emanate from an individual's environment, their context (social and economic), exposure to various career activities or interaction with role models.

In their study on determinants of career choice of agricultural professions, Adebo and Sekumade (2013) identified previous educational experience, work experience and peer groups as variables that significantly influenced individuals to pursue careers in agriculture. Furthermore, an individual's personal goals and inherent predispositions such as gender also impact on learning experiences (Turner and Hawkins, 2014).

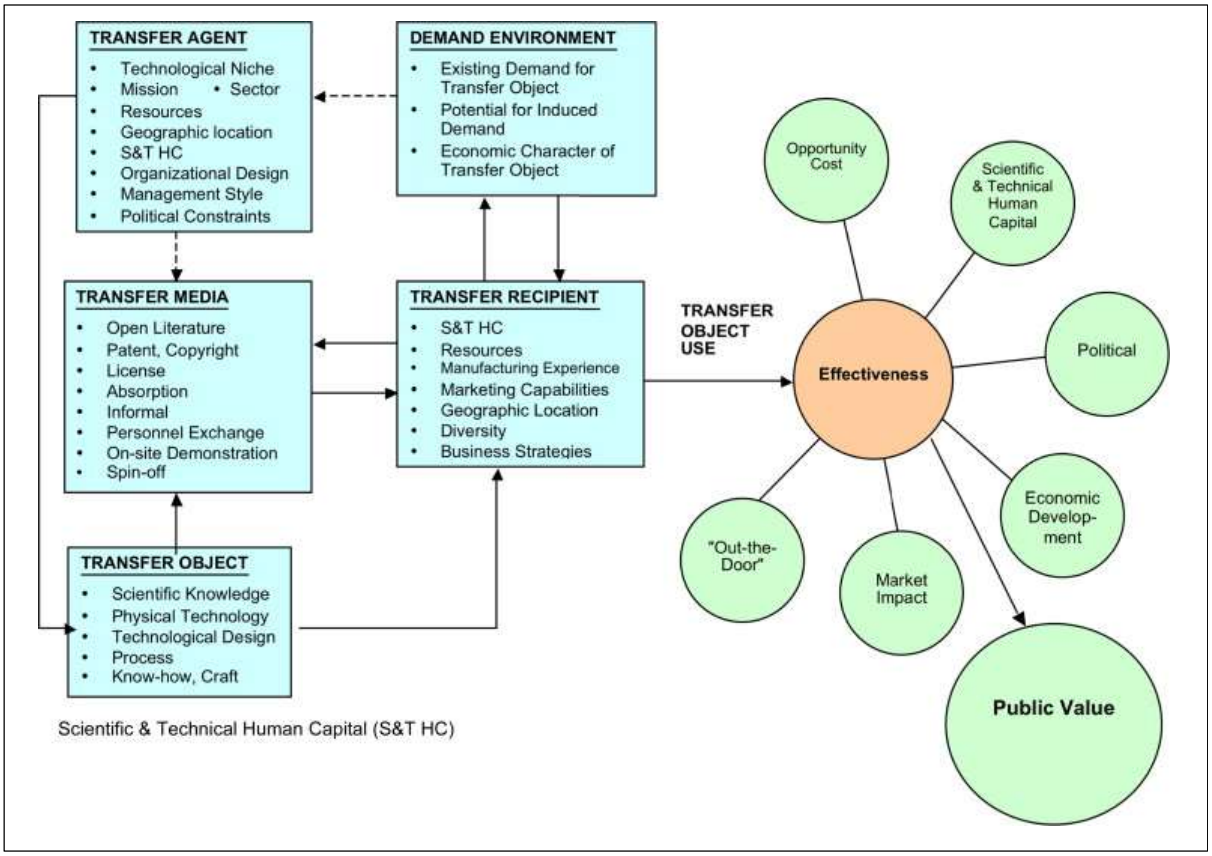
The social cognitive career theory was used in this study to gain an understanding of factors that have contributed to some people making career decisions to become knowledge workers and entrepreneurs in the agricultural sector.

In exploring key strategies that can be used to effectively transfer technology and agricultural innovations, this study drew from the contingence effectiveness model of technology transfer posited by Bozeman (2000) as a lens of analysis. This research

study used Bozeman's contingence effectiveness model of technology transfer as a theory of determinants of adoption of an innovation. The model assesses the impact of technology transfer by focusing on who is doing the transfer (agent), the mechanisms used in transferring the technology (media), the characteristics of the technology being transferred (object), who is targeted to receive the technology (recipient) and how receptive are the conditions in the environment (Bozeman, Rimes and Youtie, 2015).

The framework model **(Figure 2)** posited by Bozeman et al., (2015) depicts five categories that determine the effectiveness of technology transfer. The determinants are (i) characteristics of the transfer agent, (ii) characteristics of the transfer media, (iii) characteristics of the transfer object, (iv) demand environment and (v) characteristics of the recipient.

Figure 2: **Contingent Effectiveness Model of Technology Transfer**



Source: Bozeman, Rimes and Youtie (2015)

The transfer agent refers to the organisation that wants to move the technology to other institutions. This can be service providers of agricultural innovations such as agrochemicals, mechanization and precision agriculture technologies. Universities also serve as transfer agents. The availability of adequate funding will facilitate successful technology transfer. Inadequate funding has been reported as a financial barrier for technology transfer (Long, Blok and Coninx, 2016).

The transfer object focuses on the characteristics of the innovation being transferred. Examples include technological devices, know-how and processes that increase efficiencies of agricultural value chains (Bozeman, 2000). Attributes of an innovation are an important consideration towards adoption of that innovation by the targeted user.

The tools or mechanisms used to transfer the technology form part of the transfer medium. Examples include formal literature as well as research and extension officers that provide extension services and advisory support to producers. The availability of necessary skills and capabilities to integrate and use the agricultural innovation enables effective transfer of technology (Long et al., 2016).

The transfer recipients of agricultural innovations are the various users of technology in the agricultural value chain. These can be producers, processors, retailers and traders. An innovation is adopted only if the recipient accepts it as a useful technology (Wheeler, Zuo, Bjornlund, Mdemu, Van Rooyen and Munguambe, 2017). In addition to age, level of education and experience, uncertainty and risk perceptions determine willingness of a recipient to adopt an innovation and these factors may deter them from adopting a given innovation (Long et al., 2016).

The market and non-market factors that determine the need for the transfer object form the demand environment. Demand factors are an important determinant of the effectiveness of technology transfer (Bozeman, 2000). For example, the price of agricultural innovations such as irrigation systems is a major factor of adoption of such technologies by small- scale farmers. Policy and administrative systems that are supportive of technology enable technology transfer and diffusion. For example, the provision of subsidies by institutions such as government facilitate the transfer, diffusion and adoption of agricultural innovations by low-income producers (Long et al., 2016).

The effectiveness of technology transfer can have several meanings. In this study, it is

defined as a transformed sector where perceptions of young people about agriculture are positive; a sector that attracts young people to participate as knowledge workers or agribusiness entrepreneurs. A transformed sector comes about from the impact that technology transfer has on the people involved, markets, economic development, political environment and human capital.

Market impact focuses on how the technology transfer has made some commercial impact on the transfer recipient. The question that arises is whether the technology transfer increased productivity, output or profit. In the same vein, is there economic development in the value chain arising from the transfer of technology? The development of human capital as facilitated by transfer of skills and knowledge sharing shows effectiveness of technology transfer (Bozeman et al., 2015).

In this research, the demand environment comprises of the users of the technology in the agricultural value chain. The sources of technology include research institutes, education institutions such as universities and other further education training centres, private companies, government departments and non-governmental organisations.

2.3 AGRICULTURAL TRANSFORMATION

The research focus for this study is on the development and transfer of agricultural technologies as a driver to transform the agriculture sector and attract young people to participate in the various levels of the agricultural value chain. It is relevant to engage young people in agriculture because as the population keeps increasing, demand for food also keeps increasing. Therefore, the agricultural sector faces the twin challenge of providing food for the increasing population whilst implementing sustainable methods of producing the food (Brooks, Zorya, Gautam, and Goyal, 2013). This requires transitioning from traditional methods of farming to agricultural innovations that improve productivity.

Agriculture must be portrayed as an industry that produces the final product instead of being just the supplier of raw materials (Brooks et al., 2013). Career opportunities exist in the manufacturing and distribution of agrochemicals, water management, marketing, research and extension services as well as processing of agricultural produce. In promoting youth participation in agriculture, focus must be on interventions that promote off-farm value chain engagements besides just farming (Brooks et al., 2013).

In his research on investigating the role of knowledge economy in African business, Tchamyou (2017) highlighted the importance of the four components of a knowledge economy namely education, innovation, information and communication technology and economic incentives and institutional regime. A skilled and educated work force is needed to continuously adapt and upgrade skills necessary for the efficient creation and use of knowledge. A knowledge economy thrives on an efficient system of innovation by research institutions and a functional system for technology transfer. In addition, economic policies formulated by institutions must drive efficient allocation of resources and incentives that drive technology transfer. To facilitate effective processing, communication and diffusion of knowledge, it is imperative to develop an adequate and modern information and communication infrastructure (Tchamyou, 2017).

These pillars of a knowledge economy are echoed by Mellor (2017) in his findings on key drivers of modernizing agriculture. Mellor (2017) identifies new technologies, education, physical infrastructure and communication networks as key drivers of transforming agriculture. He defines modernizing agriculture as shifting agricultural production from traditional based methods of managing land and labour to methods that allow dynamic processes of science and technology. Education provides understanding needed to assimilate technical issues. Education facilitates adoption of new technologies. Extension workers and researchers are able to disseminate agricultural technologies to people who can understand and assimilate technical issues (Mellor, 2017).

Taking advantage of information communication technologies (ICT) to showcase agricultural innovations assist in increasing the prestige of young people taking part in agricultural value chains for example, the use of social media platforms (Irungu, Mbugua and Muia, 2015). With the transfer and adoption of agricultural innovations, there will be need to capacitate more young people with the skills needed to work on new technologies, to innovate, to be entrepreneurial and to engage in the dynamic markets (Brooks et al., 2013). There is growing literature on the perceptions of young people on agriculture. The following section reviews literature on the perceptions of youth on agriculture in Africa.

2.3.1 Agriculture – current state of the sector

Previous sections gave a synopsis of the current status of the agriculture sector in some countries in Sub-Saharan Africa. In this section, a description of the current state of the agricultural sector in South Africa is given.

South African Agriculture

The SA agricultural sector is made up of various subsectors namely field crops, horticulture, livestock and dairy farming, fish farming, game farming and agro-processing (Mordor Intelligence, 2017). **Figure 3** is an illustration of a typical agricultural value chain. Contrary to perceptions of young people about agriculture, the value chain indicates that there are various career opportunities within the sector apart from farming. Most of the perceptions are linked to the primary production where drudgery relating to farming methods exists.

The SA Agriculture sector can be described as a dual agricultural economy. On one hand, the sector comprises of a well-developed commercial farming with an established supply chain. On the other hand, is small-scale subsistence-based production where numerous production constraints exist (Kushke and Jordan, 2017). The Lewis model of dual economy, Gollin (2014), postulates that two economy sectors coexist in developing countries where labour supply is very high. The framework ascribes growth to expanding the capitalist sector. This implies that the process of development consists of moving a large mass of underemployed workers from the subsistence sector to the capitalist sector (Gollin, 2014).

However, expanding the capitalist sector requires an increase in savings. In such a country, two sources of savings exist namely the capitalist sector or other external sources. The flow of capital into the economy facilitates job creation in the modern sector. The vast labour supply in the subsistence sector will fill in these jobs. This movement of workers will increase the savings rate of the economy and this will lead to a continuous cycle that steadily raises the income level per worker in the overall economy. The model observes that poor countries are not uniformly poor but some firms or sectors perform at high levels of productivity within those countries (Gollin, 2014).

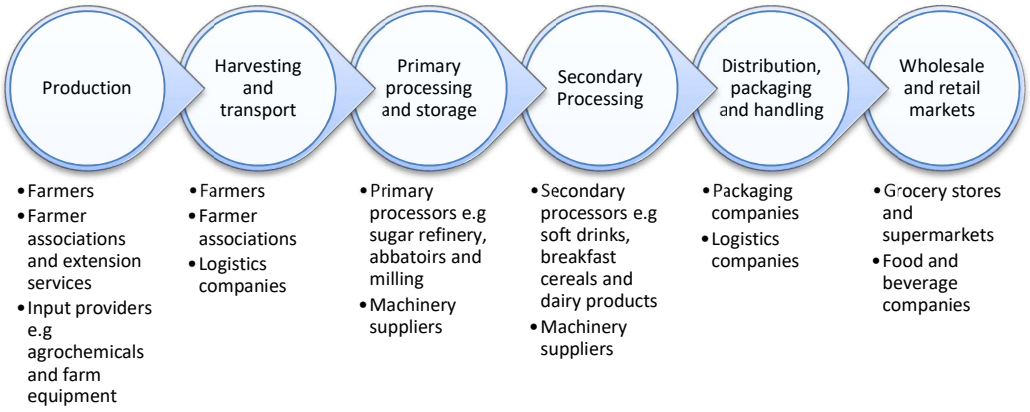
A key theme of the Lewis' model is the importance of capital investment as a source of growth. Drawing from the Lewis model and applying it to this study, technology, in this

case agricultural innovations represent the capital. The subsistence agriculture and all on-farm jobs represent the unattractive part of the agricultural sector where traditional methods of farming are still being used and drudgery is rife. The modern sector is characterized by commercial agriculture and the agro-processing sub-sector of the industry where productivity is boosted by capital. Agricultural innovations are the capital injection needed to boost the modern sector (commercial agriculture) so as create opportunities that will be exploited by those in the subsistence sector (subsistence agriculture) where marginal product per worker is insignificant.

Another key theme in Lewis' description of the traditional subsistence sector is its size in terms of labour supply. The modern sector can grow substantially without facing any labour constraints. Lewis postulates that this condition would persist, pulling many workers out of the subsistence sector until the supply of labour diminishes to a point where subsistence wages become equally attractive and marginal product per worker goes up (Gollin, 2014). These conditions can be likened to a transformed agricultural sector.

The government sets out to improve the lives of people by creating decent employment in agriculture. In addition, the government strives to increase food production by investing in agricultural processes through technology that enhances efficiencies (Kushke and Jordan, 2017). Programs implemented by government to achieve transformation within the agriculture sector mainly focus on the emerging farmer sector. This category consists of those who strive to develop their farming enterprises into viable agribusinesses (Kushke and Jordan, 2017).

Figure 3: Agricultural value chain



Source: adapted from www.greencape.co.za

Agricultural productivity depends on production technology and technical efficiency of the production process. This means that the output growth of adopted agricultural innovations is determined by the type and quality of the innovation and how well this innovation is used in combination with existing technologies. Aye, Gupta and Wanke (2018) assessed the efficiency of agriculture in SA. They found that the efficiency of agriculture in SA is enhanced by increasing expenditure in research and development of genetically modified seeds, improvement in fertilizers as well as mechanization and extension support services. High expenditure on health services to boost dissemination of social welfare has a positive impact on agricultural efficiency (Aye, Gupta and Wanke, 2018).

2.3.3 Transforming Agriculture

Transformation occurs when low income societies characterised by a large agricultural sector that provides employment to a greater portion of the population become high income societies with a small but highly productive agriculture sector, (Barrett, Christiaensen, Sheahan and Shimeles, 2017). The authors agree with the notion of transforming agriculture by increasing agricultural productivity as well as the functioning of markets.

Innovation and technology transfer processes are considered as important forces for

growth and poverty reduction in developing countries. This is achieved as a result of diffusion of agricultural innovations that ease work stress, reduce drudgery and increase productivity. Singh (2010) argued that agricultural systems cannot be transformed without affecting social systems. In his research on empowering women through agricultural technology transfer, Singh (2010) reported that the developers of technology are not neutral when it comes to who they choose for a specific technology. To successfully transform agricultural systems, it is therefore important to factor in the social context.

Sharma (2012) argued that investing in agricultural research and development, education and infrastructure is more effective in increasing agricultural growth than providing input subsidies. This means that technological change in agriculture depends on public expenditure on the sector. The author cites technological change as a sustainable strategy option for development of the agricultural sector. Continuous technological change will push the production function to the right and upwards signalling improved production.

Continuous technological change is influenced by technology, economic and institutional factors. Agricultural growth will occur when new technologies are developed and adopted to optimize production by improving production efficiencies. Investment in research and development and infrastructure are economic factors that enable innovation that brings continuous technological change to agriculture. Institutional support in the form of market sector reforms and access to financial and production resources facilitates continuous technological change (Sharma, 2012).

Snodgrass (2014) posited the concept of the multiplier effect as a necessity for transforming agriculture in sub-Saharan Africa (SSA). He argued that development of low-income countries is agriculture-based and the contribution that agriculture makes to economic development of these countries is enhanced by the multiplier. The multiplier in SSA is valued at 1.5. This implies that an increase of $1 in agricultural income resulting for example from adoption of a new technology has the capacity of growing the national income by $1.50 (Snodgrass, 2014). Using the argument on multiplier effects on development, Snodgrass (2014) justified why investing in agriculture is a much more important vehicle for eradicating poverty than investing in non-agriculture sectors. The multiplier works well in the presence of underutilized resources such as land in

agriculture as well as under-developed markets.

There are three components to how the multiplier works, (Snodgrass 2014). Firstly, an initial income stimulus is required to boost producer income and expand productive capacity. This can be in the form of adoption of technology that increases yield per hectare, investment in public infrastructure or investment in education and skills training. Secondly, the multiplier works through aggregate demand as a transmission mechanism. Leakages determine the strength of transmission. For example, the multiplier is weakened by savings, more tax paid as a result of additional income generated and spending on goods imported from other regions. Promoting consumption of locally produced products and services will strengthen the multiplier. The third component of the multiplier is the final impact. This refers to the change brought about by the stimulus. This can be in the form of improved livelihoods, more job opportunities created or modernized agriculture. To produce a larger final impact, the multiplier must be strong, (Snodgrass 2014). In transforming agriculture, a strong multiplier can be achieved by increasing investments in continuous technological change as suggested by Sharma (2012).

Riboud (2015) highlights the importance of human development and an institutional environment that is conducive for productivity growth. Human capital is critical for successful technology transfer. Investing in education and health will assist a nation in building a workforce that can facilitate innovation through research and development and ultimately facilitate the dissemination of knowledge. This view is echoed by Kumar, Engle, and Tucker (2018). In their research on adoption of technologies in aquaculture, educated farmers were early adopters and they efficiently implemented the adopted technologies into their production processes.

ICT utilization in agricultural production and marketing transformed the agriculture sector in Kenya. One such example is the collaboration between researchers and financiers in rolling out a Feed formulator software used in the Livestock Feed industry (Irungu et al., 2015). Young agribusiness entrepreneurs were involved in setting up ICT hubs to facilitate training on ICT use in agriculture. The development of ICT facilities served as an enabler of technology transfer and diffusion of agricultural technologies in Kenya. It promoted youth retention in agriculture as well as exposing young entrepreneurs to modern production technologies in agriculture, up-to-date market information as well as

providing a knowledge sharing platform (Irungu et al., 2015).

Ogunsanmi (2018) reports on a new farming technology, the stick planter, used in planting sugarcane. This agricultural innovation has provided opportunities for young people to work in the agriculture value chain in Mali, Benin, Togo and Nigeria. Young people found it easier to adopt the technique used in the new technology. The youth in all four countries established their businesses to provide planting services to sugarcane farmers. The stick planter can be used over a long period and is a low- cost investment with low maintenance costs (Ogunsanmi, 2018).

2.4 INNOVATION

Innovation is re-conceiving existing ideas or coming up with new ideas and developing them into new processes and products (Watkins, Papaioannou, Mugwagwa and Kale, 2015). Innovation refers to any form of human knowledge developed scientifically or through other organized methods to process practical tasks (Oyeku, Adesanya, Elemo, Unuigbe, Bello, Adekoya and Oduyoye 2016). Oyeku et al. (2016) describe innovation as an object (components or products) or a process or knowledge (concepts or descriptions). Innovation encompasses skills, know-how, concepts and procedures that drive systems and processes to make things to happen. Innovations seeks to provide solutions that address specific problems or challenges impeding the growth or development of an industry (Oyeku et al., 2016).

Innovation provides the means of how to use or develop the practical task effectively, for example, how to improve the performance of a system. Relating to agriculture, innovation refers to a new idea, practice or object. This encompasses agricultural technologies such as agrochemicals, seeds, agronomic techniques and managerial concepts (Senyolo, Long, Blok and Omta, 2017). To address risks posed by weather uncertainty, more climate smart agricultural innovations are being introduced to the sector (Westermann, Förch, Thornton, Körner, Cramer, and Campbell, 2018).

Watkins et al. (2015) reported on the concept of National Innovation Systems (NIS) which was built on the foundation of the theory of economic growth through evolutionary technological change. It was put forward by Freeman 1982 as an approach to aid growth. He postulated the need to address the importance of technological change and innovation for economic growth. He highlighted that innovation is a collective effort that

requires different sources of knowledge, resources and expertise. To that effect, institutional capacities for innovation will vary per country.

The NIS concept places responsibility for generating and diffusing innovation on the government. Freeman postulates that institutions have the capacity to develop and support a conducive environment for the exchange of knowledge and resources with the objective of developing new ideas and opportunities. Watkins et al. (2015) reported that for economic development to be successful, a country must be able to acquire, absorb, disseminate and apply modern technologies. When micro-firm level processes interact with macro-level institutions, successful innovations are generated, developed and shared. Government is able to stimulate entrepreneurial activity at national level then interact with institutional intermediaries in diffusing innovations to other industry actors (Watkins et al., 2015).

2.5 Technology Transfer and Diffusion

Technology transfer refers to a process that allows new ideas to be moved from point of generation to the places where the ideas can be applied (Bozeman, 2000; Dearing, 2009; Oyeku et al., 2016). Successful technology transfer occurs when there is coordination between developers and users, when the environment supports entrepreneurial activities as well as if there are collaborations that provide networks for information to flow (Oyeku et al., 2016).

Dearing (2009) explains the concept of innovation diffusion as new elements being introduced to society. Society accepts the new elements then the accepted elements become integrated into pre-existing culture.

In this study, technology related to agriculture encompasses all agricultural innovations such as knowledge as well as all variables that relate to production especially the means of increasing agricultural productivity. Examples of agricultural innovations are Controlled Environment Agriculture (CEA), vertical farming, rooftop gardens, high yielding varieties, agrochemicals, site specific management systems that encompass all forms of precision agriculture such as variable rate irrigation (VRI) and management zone identification (Bustos et al., 2016). Climate smart agriculture is another example of agricultural technological innovation designed to increase productivity whilst enabling the reduction of greenhouse gas emissions (Long, Blok and Coninx, 2016).

Technology transfer is driven by push and pull forces. New technologies are pulled into markets when there is sufficient demand for them and sufficient financial means to adopt them (Oyeku et al., 2016). Important to note is that diffusion of new technology requires the existence of communication channels among members of a social system (Dearing, 2009). Such a system comprises of what is being transferred, by whom, to whom and the mechanism used to transfer the technology (Bozeman 2000).

The dimensions postulated by Bozeman et al. (2015) are echoed by the research findings of Orr (2018) whose research found that markets, institutions and policies significantly determine the success of diffusion of agricultural innovations. Characteristics of the demand environment are likened to markets while characteristics of the transfer agent can be likened to institutions. Characteristics of the transfer media are the policies. Globally, a number of innovations have been developed in response to identified constraints in agricultural production. Whilst these innovations possess the right technical merits for adoption, the right enabling environment is much more important than just developing the right technology (Orr, 2018).

In their study on institutional interventions that promote innovations, Röling, Jiggins, Hounkonnou, and Van Huis (2014) stated that the development of technology on its own is not sufficient to address the constraints identified in industries. These authors postulated that the creation of an enabling institutional context will enhance productivity. They report that investing in an innovation platform where key stakeholders can interact is crucial for diffusion and adoption of innovations. Such platforms must be regulated by functional institutions that provide legal frameworks necessary to root-out corruption, land-grabbing, unfair competition and profiteering (Röling et al., 2014).

Institutions have a role to create conditions that enable transfer and adoption of technologies. This can be achieved by supporting value chain development through input distribution, and credit facilitation. However, in their study on innovation platforms, Hounkonnou et al., (2018) found that innovation platforms can be used to remove, by-pass or modify institutional constraints and facilitate a new institutional environment that allows smallholder farmers to benefit from agricultural innovations.

In their research on identifying barriers to adoption of smart grid technologies, Luthra, Kumar, Kharb, Ansari and Shimmi (2014) identified lack of regulatory framework as a

barrier related to institutional environment. When regulatory policies are inadequate, public awareness towards adoption of a technology is hindered. In such a case, stakeholders in the institutional environment fail to promote diffusion and adoption of innovations.

Institutional constraints to adoption of innovations in agriculture emanate from poor communication channels used in disseminating information relating to the innovation. This is especially problematic if the innovation is management intensive and requires skilled people to manage its use. When institutions develop innovations without getting users' input, the rate of diffusion and adoption is low (Long, Blok and Coninx, 2016).

Institutions are responsible for the dissemination of information on technology use to recipients of new technologies. Effective communication informs farmers about the expected returns and imparts practical knowledge useful for implementing different technologies. This increases rate of diffusion and adoption (Beaman and Dillon, 2018). This view is echoed by Vaidyanathan, Sankaranarayanan and Yap (2019) who reported that successful diffusion of innovations requires the transfer agent to have the capability to equip recipients as well as support service providers with the skills required to operate the new innovations. Institutions as transfer agents must be able to respond to reinvention of the innovation if need arises.

To innovate, farmers need access to inputs and services linked to mechanisation, access to infrastructure such as roads, irrigation and agricultural advisory facilities as well as integrated value chains that create access to profitable produce markets (Röling et al., 2014).

Orr (2018) shares the same views. The author presents findings that describe the right mix of markets, institutions and policies in providing enabling conditions for the successful adoption of agricultural innovations. When the market demand for an agricultural commodity is high, the rate of innovation adoption for a technology associated with that commodity becomes high. Innovative partnerships between private and public institutions accelerate the rate of adoption of agricultural innovations.

Orr (2018) reports on successful adoption of agricultural innovations stemming from enlisting the private sector in the development and marketing of hybrid varieties.

Favourable policies provide an enabling environment for the adoption of agricultural innovations. Examples include policies that enhance the regulatory environment to stimulate trade.

The characteristics of the transfer object determine the ease of transferability, diffusion and adoption (Bozeman, 2000). For example, if the cost of the technology is beyond the reach of transfer recipients, then the transfer and diffusion of such technology is inhibited (Long et al., 2016). Farmers who are unable to access funding are unlikely to adopt high-cost technologies (Senyolo, Long, Blok and Omta, 2018).

Technologies that require vast pieces of land are less likely to be adopted by recipients who lack such resources (Senyolo, Long, Blok and Omta, 2018). Farm size is an important determinant of technology adoption. Big farms have greater financial and management demands (Kumar, Engle, and Tucker, 2018). Know-how is considered a continuous innovation and therefore the transfer and diffusion of such an innovation requires skills capacitation of farmers and their advisors so as to enhance adoption (Senyolo, Long, Blok and Omta, 2018).

Innovations impact on agriculture by increasing productivity, allowing adaptation and or mitigation to adverse conditions. Customizing innovations to address users' pain points increases transferability and adoption. For example, agricultural innovations that are made locally have a higher chance of being compatible with existing farming practices. This will increase adoption of such innovations (Senyolo, Long, Blok and Omta, 2018).

To increase adoption rate of a given technology, Mottaleb (2018) reported on the necessity of compatibility of the innovation with local demand and the environment. He further explains the importance of making the price of the innovation competitive with existing alternatives. Subsidies and technical support during the early adoption phases can boost diffusion of the innovation. This in turn facilitates the scaling up process of the technology (Mottaleb, 2018).

Ivanic and Martin (2018) share the same views as Eberhardt and Vollrath (2016) whose report on agricultural productivity places emphasis on agricultural technology significantly increasing total factor productivity, in this case, non-labour inputs. Eberhardt

and Vollrath (2016), postulate that technology has the ability to increase the pace of development in an economy with low labour elasticity by increasing productivity.

Ivanic and Martin (2018) suggest that the efficient use factors of production, timeous availability of agricultural inputs and appropriate climate management will increase agricultural productivity. This growth in agricultural productivity will in turn enhance the standard of living of all stakeholders involved along the agricultural value chain. Furthermore, this will increase people's real income thereby increasing their purchasing power. This means that innovative methods of production are an integral component to boosting agricultural productivity. A high purchasing power means that consumers are able to afford basic commodities and alleviate poverty (Ivanic and Martin, 2018).

However, in the absence of drivers of technology transfer and diffusion, agricultural innovations fail to reach farmers and productivity remains low. Ivanic and Martin (2018) report that agricultural productivity would then be increased only as a result of expansion in cultivated land area. The authors cite low adoption of agricultural inputs such as fertiliser and hybrid seeds, inadequate public investment and low adoption of agricultural mechanisation as disablers of agricultural productivity. This drudgery combined with perceived low returns on investment has resulted in the agricultural sector being perceived as unattractive by most young people (Ivanic and Martin, 2018).

This can be facilitated in agriculture by extension services. Agricultural extension plays a critical role on adoption of agricultural innovations. This is because extension is a two-way relationship that provides farmers with technical knowledge needed to overcome farming constraints (Wheeler, Zuo, Bjornlund, Mdemu, Van Rooyen and Munguambe, 2017). However, the credibility and authority of the extension officers and the organisation they represent plays a critical role on the recipient's willingness to adopt a given innovation (Long et al., 2016).

With the penetration of ICT and use of social media platforms, Beaman and Dillon (2018) reported on the usefulness of social media in diffusing information in the absence of institutions. In their research on role of social networks in diffusing information relating to adoption of technologies in rural communities, Beaman and Dillon (2018) found that diffusion of information declines with social distance. Furthermore, targeting most connected individuals did not yield any increase in aggregate knowledge about the technology.

In their study on measuring technology progress and readiness of a country to participate in a knowledge-based economy, Ali, Bashir and Kiani (2015) identified ability and knowledge as enablers of technology diffusion. The authors used technology achievement index (TAI) as the unit of measure. This index is derived from technology creation, diffusion of old innovations, diffusion of recent innovations and development of human skills. The findings revealed how significant education, research and development and innovation are on socio-economic growth and industrial development. A low TAI indicated low level of technology readiness. This was attributed to lack of interest of political leaders in factors that drive economic growth (Ali et al., 2015).

2.6 Conclusion

The basis of this research study stems from the presumption that modernizing the agriculture sector is a sure way of attracting young people to the agricultural sector. The conceptual model of interactions given in **Figure 1** postulate that the agricultural sector can be transformed when investments in technological change are made by creating an institutional environment comprising of policies and institutions that enable transfer and diffusion of agricultural innovations.

Social cognitive career theory provides an understanding of determinants of career choice in agricultural value chains. The contingent effectiveness model of technology transfer **(Figure 2)** provides an understanding into the role played by the institutional environment in facilitating diffusion of agricultural innovations.

The literature review details how young people across Africa perceive agriculture as an industry of the uneducated and unskilled (Naamwintome and Bagson, 2013), as sector for those that lack the resources needed to further education after primary and secondary school (Chinsinga and Chasukwa, 2018), as a sector for the elderly and the poor (Njeru et al., 2015) and they view agriculture jobs as strenuous, old-fashioned and less profitable compared to jobs offered in other non-agriculture industries (Chinsinga and Chasukwa, 2018).

These perceptions stem from the drudgery that they see in subsistence farming communities as a result of the low rate of adoption of new technologies and how that has resulted in low levels of productivity in farming (Ahaibwe et al., 2013). Communications

media fail to capture the enthusiasm of young people by portraying agriculture in advertisements as a career option for the poverty stricken (Chinsinga and Chasukwa, 2018). In addition, the average age of a farmer in Africa is between 50 and 70 years old (Njeru et al., 2015). It is reported how young people are inspired into choosing careers by emulating what their role models have achieved. This age group of farmers is not exactly inspiring.

The literature review highlighted on the constraints hindering transfer and adoption of agricultural innovations. These include under-developed agricultural value chains where markets and trade policies are unfavourable for producers and there is limited access to extension services and modern inputs (Chinsinga and Chasukwa, 2018). The literature review details how agricultural growth will occur when production efficiencies are improved through continuous technological change. This can be developed sustainably by investing in mechanisms that improve markets, policies that guide access to financial and production resources as well as the interaction of institutions within the agricultural sector (Sharma, 2012).

The concept of the multiplier was highlighted by Sharma (2012) as a necessity for transforming agriculture in sub-Saharan Africa (SSA). The multiplier works well where resources are underutilized and markets are under-developed (Sharma, 2012). According to the description of the agriculture sector in SA given by Kushke and Jordan (2017), the multiplier effect would work well in transforming agriculture. Agricultural land in SA is underutilized, the agricultural markets do not function optimally.

The role played by ICT and education in attracting young people to agriculture was highlighted by Ahaibwe et al., (2013) and supported by Irungu et al. (2015) who report on young educated people choosing to participate in value chains of specialty crops with a niche market. The same sentiments are echoed by Riboud (2015) who report on the importance of developing human capital for successful technology transfer.

Ogunsanmi (2018) reported on a new farming technology that has attracted young people to work in the agriculture value chain in Mali, Benin, Togo and Nigeria. The example of ICT utilization in facilitating transfer, diffusion and adoption of agricultural technology in Kenya (Irungu et al., 2015) is another example of modernizing agriculture to attract young people to the sector.

The SA Agriculture sector was described as a dual agricultural economy (Kushke and Jordan (2017). Gollin (2014) postulated on the importance of capital investment in developing infrastructure of the subsistence economy so as to increase productivity and develop into a modern sector. Watkins et al. (2015) share the same sentiments; for economic development to be successful, a country must be able to acquire, absorb, disseminate and apply modern technologies.

The contingent effectiveness model of technology transfer by Bozeman et al. (2015) indicated the determinants of effective technology transfer and what successful technology transfer looks like. Orr (2018) placed emphasis on the role of institutions, markets and policies on successful adoption of agricultural innovations. Against this backdrop, what institutional, market and policy factors have attracted some people to participate in SA agricultural value chain? The following sections of this study present analysis of data collected through semi-structure interviews and discussion on effectiveness of technology transfer in SA and the institutional, market and policy barriers of technology transfer.

CHAPTER 3: RESEARCH QUESTIONS

3.1 INTRODUCTION

This chapter presents research questions used to explore how attributes of the innovation, the demand environment, policies and institutions are facilitating diffusion of agricultural innovations with the objective of transforming agriculture value chains in South Africa. In seeking to understand the extent to which agricultural innovations increase the involvement of youth in crop production value chains in South Africa either as entrepreneurs or in taking up professional careers in agriculture, the researcher taped into the experiences of agri-business owners as well as knowledge workers in the agricultural value chain.

The research questions were formulated from concepts that emerged from the literature reviewed and discussed in chapter two as well as incorporating the expression of the problem definition in chapter one.

The literature review in chapter two highlighted the perceptions of young people on agriculture in Africa. Research on the role of markets in transforming agriculture as well as how institutions can promote technology transfer was given (Dearing, 2009; Röling et al., 2014; Bozeman et al., 2015 and Orr, 2018). The literature review in chapter 2 highlighted the effect of developing human capital through investing in health and education (Riboud, 2015). Knowledge gap is one of the reasons given for the perceptions that young people have on agriculture (Abdullah and Sulaiman, 2013). It was reported that the education curriculum in primary and secondary education neglected agriculture as a subject. In further education training (FET) and teaching and vocational education training (TVET) institutions, the curriculum is out of touch with the real skills required in the industry. Technology diffusion and adoption has been identified as a vehicle which can be used in transforming the agriculture sector thereby promoting youth engagement in agriculture.

If the development strategies and policies in SA acknowledge the relevance of the agricultural sector in creation of decent and productive employment in line with the vision of the National Development Plan 2030, what initiatives will effectively modernize agriculture and promote youth engagement (Department of Planning, Monitoring and Evaluation, 2018)? Further to this, if the youth view agriculture as a dull and unattractive

field because of the perceived traditional labour-intensive methods of production, what are the key strategies and policy options that can be applied to promote diffusion of agricultural innovations so that the agricultural sector can be transformed and attract youth involvement?

It is against this background that this research sought to understand the enablers of transfer and diffusion of agricultural innovations in the SA context by interviewing professionals and agri-businesses participating in the agricultural value chain. The research questions unveiled factors of agricultural innovations diffusion that have influenced individuals to participate in the agriculture value chain either as entrepreneurs or as knowledge workers. The results collected and analysed informed recommendations that can assist the business fraternity in developing policies and interventions that can promote youth involvement in the agricultural sector thereby improving the economic competitiveness of the sector.

3.2 RESEARCH QUESTIONS

3.2.1 Research Question 1

Do observations of agricultural innovations incite young people to participate in agriculture? The question asks whether the knowledge of agricultural innovations influenced individuals to choose careers or start businesses in the agriculture value chain.

3.2.2 Research Question 2

What are the enablers of agricultural innovation diffusion that can contribute to transformation of the agriculture sector? This question evaluates the composition of the agricultural value chain in terms of the role played by the various players in facilitating the transfer and adoption of agricultural innovations. The question seeks to unveil institutional, policy and demand environment barriers that restrict the dissemination of agricultural innovations in SA. By so doing, factors of technology transfer, innovation diffusion and adoption that enable modernization of agriculture will be highlighted.

3.2.3 Research Question 3

In what ways can enablers of diffusion of agricultural innovations be scaled to transform the agriculture sector? In light of the factors of technology transfer, innovation diffusion and adoption that were highlighted as enablers of modernizing agriculture, how can the activities undertaken by various stakeholders in the agricultural value chain be enhanced to promote youth participation in agriculture?

3.3 CONCLUSION

The research questions raised above guided this research into exploring what was proposed in the conceptual model of construct interactions **(Figure 1).** The objective was to endorse, disagree or find new research that can address the problems limiting youth participation in the agricultural sector.

The rest of the research paper is as follows: The next chapter will discuss the methodology chosen to address the research questions raised above. Research findings will be presented in chapter five. In chapter six, a discussion of findings is given before conclusions and recommendation on policy options are presented in chapter seven.

CHAPTER 4: RESEARCH METHODOLOGY

4. INTRODUCTION

This chapter provides a framework on which the process of this research study is based. The following sections presents how the study was conducted. Key elements of the research methodology namely research design, description of target sample, data collection instruments and data analysis techniques are described.

4.1 CHOICE OF METHODOLOGY

The aim of the study was to explore the enablers of innovation diffusion that can contribute to transformation of the agricultural sector. Therefore, the study philosophy used in this research is critical realism (Saunders, Lewis, and Thornhill, (2009). The ultimate goal of the study was to examine the possibility if scaling enablers of innovation diffusion in a bid to effectively transform agriculture thereby making the agriculture sector attractive to young people.

A deductive approach was used. Whilst reviewing of literature provided theory around innovation diffusion in general and diffusion of agricultural innovations in particular, the study sought to unveil factors of agricultural innovations diffusion that have contributed to individuals deciding to participate in the agriculture value chain either as entrepreneurs or as knowledge workers. Using existing theory, the deductive approach tested the proposition that innovation diffusion will transform the agriculture sector and attract young people to participate in the agricultural value chain.

A mono-method was used. Srivastava and Thomson (2009) describe qualitative research as a study that follows an inquiry process of understanding which is based on distinct and methodological traditions of inquiry. Qualitative method is the suitable method of data collection considering the phenomenon under study is of a social development nature. Qualitative inquiry explores a social or a human problem. During the study, the researcher built a holistic picture and analysed words and reports collected from participants.

The research study is exploratory. Zikmund, Babin, Carr and Griffin (2013) reported that exploratory research seeks to provide information that will shed a better understanding of the management problem so that future study will not begin with inadequate information. This exploratory study was taken to diagnose the prevailing situation in

seeking a basis on which further research can be built.

The research strategy for this study was through interviews. For this study, the researcher identified professionals in agriculture and those participating in various agri-businesses as the target population and unit of analysis from which data was be collected.

The time horizon for this study was cross-sectional because of the resource and time constraints. With a cross-sectional study, data is collected at a single point in time (Saunders et al., 2009). A Longitudinal time horizon would have required the researcher to revisit the target population and collect data over a certain period of time and this requires depth. In this case, the researcher was working on a prescribed deadline that did not allow re-visiting of the target population.

This study followed the procedure reported by Saunders et al. (2009) that exploratory studies are conducted by reviewing academic literature, interviewing subject experts and then conducting interviews amongst players or actors within the industry.

4.2 POPULATION

Semi-structured interviews were conducted with participants selected through the researcher's professional networks. The target population comprised of knowledge workers and entrepreneurs in agriculture. **Table 2** indicates a summary of the profiles of participants of this research. These have been chosen as this research seeks to explore the factors that have enabled the diffusion of agricultural innovations leading to some people taking up professional careers in agriculture and others starting agribusinesses within the sector. Interviews were conducted to gather broad perspectives on how such enablers can be scaled to contribute meaningfully in making the agriculture sector attractive to youths.

4.3 UNIT OF ANALYSIS

The level of investigation focused on collecting data from individuals who either own a business in the agriculture value chain or has a professional career in agriculture. The objective was to probe participants so as to get their theories and experiences on agricultural innovations and the conditions that they consider would make the agriculture

sector attractive for youths.

Participants were selected based on the characteristics they possess. In this study, the inclusion criteria used by the researcher were a) individuals who were professionals with a management role that involves decision making b) taking part in the agricultural value chain c) either as an employee or an agribusiness owner. The decision-making component was deemed relevant to this study because the study explored the role played by the participants in enabling technology transfer. An employee or an agribusiness owner qualified as a unit of analysis because one of the objectives of the research was to determine factors that influenced career choice. Participants had to be involved in agriculture because the purpose of this research was to explore the institutional environment with the agriculture sector.

4.4 SAMPLING METHOD AND SIZE

There was no definite sample frame so non-probability purposive sampling was chosen. It is non-probability because the researcher used own judgement in choosing the sample population and not every individual along the agriculture value chain had an equal chance of being selected (Saunders et al., 2009). It is considered purposive sampling because the twelve participants that were identified to participate in the interview were selected purposely to fulfil the research objectives. The unit of analysis chosen represents a particular sub-group and this provided minimum variation in the data collected.

To incorporate trustworthiness and rigour into a research study, an appropriate sample must be selected (Morse, Barrett, Mayan, Olson and Spiers, 2002). To this effect, the researcher selected participants that were knowledgeable on the research topic. For example, in two of the organisations, the researcher approached managers in senior leadership positions and explained the purpose of the study. These managers then advised on best suited participants in their organisations

Table 1: Summary of participants' profiles

Interview	Gender	Race	Occupation	Role
1	Male	Black	Production manager	Producer- Skills transfer
2	Female	Black	Junior Farm Manager	Producer- Skills transfer
3	Male	Black	Agricultural Extension Officer	Support services- Production Knowledge
4	Female	Black	Agricultural Engineer	Support services- Infrastructure and training
5	Male	Black	Agricultural Engineer	Support services- Infrastructure and training
6	Male	Black	University Lecturer (Professor)	Training- R and D
7	Male	Black	Managing director	Producer and Processing
8	Female	Black	Agricultural Advisor	Support services- Production Knowledge
9	Male	Black	Managing director	Support services- Infrastructure and training
10	Male	White	University Lecturer (Mr.)	Facilitate experiential training
11	Female	Black	Senior Farm Manager	Producer- Skills transfer
12	Female	Black	Researcher (Doctor)	Research and development, Training-

4.5 MEASUREMENT INSTRUMENT

In designing the interviews, the researcher reviewed literature on theory and past research studies involving innovation diffusion and technology transfer. The researcher compiled an interview guide comprising of a list of themes and questions that focus on the research questions. This ensured that the researcher would ask relevant questions and not miss anything from the interview. Using themes that came out of the detailed literature review, the researcher was able to design an interview guide with five questions under the following themes; a) determinants of career choice, b) role/responsibility of participant in the value chain, c) institutional actors and Institutional arrangements, d) characteristics of the institutional environment and e) mechanisms of technology transfer and innovation diffusion.

The researcher incorporated verification mechanisms in the data gathering and data analysis process. Qualitative research is iterative in nature and therefore there is need for moving back and forth between research design and research implementation (Morse, Barrett, Mayan, Olson and Spiers, 2002). After reviewing literature from past studies, the researcher designed an interview guide based on themes relating to theories on technology transfer and social cognitive career theory. The researcher identified two participants to carry out pilot interviews as a way of checking for the fit of the data to

theory used as lens of analysis. The modifications required to fulfil the research purpose were then made. After making the necessary changes, the data collection process commenced.

The questions in the interview guide were treated as prompts during the interview. This allowed the flow of the interview to progress as conversational as possible without deviating from the objectives of data collection (O'Keeffe, Buytaert, Mijic, Brozović and Sinha, 2016). The researcher allowed participants to ask any questions they deemed relevant at the end of the interview. A copy of the interview guide used is presented as **Appendix 2.**

4.6 DATA GATHERING PROCESS

Semi-structured interviews were conducted. Semi-structured interviews allowed the researcher to prepare some topics that needed to be discussed at the same time remaining open to additional information coming out of interviews (Osti, Land, Magwegwe, Peereboom, Oord and Dusart, 2015). Semi-structured interview allowed the researcher to steer the interview process in a way that allows probing for additional information. It also allowed the researcher to determine sequence of questions to be followed not necessarily sticking to the exact structure on the interview guide. Semi-structured questions allowed the interview process to be conversational and not interrogative (Saunders et al., 2009). The most important aspect of data collection for this study was to get accurate opinions, theories and experiences from participants. Semi-structured interviews allowed respondents to give open responses. The participants making up the sample from which data is collected are regarded as experts by experience. When allowed to speak freely, participants can provide new and relevant information (O'Keeffe, Buytaert, Mijic, Brozović and Sinha, 2016). One way in which the researcher ensured trustworthiness of the data collection method was by not steering respondents in a certain direction.

In preparing for the interviews, the researcher gathered information about the respondents to be interviewed. This helped prepare the researcher on the likely conversations that could pop up during the interviews. To make initial conduct with the respondent, the researcher phoned and sent emails to introduce themselves and secure an interview. Once a potential participant was identified, the researcher contacted them by telephone or email and gave a brief description of the purpose of the study. Once the

potential participant had agreed and scheduled a convenient date, time and place, the researcher sent them an electronic copy of the informed consent form . The consent form was signed prior to conducting the interview either on the day of the interview or well in advance. All twelve interviews were conducted face to face and recorded using a mobile data recording device.

This research considered ethical values throughout the data gathering process. The privacy and confidentiality of participants was protected throughout the study process. This was done by ensuring that names of participants were not mentioned during interviews. To gain an informed consent from the participant, the researcher sent selected participants a clear and concise description of the research purpose. Potential participants were informed of the data gathering process, how the information will be used and stored as well as the freedom to exit the interview at any given time. The researcher assured all participants that the information gathered would only be used to fulfil research objectives. The participants were informed that they were not obliged to answer questions that they did not feel comfortable answering and that they had a right to withdraw from the research study anytime. A copy of the informed consent letter is presented as **Appendix 1**.

Data saturation was achieved after the eleventh interview. The twelfth interview did not contribute any new data to add to aspects of technology transfer and innovation diffusion. Data saturation is an indication of sampling adequacy (Morse, Barrett, Mayan, Olson and Spiers, 2002).

4.7 ANALYSIS APPROACH

The research is qualitative in nature as it aims to provide an in-depth, socio-contextual and detailed description and interpretation of the research topic. Being a qualitative study, it contributes to description and interpretation of complex phenomena. This is achieved by developing and revising understanding, rather than purely verifying earlier conclusions of theories. The systematic process of coding, examining of meaning and provision of a description is given as techniques that can be used to analyse textual data by Vaismoradi, Jones, Turunen, and Snelgrove, (2016).

Research that lacks rigour is characterized as worthless, fictious and lacking utility

(Morse, Barrett, Mayan, Olson, and Spiers, 2002). During data analysis, bias can be introduced through selective data extraction from interview recordings. To avoid this, the researcher transcribed all interviews verbatim and uploaded the transcripts onto a software program called Atlas.ti. Transcribing helped eliminate researcher's bias resulting from pre-conceived codes (O'Keeffe, Buytaert, Mijic, Brozović and Sinha, 2016). This was another way of ensuring rigour and trustworthiness of this study. Due to the large volume of data in the twelve transcribed documents, the researcher used Atlas.ti for thematic analysis.

Thematic analysis is a tool postulated by Braun and Clarke (2006) to identify, analyse and interpret patterned meanings of themes in a qualitative data set. Themes were developed through coding. The themes were assessed using set criteria. Braun and Clarke (2006) reported that Thematic Content Analysis (TCA) is an objective way of analysing qualitative data since the analysis is based on the content of the respondents' responses and not the characteristics of the respondents. Interview text data was broken into smaller units of content and then submitted to descriptive treatment by identifying themes. This research meets the criteria described by Braun and Clarke (2006) making TCA an appropriate tool to use for analysis of results.

Thematic analysis began with the researcher reading all transcribed interviews and recording themes as they emerged. A quote from the transcribed document was attached to each recorded theme. Emerging themes were recorded as codes in Atlas.ti. As the analysis progressed, the researcher observed common codes that were emerging from each of the twelve transcribed documents for example affordability as a characteristic of innovations, knowledge sharing platforms, research and development initiatives to solve farmer pain points and exposure to agricultural value chain through experiential training. After coding, dominant themes were identified through frequency counts.

Another strategy to ensure validity is the use of peer reviews (Morse, 2015). To prevent bias in the development of codes and code groups, the researcher sought reviews of the transcribed data from peers. This allowed the researcher to consider alternative views on emerging codes. However, the responsibility of result analysis and application still remained with the researcher.

4.8 LIMITATIONS

The researcher incorporated some level of bias in her selection of interviewees. Respondents were selected through the researcher's professional networks. This means that the opinions and experiences of those known by the researcher were used in contributing to the body of literature on the subject under study.

This research is qualitative in nature. There is a strong possibility of interviewees providing feedback that is more subjective rather than objective. This has a potential of reducing validity of the recommendations made in relation to the objectives of the research. To reduce the possibility of respondents giving subjective responses, the researcher compiled an interview guide comprising of questions guided by the list of themes. These questions were structured in a way that probes respondents for facts. Results of a qualitative study are more plausible when a semi-structured interview guide is developed. A semi-structured interview guide adds objectivity and trustworthiness to qualitative studies (Kallio, Pietila, Johnson and Kangasniemi, 2 0 1 6).

The researcher's lack of experience in data collection methods that involve interviewing respondents is another limitation of this study. To mitigate this, the researcher started the data collection process by piloting the semi-structured questions and did a practice-run by interviewing a few selected individuals before carrying out the actual interviews.

Another limitation stems from the inherent bias of qualitative method of research. This study does not use a random sample. The sample from which interviews were collected is small and the data collected is too wordy and a lot to handle. To overcome the challenges of handling voluminous data, the researcher used Atlas.ti as a coding tool.

Despite the highlighted limitations of this study, the approach used can be applied in exploring the factors that enable or restrict transfer, diffusion and adoption of agricultural innovations.

CHAPTER 5: RESULTS

5.1 INTRODUCTION

This study sought to explore the key strategies and policy options that can be applied to promote diffusion of agricultural innovations so that the agricultural sector can be transformed and attract youth involvement. A total of twelve face to face semi-structured interviews were conducted with people who have professional careers in agriculture as well as agri-business owners. In the following sections, findings that emerged out of the interviews are presented. An interview guide was prepared prior to conducting the interviews.

The interview guide comprised of five questions. The first question asked the participant how they ended up in agriculture. The questions were developed and asked in a way that would put participants at ease as well as ensuring that the interview process would remain formal and still maintain the professional order required. The first question sought to get an understanding of how the participants ended up in the agriculture sector. The responses given for the first question of the interview contributed to findings that address the first research question of this study.

The second and third questions on the interview guide were designed to address the second research question of this study. Participants were asked to give details of their current roles in their various places of work.

Questions four and five sought to address the third research question. Participants were asked of their contribution towards technology transfer and diffusion of agricultural innovations and the contribution made by the various actors mentioned in question two and three. The probing questions were directed by responses given by the participants. Probing questions were asked to seek clarity on responses given or to probe for more information. After the fifth question, participants were given an opportunity to ask questions or add any of their thoughts related to the topics discussed during the interview.

5.2 EMPIRICAL DATA

5.2.1 Duration of interviews

A total of twelve interviews were conducted. The total duration is 399.56 minutes. The longest interview lasted 59.34 minutes and the shortest 12.38 minutes. The average duration of the interviews is 31.13 minutes **(Table 2)**

Table 2: Duration of interviews

Description	Quantity
Number of interviews	12
Total duration	354.33
Average	29.52
Longest	59.34
Shortest	12.38

5.2.2 Sample

The sample comprised of knowledge workers and entrepreneurs in agriculture. These were chosen as this research seeks to explore the factors that have enabled the diffusion of agricultural innovations leading to some people taking up professional careers in agriculture and others starting agribusinesses within the sector.

Table 3 gives a summary of the profiles of the sample. Of the twelve participants, 62% were male and 38% were female. The sample lacked diversity in terms of race with 92% of the participants being black and only 8% being white. This is because the researcher relied on her professional networks which are biased towards mostly black professionals in the agricultural sector. The sample comprised of people participating at various levels of the agricultural value chain. Two of the participants are entrepreneurs in agriculture and the rest are knowledge workers as summarized in **Table 3.**

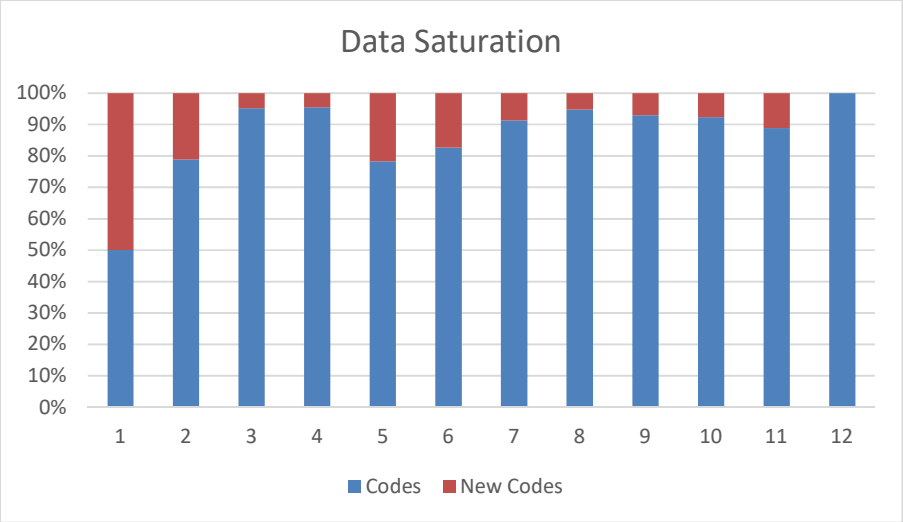
Table 3: Summary of profiles of participants

Participant	Gender	Race	Occupation	Role	Length	Word Count
1	Male	Black	Production manager	Producer- Skills transfer	32.41	1883

2	Female	Black	Junior Farm Manager	Producer- Skills transfer	24.18	1251
3	Male	Black	Agricultural Extension Officer	Extension services- Production Knowledge	14.19	734
4	Female	Black	Agricultural Engineer	Support services- Infrastructure and training	12.38	678
5	Male	Black	Agricultural Engineer	Support services- Infrastructure and training	28.13	1841
6	Male	Black	University Lecturer (Professor)	Training- Research and Development	51.21	1675
7	Male	Black	Managing director	Producer and Processing	34.31	1411
8	Female	Black	Agricultural Advisor	Extension services- Production Knowledge	14.34	903
9	Male	Black	Managing director	Support services- Infrastructure and training	33.16	2484
10	Male	White	University Lecturer (Mr.)	Facilitate experiential training	22.13	2679
11	Female	Black	Senior Farm Manager	Producer- Skills transfer	28.55	2990
12	Female	Black	Researcher (Doctor)	Research and development, Training-	59.34	3949
Total					**354.33**	**22478**

A total of 36 codes emerged from the coding process. These codes were categorised into six groups based on commonality of theme. Fourteen codes emerged from the first interview. Each additional interview brought in new codes and these were recorded. However, the twelfth interview did not contribute any new codes to add to data on aspects of technology transfer and innovation diffusion. Therefore, data saturation was achieved after the eleventh interview . This is graphically illustrated in **Figure 3**. A copy of the total codes and groups is represented in Appendix 4.

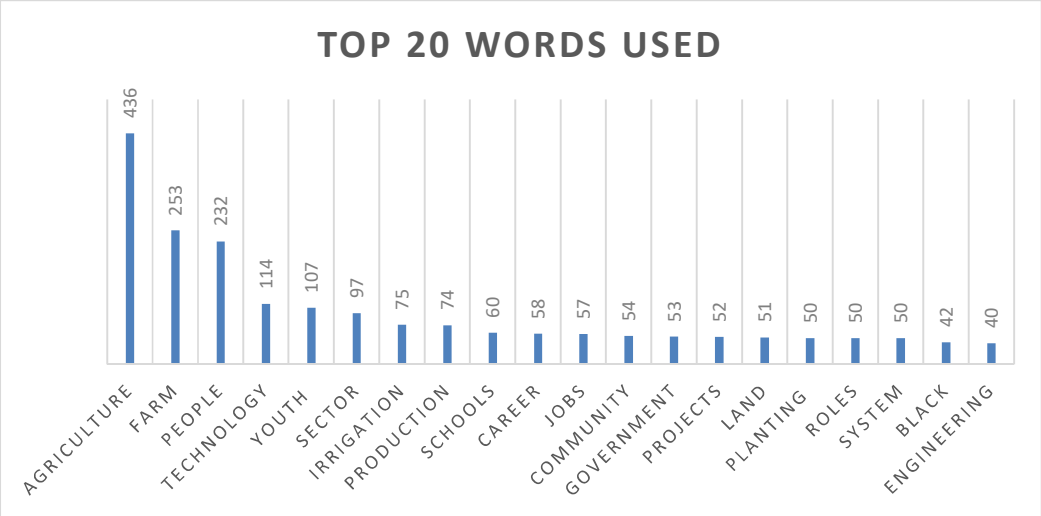
Figure 3: Data Saturation



5.2.3 Coding using Atlas.ti

Using Atlas.ti to analyse the transcribed interviews, a word analysis was done on all twelve transcriptions to determine words that occurred more frequently in all interviews. The total word count for all the twelve interview transcriptions was 25 354 words. Upon removal of words that were repeated occasionally, 2 865 distinct words were counted. Furthermore, the word analysis excluded words deemed less relevant to the content of the interviews in relation to the subject matter. Such words include conjunctions (when, which, because, but) punctuation (full stop, comma, hyphen), stop words (a, the, I, of) and lexical words (take care of, by the way). A total of 1226 remained. From this list, words appearing once were excluded from the top 20-word frequency analysis. **Figure 4** shows a word frequency count for the top 20 words emerging from the interviews. **Figure 5** is a visual representation of the most frequent words emerging from the interviews as analysed using the Atlas.ti word cloud analysis tool.

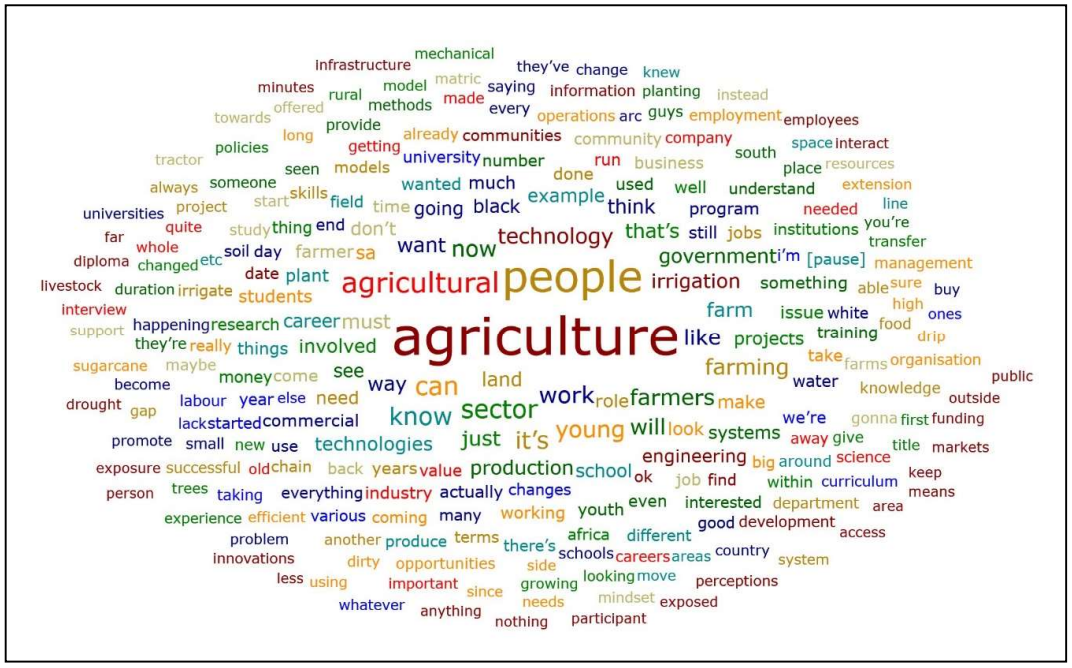
Figure 4: Top 20 words used in the interviews



5.2.3.1 Agriculture

The most frequent word is “agriculture”. The total frequency of 436 was derived from combining the frequency of the words agriculture and agricultural. Having the word agriculture as the most frequent word is expected since this research study is centred on agriculture as a sector. The sample was drawn from a target population of professionals in the agricultural sector who shared their experiences and insights about the sector.

Figure 5: **Atlas.ti Word cloud analysis**



5.2.3.2 Farm

The second most frequent word is “farming”. The total word count was derived from combining the frequency of the words; {Farm, farmers, farming, Farms, Farmer}. Farming is the most known career opportunity within the sector. This is in alignment to the research study given that farming is one of the disciplines of agriculture. In some instances, the word “farming was mentioned in the same sentence with the word “agriculture”. Codes linked to farming that emerged from the findings include innovations used in farming, experiential training on farms and career opportunities linked to farming. These codes will be discussed in other sections in this document.

> “People look at agriculture as just farming with mud but this is a field which is full of science and research”. (Participant 1)

5.2.3.3 People

The third most frequent word is “people”. This is reasonable considering that the key objective of this research study is to explore strategies that can be implemented to transform agriculture in SA in a bid to attract young people to participate in the sector. At the centre of technology transfer and diffusion of innovations are the people. Codes relating to people that emerged from the interviews include Skills development of people, Role models, mentoring people participating in the value chain, recognition and awards for people succeeding in agriculture. These will be discussed other sections of this document.

5.2.3.3 Technology

The word “technology” comes as fourth of the most frequent words is congruent with the research study. This is one of the constructs of this research study. All participants identified the various technologies that they either work with or know of. This is presented in codes linked to technology such as attributes of the technology, technology diffusion mechanisms as well as types of technology. These codes will be discussed in other sections of this document.

5.3 FINDINGS OF THE RESEARCH

The researcher conducted the interviews by following a semi-structured interview guide. The questions asked by the researcher were not exactly and the sequence of questions asked was not the same for all participants. This is because the responses given by the participant during the interview determined the probing question to follow as well as the

sequence of asking. This research study is exploratory in nature. This approach allows the researcher to ask questions and probe further in order to gain an understanding of the underlying reasons, opinions and motivations. Furthermore, this allowed the researcher to determine sequence of questions to be followed not necessarily sticking to the exact structure on the interview guide. However, the researcher was able to steer the interview process to be conversational and not interrogative whilst covering all questions necessary to unveil findings that address the research questions of this study. A qualitative approach brings out an in-depth view of how the various institutions, policies and demand environment are interacting in the agriculture value chain in transforming the agriculture sector.

5.3.1 Research Question 1

Do observations of agricultural innovations incite young people to participate in agriculture? Does the knowledge of agricultural innovations attract individuals to choose careers or start businesses in the agriculture value chain?

To address the first research question, the semi-structured interviews sought to find out how participants ended up in the agriculture sector. Agriculture is perceived as an unattractive sector and young people shy away from pursuing careers in this sector. The perceptions are based on lack of information about career opportunities in the agricultural value chain. In light of this, the first research question sought to ask those pursuing careers and business interests in agriculture why they chose agriculture as a career choice. What are the sources of agricultural value chain exposure that sparked an interest in them to join the industry?

5.3.1.1 Determinants of agriculture as a career choice

It emerged from the interview responses that the decision to pursue agriculture as a career was influenced by family, learning institutions and one's upbringing and the social context they grew up in. This can be visually summarized by **Figure 6.**

However, upon further probing it turned out that five of the participants were influenced by family but exposure to agriculture as a subject in secondary school further cemented the passion to pursue careers in agriculture. **Table 5** gives examples of responses by those that were influenced by family to pursue careers in agriculture.

Figure 6: Exposure to agriculture

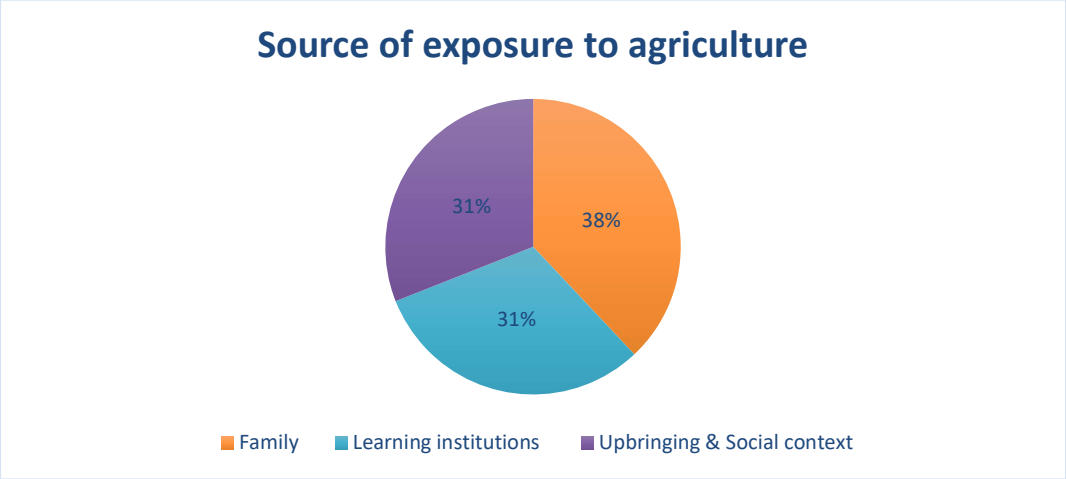


Table 4: Selected responses from the theme: Family

"My older brothers were into agriculture. The first brother was doing botany and the other was in Matric just like me and he applied for a National Diploma in Agriculture". (Participant 2)
"Fortunately, my dad was the mayor where we stayed and busy organizing bursaries for agricultural engineering in the province. So that's how I got to know about agricultural engineering". (Participant 4)
"I didn't know much about agricultural engineering, but my sister who had studied animal production knew a little more about the various career opportunities within agriculture and told me about agricultural engineering". (Participant 5)
"I only had an aunt who raised me and worked in the agricultural field. She worked as a general worker. I think she looked up to the agricultural advisors so she just made it seem like it was a cool job". (Participant 8)
"Growing up at home I had my mom and my brothers. So, they were quite very influential on the agriculture sector for me". (Participant 10)

Four of the respondents learnt about agriculture during their primary and secondary school years. They did not understand what it entailed until they studied agriculture

further in tertiary institutions of learning **(Table 6)**. Four participants were influenced to choose careers in agriculture because of their upbringing **(Table 7)**. Growing up in an agricultural environment influenced them to choose agriculture as a career choice. None of the participants interviewed chose agriculture because of the innovations or technologies in the sector. The innovations are not visible to those outside of the sector. These results were expected because the research study aims to unveil key strategies of modernizing agriculture and so as to attract young people to join.

Table 5*: **Selected responses from the theme: Learning institutions***

"One of my subjects in matric was agriculture. During grade 12, matric year, we used to and visit Cedara Agricultural college to gain some practical exposure ...The exposure at Cedara College made me realise that I could choose agriculture as a career". (Respondent 3)
"I had agriculture as one of my subjects in high school. I had some love for agriculture, I was very good at it…In matric I then took a subject in agriculture and did well". (Respondent 4)
"In high school, I had agricultural science as one of my subjects at matric. I had a bit of an understanding of concepts in agriculture". (Respondent 5)
"I also managed to study agriculture at secondary school". (Respondent 9

Table 6 : Selected responses from the theme: Social context and upbringing

"And I grew up in the rural area. At home we had a one-hectare plot where we used to plant maize". (Participant 5)
"I interacted with co-operatives in agriculture when I was providing a service to them…" (Participant 6)
"It's an inspiration that I got from the elderly. There was a group of elderly people, my parents included, who started to clean a dumping site and started a vegetable production enterprise". (Participant 7) "I got exposed to agriculture as a career choice because we grew up farming at home…" (Participant 9)

5.3.1.2 Knowledge of career opportunities in agriculture

Further to findings on sources of exposure to agriculture, participants identified the various careers available in the agricultural value chain. This is in alignment to this research study because people's perceptions about agriculture are based on lack of information about career opportunities in the agricultural value chain. The participants were able to identify the various career opportunities now that they are engaged in agriculture. They identified career opportunities based on their experiences and who they interact with in their various roles. The career opportunities identified and are in research and skills development (**Table 8)**, farm management **(Table 9)** as well as consultancy and advisory (**Table 10)**.

Table 7 : **Selected responses from the theme: Research and Skills Development**

"Qualifications is also a status symbol amongst the youth. There are doctors and professors in agriculture but beyond the reach of many young people". (Participant 1)
"Now I run the whole program. The third-year program which is the experiential training on plants which is the work integrated learning of their diploma…And then they've got a whole lot of assignments and theses that they have to hand in to me". (Participant 11)
"If you look at ARC, we have breeders, agricultural economists, researchers, pathologists…" (Participant 12)

Table 8: Selected responses from the theme: Farm management

"I report to the Area Manager of the Cane Operations Division. I manage four farms with four farm managers who report directly to me. Underneath them are a number of section leaders who report to these farm managers and in some ways, they interact with me. On a daily basis I interact a lot with the farm managers. I informally also interact with employees just to build relationships but I interact mainly with Farm managers". (participant 1)
"We also have a wormery project running alongside the plant production project where we rear earthworms. This is our way of putting nutrients back to the soil". (participant 7)
"On a daily basis there are my section leaders and then there are the people that work under them, the employees. And then I've got my production manager. And then I've got 3 contractors that I communicate with on a daily basis". (participant 10)

5.3.1.3 Summary of findings for research question1

The findings revealed that 38% of the participants were influenced by family to pursue careers in agriculture. Learning institutions influenced 31% of the participants to choose agriculture as a career choice. Growing up in rural areas and farming on the family plot influenced 31% of the participants to pursue a career in agriculture. Participants lacked knowledge of agricultural innovations before participating in the sector. Exposure to agriculture revealed career opportunities available in the value chain. There are careers in farm management, research and skills development and consultancy and advisory support services.

Table 9: Selected responses from the theme: Consultancy and advisory

"We therefore need soil scientists to come and fix the microbial life in the soil… It is about research, chemistry. If you introduce someone as an entomologist, the young people will be intrigued". (participant 1)
"There is more to agriculture than just farming. Focus is placed too much on the actual production in-field yet there are several other careers along the agriculture value chain. The production chain from the farm to the mill has various careers such as artisan, electricians, agricultural engineers, HR officers, finances and training dept as well as agronomists..." (participant 2)
"Our core responsibility is irrigation system design, offering technical support to commercial farmers, system maintenance. We focus on the technical side of agriculture. We provide a service to the producer". (participant 4)
"The agriculture sector is huge with many career disciplines in the value chain… farming is not just using hand tools to till the land, or just driving a tractor pulling an implement but that a lot of engineering was involved and that there is precision farming involved… They did not understand how there can be engineering, or science and technology in agriculture". (participant 5)
"…we are into consulting for agricultural engineering. We are also involved in the actual designing of irrigation systems/projects. We also do the implementation of those projects. We build pump stations, pipeline construction and installing the different irrigation systems". (Participant 9)

5.3.2 Research Question 2

What are the enablers of agricultural innovation diffusion that can contribute to transformation of the agriculture sector?

The research question sought to bring out institutional, policy and demand environment barriers that restrict the dissemination of agricultural innovations in South Africa. Tied to that, the factors of institutions, policies, attributes of agricultural innovations and the demand environment that can enable modernization of agriculture were identified.

In addressing this research question; Firstly, the different types of agricultural innovations used in the sector were identified. The identification of examples of innovations used in

the sector allowed the researcher to ask probing questions to gain the underlying reasons, insights and opinions regarding the attributes of the innovations and institutional environment facilitating technology transfer and innovation diffusion. The second section gives findings on how the attributes of an innovation influence its transfer, diffusion and adoption by the intended users. Thirdly, the role of institutions in technology transfer and diffusion and adoption of innovations is given. The fourth section gives findings on the role of policies in technology transfer and diffusion and adoption of innovations. The fifth section gives findings on how the demand environment enables technology transfer and diffusion and adoption of innovations.

5.3.2.1 Types of innovations

In order to answer the question of enablers of diffusion of agricultural innovations, responses revealed the types of innovations in agriculture and their usefulness. The findings revealed innovations that the participants are currently using in their various business settings. Participants 1, 2, 4 and 10 have management roles in the commercial farming sub-sector. They identified all the listed innovations in **Table 10**. This indicates that they are exposed to all of these technologies. Participants 3,7 and 8 identified tractors and water saving irrigation technologies as these are relevant to their roles in the subsistence farming sub-sector. Participant 5 and 9 are involved in infrastructure development projects. They identified water management, mechanization and IoT technologies. This is an expected result considering that their roles are in engineering. Participants 6, 11 and 12 have roles in research and skills development. Their exposure to the identified technologies in **Table 10** is limited. Their roles are more involved with disseminating agricultural know-how to recipients. The identified technologies impact on agriculture in by increasing productivity, allowing producers to adapt to dynamic environments as well as allowing mitigation from adverse conditions.

Table 10: Agricultural innovations identified

Innovation identified	Usefulness	Potential impact
CanePro, FarmSense	Managing databases	Assists with decision making to increase productivity
Soil moisture probes	Precision irrigation scheduling	Water saving, yield improvement,
Drip, Centre pivot, sprinkler	Labour saving, water management	Water saving, less labour, adaptation to dry spells
Mechanical harvester, planter, GPS tractors	Labour saving,	Increase efficiency of operations,
Tunnels, greenhouses	Allows crop production in	Yield increase

	harsh climate	
Precision fertilizer application	Allows site specific nutrient management	Allows efficient use of fertilizers, Yield increase
Automation of irrigation systems	Improves water management, labour saving	Increase water use efficiency, Yield increase, reduce electricity costs
Drones and Internet of Things (IoT) technology	Managing operations, labour saving	Provides accurate information to assists with decision making in management of resources, productivity increases

In addition to the agricultural innovations given in **Table 10**, five participants whose roles involve giving extension advice to farmers cited agricultural best practices as important technology to farmers. This is in alignment to this research study because in this study, technology related to agriculture encompasses all agricultural innovations such as knowledge as well as all variables that relate to increasing agricultural productivity. **Table 11** shows some of the responses given on agriculture best practices as an example of agricultural innovations.

Table 11: Selected responses from the theme: Agriculture best practices

"I give advice to farmers on best practices and production assistance in producing quality sugarcane". (Participant 3)
"Our core responsibility is irrigation system design, offering technical support to commercial farmers, system maintenance. We focus on the technical side of agriculture. We provide a service to the producer". (Participant 4)
"With the agricultural know-how I have, I impart production skills to the farming community or link them to networks of those that are able to support them". (Participant 5)
"My job entails giving agricultural support related to irrigation". (Participant 8)
"I started focusing more on making sure that the technologies of the ARC are accessible to small holder farmers. In a way trying to change the perception as well. I have projects on skills development, training extension officers, and training farmers". (Participant 12)

5.3.2.2 Attributes of innovations

Further to identifying the various agricultural innovations in the industry, the responses

revealed attributes of these innovations that enable or create a barrier to adoption. All participants cited removing drudgery and increasing productivity as characteristics of the identified technology that enable adoption. These results were expected because the basis of this research study is on modernizing agriculture through innovation and technology transfer so that the sector can move away from labour-intensive and traditional methods that make agriculture unattractive to young people. Some selected responses on productivity increase as a characteristic of agricultural innovations are given in **Table 12**.

Size of the innovation determines likelihood of adoption. An innovation that require big area of land is less suitable for recipients with small farms. This is supported by participant 3;

> "The farm sizes are very small, roughly 3ha to 10ha plots so bigger and expensive irrigation systems such as centre pivots would not be suitable". Participant 3

Participants 2, 8 and 9 all concurred on the view that affordability is a deterrent for adoptions of agricultural innovations. This result was expected from the participants who work closely with users of the identified innovations. They interact closely with the producers to influence them to adopt the innovations and therefore are well informed about barriers to adoption. **Table 13** gives some selected responses from participants who felt that agricultural innovations are expensive to adopt.

Table 12: selected responses from the theme: increased productivity

"Mechanisation increases the rate at which operations are completed, take for instance, the mechanical planter can plant 10ha/day. Manual labour can only do less, about 2ha/day. With manual labour, more people are needed, cutting seedcane, planting, applying fertiliser and closing…" (Participant 2)
"Drip irrigation system is less labour intensive. One person can operate the system and irrigate more than 2 or 3 fields… drip is more modern whereas dragline is very traditional and labour intensive and needs a lot human labour to move the pipes day and night." (Participant 3)
"…pump stations do not require human control, they can run on their own remotely. Centre pivots are mechanized irrigation systems that move on their own… aspects of irrigation, people do not have to carry water over long distances to water their crops…drip irrigation which helps with water utilization efficiency…" (Participant 9)
"It has improved quite a lot. I think with especially the scheduling with your probes it has really improved the yields. You can irrigate the amount of water that's actually needed by

Table 13: selected responses from the theme: Affordability

"However, it is very expensive in the sense that all mechanisation happening uses fuel and skilled labour". (Participant 2) "In irrigation management, technologies are there. Be it in water management or how to save water, how to irrigate even from miles away. However, the technologies are very expensive… the small-scale farmer struggles to adopt such technologies… technology to improve agricultural productivity is there in our province but not many farmers can afford it". (Participant 8) "The issue of innovation is indeed expensive". (Participant 9)

5.3.2.3 Institutions

To address the objectives of the second research question, the responses revealed the various mechanisms being used by institutions to facilitate technology transfer, diffusion and adoption of innovations in agriculture. This is in light of the types of innovations and attributes of the innovations identified in the previous section. The participants identified the various institutions involved in innovation and technology transfer in agriculture. The identified institutions form part of the expected ecosystem in which a value chain operates and the agriculture value chain conforms to this notion. The identified institutions are presented in **Table 14**.

Table 14: Institutions identified

Category	Description
Public sector institutions	• Government departments (Public works, Land reform, Rural development, Water affairs, Social development) • Skills development instruments (AGRISETA, YDA, MEGA)
Private sector institutions	• Producers • Processors • Retailers • Input suppliers (suppliers of agro-chemicals, machinery and implements, consultancy and infrastructure development,) • Not-for-profit organisations

	• Workers' Union organisations (FAWU)
Education	• Schools • Further Education and training • Universities
Research institutions	• Government funded (ARC) • Private funded (SASRI)
Financial institutions	• Banks • Trade and industry development

Table 15 is a summary of findings that emerged from the interviews of the various mechanisms implored by institutions to facilitate transfer and adoption of innovations. The various institutions interact and make arrangements that create an institutional environment that facilitates diffusion of agricultural innovations. Some of the responses from the interview in support of the theme are also given in **Table 15**.

Table 15: Mechanisms of transfer and diffusion of innovations identified

Mechanism of transfer and diffusion	Example from selected responses
Strategy of business aimed at removing drudgery in operations	"It is important that we have embarked on adopting new technologies for production. The aim is to simplify the farm-work for all general employees. We are trying to move away from old dragline irrigation systems in favour of new systems such as drip, Centre pivots and semi-permanent systems so as to make the work much lighter". (Participant 1) "And then in terms of technology, every week there's something new discovered that they want us to try. For instance, mechanical harvesting. So, before it was all hand harvesting and then now we are doing the mechanical harvesting. We are going that way. Even when we do the replant, we are planning it in that accordance…we want to do everything mechanical where it allows..." (Participant 10)
Client orientated Research and Development	"There is also breeding that is going on to breed fruits that are resistant to pests and diseases rife in the sector, long shelf life so as to increase quality for export". (Participant 12)

Providing a platform for development of innovations	"I have a PhD student who is doing research on franchising as an option for technology transfer...if one can have a franchise for hydroponics as an example, what is needed to succeed. What is the standard operating procedure? What are the daily operations? How much money for a certain tunnel size? How do you grow the franchise?" (Participant 12) "We are looking also at some of the small-holder farmer while they are growing their trees, what else can we grow in between. Trees take long to produce fruit. So, they can plant something else in between rows, spacing is usually very wide between rows". (Participant 12) "If you look at the commercial sector, there is a lot of research taking place, which they finance on their own there. Government could also do the same in the subsistence sector". (Participant 9)
Improving the functioning of markets through value chain development	"How can say six people in the same village doing the same thing come together to form synergies in business? Where will they buy inputs and sell their product as a group? Some people only want to be providers of transport. Others want to be leading the pack. We are looking at that with some of our technologies as anchors to try and uplift communities". (Participant 12)
Development of Infrastructure that facilitates diffusion and adoption of technologies	"What we do is we are into consulting for agricultural engineering. We are also involved in the actual designing of irrigation systems/projects". (Participant 9) "In parts of the province, government has provided some irrigation technologies to farmer". (Participant 8) "My last project was on Livestock infrastructure...Once we had that data, we decided to use the funds to revamp livestock infrastructure such as plunge dips, handling facilities as well as the housing". (Participant 12) "…As for me, I now know that the projects I have completed in

	agricultural engineering work have helped a lot of communities. For example, the projects we do provide jobs to rural communities. When I work on projects, I engage with young people a lot…I try to encourage most young people to engage in these projects so as to learn more and perhaps earn a livelihood out of agriculture. I'm mostly involved in infrastructure development projects". (Participant 5)
Facilitating enterprise development	"Somebody is interested in seed production and contract farming. If its seedlings who grows which varieties". (Participant 12) "…we had a program at ARC to take unemployed graduates through a course to equip then with business skills to run their own ventures in any discipline they chose". (Participant 12) "We are also supporting communities to sell amongst each other than saying I don't trust the seedlings coming from so and so. We need to look at different models, for different areas and different people. We need flexibility and for people to adopt, a technology must not be forced upon them because government wants votes". (Participant 12)
Collaborating with other institutions/stakeholders to facilitate diffusion of technologies	"For fruit to get into the food basket, we have to get assistance from government departments such as social development who sometimes give out seeds people to plant trees. So, we can give out fruit trees in addition to the ones given out by social development department". (participant 12) "…through joint ventures with communities that we are farming sugarcane with. Within those communities we try to involve community members in the production process so much that whenever there's something that must be done on the farm, we get members of the community to assist us e.g. planting, irrigation and harvesting". (Participant 2)
Facilitating the creation of knowledge sharing platforms	"We have already invited other growers in the vicinity to come and hear what ARC is proposing and how the trials will be run. My idea was ARC might want to link with several other growers too in their seed potato trials". (Participant 7)

	"We formed a forum to grow agriculture by disseminating the information that we have. We assist people the same way we were assisted. We were brought up a number of organisations…" (Participant 7) "Once the commercial farmers in the surrounding areas saw that the community now understood taking care of their animals and dipping them, they committed to donating their bulls to assist in maintaining quality herds". (Participant 12)
Skills development through facilitating exposure to various disciplines in the agricultural value chain	"We would go to the field to do surveys and learn social skills. Almost all students that I have supervised, once they have done that portion of the program, most of them do not want to go back to the office work". (Participant 12) "Those that were exposed to farming operations, decision making and management of resources will do better at running their businesses than those that lack exposure to agriculture". (Participant 6) "So, we place the students on the farms. They work for the farmer. Work on the farms. And then they've got a whole lot of assignments and theses that they have to hand in to me". (Participant 11) "I am still inclined to make sure that black people include fruit in their homes. Secondly, I would like more black farmers involved in the commercial production of fruit. Besides managing the institute and its various campuses, I am still very much interested in getting more and more black people interested and doing this kind of business". (Participant 12)
demystifying agriculture by improving the education curriculum and exposing young people to career opportunities in agriculture	"…at my daughter's school, they have adopted the theme of hydroponics for this year... This means all examples will be aligned to hydroponics. Even when they are doing mathematics, the examples will be around hydroponics, in science the chemical examples will be chemicals used in hydroponics. These kids will

	value agriculture because they will know that there are different career opportunities in agriculture". (Participant 12) "I have been involved in workshops fighting to have this curriculum changed. My suggestion was that we adopt the Land-Grant model. The universities do extension work". (Participant 12)
Facilitating access to resources and providing incentives	"I think for our department it is mainly the awards, recognition given to those who are already participating in the sector. There are Female Farmer Awards, Youth awards and there is funding that goes directly into such projects". (Participant 8)

5.3.2.4 Policies

The role of policies in facilitating transfer, diffusion and adoption of agricultural innovations is given in the following section. There were contradicting views about the role being played by policies in transforming the agriculture landscape in South Africa. The findings reveal how policies in agriculture are lacking in facilitating the modernization of agriculture. The findings point to the view that policies are good on paper but implementation is bad. This is expected because of the profiles of the people making up the sample chosen by the researcher. Only 31% of the sample have roles in commercial agriculture. The other 69% has roles in the subsistence sector. The views of the participants reflect the state of affairs in the environment that they work.

Participant 1 revealed how labour policies are good on paper but the implementation has caused rift amongst the various stakeholders involved.

> "…there are a lot of opportunities in agriculture but the political institutions, the workers' union and the business institutions are not in unison. The policies are clear and good and show proper workmanship without misusing or abusing employees. When it comes to unions, these institutions focus more on membership and power than benefit to the community. This tends to distort the intention of the union towards fighting with the employer unnecessarily. It drives the employer to come up with other means of driving production without employing people. Hence, we go adopt mechanical ways of doing the work as well as automating our systems". (Participant 1)

Participant 9 and participant 12 agree that policies are good on paper but the

implementation does not ensure sustainability of projects.

> "The current policies in SA do not really promote participation of young people and black people in agricultural value chains. I have worked a lot on land reform projects in SA but what you see is that it is more concentrated towards uplifting old people. You would find that the emphasis of land reform and government is placed more on projects that are run by old people instead of bringing in what we can call a new crop of farmers. A farmer that is young and black. You get tendencies that government is merely paying lip service to land reform policy. There is no sustainability in the way the projects are run. By this I mean, why would we invest in people who are old and, on their way, out? Instead of concentrating on young commercial farmers who can be given targets to achieve and get the necessary government support". (Participant 9)

> "We have nicely designed policies but we fail to implement them to successfully transform agriculture… There are government programs every term. All of these programs are about land restitution, where people are given land and not skills. These programs fail miserably". (Participant 12)

Coupled to this, policies are mis-aligned with the goals of farmer development projects. The rolling out of technologies is meant to boost productivity and therefore uplift emerging farmers into the commercial mainstream economy. Participant 8 and 9 highlighted their views in this regard.

> "There is a gap in policies implemented towards the provision of technology in agriculture and the actual capability of the farmer" (Participant 8)

> "…Government officials are so convinced that this co-op model works. They can't fund you until you have formed a group and called yourselves, a co-op…For each group of people there has to be different strategies. We must do a lot of pre-work before implementing a project so as to get people to own things. I also do not like the group approach. There are no owners there. Either everyone wants to be chief there and no one wants to work or no-one wants to lead and take responsibility". (Participant 12)

The role of policies in improving the functioning of markets is lacking. This was

highlighted by participant 1. His views point towards an under-developed value chain with regards to trade of agricultural commodities on the international market.

> "This was done to keep the SA industry sustainable. I would only be allowed to buy from external markets once I have exhausted what is on the domestic markets. But now, the regulations of trade hardly protect the domestic market". (Participant 1)

Research and development of technology customized to solve the problems affecting farmers is lacking. This is one of the reasons why farmers are not able to access the innovations that suit the resources at their disposal, such as size of land. Participant 9 corroborates with this view.

> "There aren't a lot of platforms where these technologies are showcased… In SA there are cartels running these aspects of agricultural inputs and as a result, technology diffusion to the farmer and communities is hampered… What lacks in SA is research that is relevant to the farmer so that technologies become accessible to the farmer" (Participant 9)

5.3.2.5 The demand environment

As described in previous chapters, there is a dual economy in the SA agriculture sector. On one hand, the agriculture sector is made up of highly mechanized, technologically advanced, organised and skilled commercial farming subsector and on the other hand, under-developed subsistence sector. The various players in the value chains in these sub-sectors make up the demand environment for agricultural innovations.

Findings of the interviews reveal factors within this demand environment that are affecting technology transfer and adoption of agricultural innovations. Such factors include knowledge gap (Participant 2), limited access to factors of production (Participant 3), gap in knowledge sharing and innovation platforms (Participant 4 and 7), Stereotypes and perceptions (Participant 8) and the value of social media platforms (Participant 12). These findings are expected considering the business ecosystem in which the agricultural value chain operates. Farming is evolving from labour-intensive methods of farming to adoption of innovations that reduce drudgery. It is expected that people working in such environments will feel that their jobs are threatened.

> "It takes a lot for the employees in low level positions to understand the need for adopting these new technologies". (Participant 2)

In the same vein, farmers were accustomed to the old methods. As mentioned in the previous section, the policies of rolling out agricultural innovations to small scale farmers are not aligned with the goals of transforming agriculture. This is further evidenced by the response given by participant 8 on how farmers perceive the new innovations.

> "Unfortunately, most farmers are just unwilling to ditch their conventional methods of farming… If advised on no-till systems that reduce cost of land preparation without hampering on the yield, most farmers still choose the conventional tillage methods…If you advise them to irrigate at night and switch off during the day, they will still revert to the old ways. If you advise then that irrigating 20mm is enough for your crop then you irrigate again after two days, the farmer will irrigate continuously for the whole day and every day of the week because they believe in traditional methods. This then add on to their costs… if you advise them to install other systems like microjets, they are not willing to adopt anything else even if the output is the same because they just want to see a big machine on their farm". (Participant 8)

Effective technology transfer and diffusion of innovations occurs when the targeted users are receptive to the idea of changing how work is done. Participant 4 highlighted how culture and social context of individuals influences technology transfer and diffusion of innovations.

> "I don't know whether it stems from our culture? The agriculture sector is huge with many career disciplines in the value chain and we do not share amongst ourselves who's doing what… We don't know each other. I don't know what is going on in renewable energy, I don't even know what is happening in infrastructure and even in my space of irrigation systems, I only know what we are busy with here as a team but as for what others are doing elsewhere remains closed. We work in silos". (Participant 4)

This view is further highlighted by Participant 7 who concurred with this finding;

> "The MEC was of the opinion that all farmers are will to participate in knowledge sharing. But the way we clustered ourselves revealed how we group ourselves according to levels of success in the agricultural field. We do not interact. We

work in silos". (Participant 7)

Regarding the demand environment for innovations, farmers would want to adopt the efficient methods of farming. Their only limitation is capital. This is an expected finding considering the other findings raised about cost of innovations. In addition, policies that effectively facilitate access to resources were found to be lacking.

> "If there is capital, I'd advise them to invest in less labour-intensive methods… The farm sizes are very small, roughly 3ha to 10ha plots so bigger and expensive irrigation systems such as centre pivots would not be suitable…" (Participant 3)

A positive finding about the demand environment and technology transfer is the role played by social media platforms. This is an expected result considering the penetration of information communication technology and use of smartphone devices especially amongst young people targeted as users of innovations. This research sought to unveil strategies of transforming agriculture to make the sector attractive to young people.

> "With Facebook now, we got to know of people who are serious about agriculture, young people whose eyes are wide open, who know the realities. All these people are reading up on developments in agriculture. Successful people are there". (Participant 12)

5.3.2.6 Summary of findings for research question 2

The research question sought to bring out barriers posed by institutions, policies and demand environment in the dissemination of agricultural innovations in South Africa. Further to this, the question sought to unveil factors of institutions, policies, innovation attributes and the demand environment that can enable agriculture to transform. The following findings were revealed;

Participants identified tangible technologies and agricultural know-how as innovations in agriculture. Tangible technologies identified include irrigation systems, soil moisture probes, mechanisation and controlled environment agriculture. Best agricultural practices form part of agricultural know-how disseminated by agricultural advisors to farmers. In the farming environment, attributes of the identified agricultural innovations have an impact on productivity, adaptability and mitigation. Affordability was revealed as a factor hindering diffusion and adoption of innovations.

There were contradicting views on the role played by policies in enabling diffusion of agricultural innovations. These views stem from the basis of the dual economy of the SA agriculture sector. Those with roles in the commercial sector, 31% of the participants, were of the view that the policies are good but only need effective implementation. The other 69% have roles in the subsistence sector. In their views, policies are not enabling transformation of agriculture. They cited mis-alignment of goals between policy objectives and small-scale farmer development goals. Policy implementation fails to deliver sustainable infrastructure projects.

The demand environment is inundated with factors that do not promote effective innovation diffusion and adoption. Findings revealed factors such as knowledge gaps, limited access to capital and land and culture and perceptions. These factors are a barrier to innovation diffusion and adoption. However, social media platforms are facilitating knowledge sharing amongst value chain actors.

5.3.3 RESEARCH QUESTION 3

To address the third research question, the following section gives findings that emerged from the interviews on the actions that institutions should be taking towards transformation of the agriculture sector. The findings revealed how policies must be implemented in a bid to push for agricultural transformation. Of the identified characteristics of agricultural innovations, the findings revealed how these attributes could be used to transform the agriculture sector. The demand environment is inundated with factors that affect the effective transfer and diffusion of technologies. How these factors can be manipulated in a bid to modernize agriculture forms the findings presented in section

5.3.3.1 Role of institutions in technology transfer and diffusion of innovations

In light of the changes taking place in the agricultural sector in SA, the researcher asked participants the ways in which various players in the agriculture sector could contribute towards the transformation of the sector. All participants were of the view that there is limited exposure to career opportunities in the agricultural sector and knowledge sharing platforms are under-developed. To that effect, there was a consensus in the findings that efforts must be made by institutions both public and private, to demystify agriculture.

> "I think we must invest much more into career expos days for high school and tertiary institutions… If the govt can get involved in taking what is happening in the private sector to schools and communities, maybe then, more people might be attracted to agriculture". (Participant 3)

> "In schools, our kids need to know that information from the beginning and agriculture will not just be tilling the soil…" (Participant 12)

Furthermore, Participant 9 was of the view the sector is not visible to those looking for opportunities to pursue business interests.

> "There is that need to demystify the sector and make it more visible out there, make it "sexy" to want to know more about the agriculture sector especially amongst African people… On that aspect, I think the agricultural sector itself must be more visible to potential entrants". (Participant 9)

Relating to visibility of the sector, there is a view that learning institutions that offer agricultural course are scarce. This view was highlighted by participant 7.

> "...colleges of agriculture are very few. I cannot leave here to go to Pretoria or Free State to study agriculture yet there are so many colleges in the area that offer other courses such as HR, Marketing and Business Management. So, I think one of the things is a limited exposure of young people to agriculture". (Participant 7)

There are mixed views regarding the skills being imparted to students in agricultural learning institutions versus the skills required by organisations in the industry. Whilst all participants agreed that the current education curriculum requires to be reviewed and updated to reflect skills required by the industry, Participant 11 acknowledged the changes in the agriculture sector resulting from technology adoption and the need to review and update the curriculum but insisted that concepts of plant production as a discipline of agriculture do not change.

> "Maybe technology has changed but the basic farming methods haven't changed. In other words, how you prune a peach tree has that changed in 28 years? No, it hasn't. Yes, the equipment that you spray that peach tree has changed. The chemical has changed. The way of thinking of how to spray has changed but you still have to spray. So, the basic principles of farming will never change".

(Participant 11)

However, Participant 9 and participant 12 were of the opinion that graduates are not being equipped with skills required in the industry.

> "Most of the syllabi that you get in institutions of higher learning and agricultural training are based on perceptions. They have not been tailormade to suit what is really required at this point in time so it is mostly theory and there is need to bridge the gap between the content of the syllabus and what is required in the industry" (Participant 9)

> "There is a mismatch between quality of graduates coming out of the tertiary colleges versus the quality required by industry. Our graduate is for 1983 farmers! We haven't caught up with how things are done now… The curriculum of the extension officer is not even in tune with what is happening right now". (Participant 12)

It emerged in the interviews that the issue of inadequate skills is not only as a result of the curriculum but the mindset of graduates churned out of learning institutions. Participant 6, 8, 9, 10 and participant 12 all concur that graduates study agriculture so as to seek employment in the industry without any goal to start their own agri-businesses. This is what has led to high unemployment rates of agriculture graduates.

> "An entrepreneurial approach will help promote youth participation in agriculture. If you make them realise that there is entrepreneurship in agriculture then you will see them flocking there". (Participant 6)

> "Many graduates in agriculture are frustrated and what is funny to me is that the people who are doing the actual farming are not those who studied agriculture. Those who studied agriculture did that in anticipation of getting work, that someone will employ me. They are then employed by those that did not study agriculture but started agribusinesses" (Participant 8).

> "So, it's more like you are just studying so that you get employed and get paid. The aspect of pushing people to be more entrepreneurial and more in touch with the production aspect of agriculture is kind of non-existent in the current set-up".

(Participant 9)

> "They need to catch up and change the mindset of getting employment and have more of the mindset of I want to be the person who creates employment…there are quite a lot of farms that I've seen failing because yes, the young people are there, yes they've gone to university, yes they have the qualification but the experience and the knowledge is not there. Because in their minds, they were here to be employed and not to learn how to run their own businesses". (Participant 10)

> "It's difficult to change a mindset because if you say agriculture is a business, they expect to make money immediately like a spaza shop. They are not interested in waiting, they are not interested in understating the science involved… Most of the young people just want to be employed and not to be entrepreneurs". (Participant 12)

5.3.3.2 Role of policies in technology transfer and diffusion of innovations

Participant 1 was of the opinion that institutions must take part in capacitating young people with skills required in the industry. To that effect, he gave an example of how their organisation is assisting employees interested in pursuing careers in agriculture.

> "The company has a study grant offered to employees who want to further their studies. They will pay 55% of the study fees as long as the qualification is in line with agriculture and to the benefit of the company and yourself. We have policies to develop people who are willing". (Participant 1)

Another finding highlighted by participant 12 in line with the role of institutions is the need to facilitate infrastructure development in the agricultural sector by working together with communities instead of providing handouts or grants to communities. This ties in together with the role of polices in facilitating technology transfer and adoption of innovations.

> "We used that participatory approach...We realised that this approach taken by government to encourage people to work together, and not throw money to solve a problem works...Its ideal to get the community to do work for themselves so that they can appreciate the technology". (Participant 12)

The same sentiment is echoed by participant 6 and participant 10 who revealed that the strategy of government of giving grants to young people was inhibiting entrepreneurial

development in youths.

> "The government strategy on agricultural development does not promote transformation of the sector. If the government offers grants, why would one want to venture into agriculture? But if the government says here is land, seeds and the necessary support without a grant, then one must survive. There is too much dependency on the state". (Participant 6).

> "… the mindset with them has to change and understand that we're moving away from employment and we're going into business but then the other thing that needs to be noted is that this opportunity of grants that's here is now is not always going to be here". (Participant 10)

Initiatives that promote mentoring and entrepreneurship were highlighted by participant 6, and participant 8 as a way of promoting knowledge sharing and skills development.

> "Commercial farmers organise themselves. They are skilled and there exists a skill set that we should be tapping into in-order to develop agriculture. This could be achieved by developing some mentoring schemes". (Participant 6)

> "I think the best way to achieve this is if we are going to promote individuals to start their own agribusinesses. I do not think the government has the capacity to absorb us all. There are a lot of graduates in agriculture that are unemployed and very frustrated". (Participant 8)

Another important contribution that can be made by policies towards the transforming agriculture through technology transfer and innovation diffusion is curriculum development. The findings reveal the need to review and update the current education system and curriculum so that learning institutions can abreast with new technology especially the technology being used by private sector institutions. Participants 5, 6, 11 and 12 highlighted this finding.

> "we must have a career course as a subject offered in school where learners are taught about the various careers out there. Or a subject where we can look at the challenges faced by our country and then that will inform us to say in a particular sector where are we lacking...Then a young person can decide to go and study agricultural engineering to fill in that gap, or maybe it's economics or agronomy

> or soil science". (Participant 5)

> "So, we must say; hands up those that are in agriculture and successful. Because they are there. Then once identified, schools must arrange visits to interact with such people…incorporate agriculture into school curriculum for example school projects in agriculture". (Participant 6)

> "…But now, that curriculum hasn't changed for 28 years. So, I know they're looking at getting people in. They've ear-marked a whole lot of people but if I look at it they've asked a lot of professors from other universities to come and look at our curriculum. And maybe 10 % of that board is actual farmers. So, is that a problem? I believe it is. It is because we're not getting what the industry wants". (Participant 11)

> "Transforming the sector requires that we start from primary school level...The education curriculum must be influenced at all levels where agriculture is concerned...Our curriculum must portray agriculture as a modern subject and a broad subject". (Participant 12)

Policies can facilitate access to resources. This is in line with value chain development as a means to facilitate transformation of agriculture. This development can be achieved through improvement of the functioning of markets. This finding was revealed by participants 6, 7,9 and 12. Participant 6 gave examples of China and Kenya as countries with policies that support emerging farmers by providing access to market.

> "…it is also important to provide access to markets. The current policies of government support do not address issues of markets. This makes farming unattractive". (Participant 6)

This was echoed by participant 7 who revealed how their organisation had formed a forum to assist members in facilitating access to markets for their fresh produce.

> "Most people plant and their crops end up getting rotten because of lack of markets. They don't have anywhere to sell. Those that buy from them exploit them a lot by buying at the lowest prices". (Participant 7)

Participant 12 also highlighted the importance of having policies in place that facilitate

access to markets to transform agriculture.

> "Another example is black farmers growing tomatoes because the government tractor came and ploughed, they got seedlings from the government, production advise from extension workers. When the tomatoes are ripening then they start looking for markets. This is one of the many examples where government has misled the people". (Participant 12)

The findings go beyond policies related to access to markets. Participant 7 and participant 9 cite the gap in general access to resources needed for production.

> "I see agriculture growing as long as resources are made available to those that are interested and capable of participating in agriculture value chains…" (Participant 7)

> "We have young farmers that would want to progress to be commercial farmers but they are overlooked in favour of those that are old. You would have expected government to make a concerted effort to say we are acquiring these farms but targeting young people whom we are actually grooming to become the next generation of farmers". (Participant 9*)*

Participant 9 gave an example of countries such as Israel whose policies strengthen agriculture through the creation of strong research and development entities. He further suggests a way of making innovations to be more affordable in SA.

> "The issue of innovation is indeed expensive. That can be addressed by putting more money into research on those aspects which is something that is lacking in SA. If you go to institutions such as ARC, they are underfunded yet we have institutions whose mandate is to promote development such as IDC, NEF that could actually be assisting with such initiatives by allocating some of their budget to research that can help solve farmers' problems. That way, technology can diffuse successfully to them." (Participant 9)

He further highlights the lack of visibility of government with regard to research and development in agriculture.

> "What lacks in SA is research that is relevant to the farmer so that technologies

become accessible to the farmer. Technology is there, but there isn't that concerted effort to push that technology right to where it is needed. You see that gap. Government on its own, provincial, local, national department of Agriculture; you do not see their role in research. They are not very visible" (Participant 9).

Participant 12 disagrees with this notion of saying government is not visible in research. She ascribes the challenges to the existence of a dual economy in the SA agriculture sector.

"ARC is a state organ that operates in both the commercial and subsistence sector. We face a lot of challenges in addressing these issues. My role is to find a solution in the fruit industry and I must do that before my tenure ends. Government pays our salaries; however, government does not pay for the breeding programs. Once the best technologies are developed, the commercial sector takes them and privatise them". (Participant 12)

5.3.3.3 Demand environment

The researcher asked how changes in the agriculture sector have impacted on the supply and demand for skills and opportunities for people as a result of adoption of agricultural innovations. A huge concern is that manual labour is being made redundant in organisations that have mechanized operations and automated their irrigation systems. This is a general view revealed by five of the participants.

"It doesn't sit well with a number of people. They feel that soon they will be out of jobs". (Participant 2)

"Adoption of agricultural innovations such as the automation of irrigation systems poses challenges for the unskilled. Less job opportunities for them… The thing with technology is that it does not need much of human interventions. For example, the mechanical harvester only needs the operator and one person walking in front of the machine". (Participant 4)

"And then also taking into consideration the computerised irrigations systems that we have. That makes our work more efficient. I always tell my employees; we're not doing it to get rid of you guys but were doing it to make the whole production efficient. So, it means that you have less work to do while we're making more yields and we're making it more efficient". (Participant 10)

During the interviews, the researcher probed to find out whether redundancy was affecting only unskilled labour. Participant 11 explained that it affects even skilled labour and alluded the high unemployment rate amongst agriculture graduates to technology adoption in farming.

> "Irrigation used to be a guy that used to go and open a valve and close it. Now there are all computerised valves… if you go and look at the organogram of the farmer you've got the farmer at the top. He's got 2 farm managers. Maybe 4 junior managers and then supervisors and lots of workers. Now we are getting rid of a lot of workers at the bottom, then what's happening is that all of a sudden you don't need 4 junior managers anymore. Now all of a sudden you need 2 because you're just managing equipment that is doing all the work for you. So, I think it's cutting everywhere but unfortunately that's life." (Participant 11)

Whilst participant 5 agrees with the general view that adoption of agricultural innovations takes away people's jobs, he revealed how this poses opportunities to reconfigure resources and develop a new skill set.

> "Mechanization and automation might be regarded as taking away people's jobs. This is why I believe that technology must not be just about coming up with new innovations but it could be reallocating resources and re-aligning our priorities…. Research must be informed by the needs of the people. If we come up with tools that do the work instead of man doing the work, then we must be able to move people to trades were these people can be accommodated. For example, we were talking about manufacturing. These people can be equipped with skills needed in the other sub-sectors of agriculture or in off-farm jobs in the agriculture value chain. We can stop importing the machines from abroad, move people into manufacturing jobs that will produce the technologies that are mechanizing agriculture operations in the lower levels of the value chain". (Participant 5)

5.3.3.3 Summary of findings for research question 3

Based on the factors of technology transfer, innovation diffusion and adoption unveiled in research question 2, the third research question sought to find ways of promoting an institutional environment that enables diffusion of agricultural innovations to transform the agriculture sector. The question sought to unveil ways to enhance the activities undertaken by various stakeholders in the agricultural value chain to promote youth participation in agriculture. The findings revealed that;

A concerted effort must be made to demystify agriculture Suggested ways of achieving this is through career expos in schools, reviewing and updating the education curriculum to align it with skills required business, facilitating mentoring programs that aim at promoting enterprise development as well as promoting skills development through value chain exposure. Training of farmers will equip them with the knowledge required for them to successfully implement agricultural technologies. The model of using participatory approach in infrastructure development projects in agriculture enhances sustainability of the project and increase rate of innovation adoption. Implementation of policies that promote young people to start agribusinesses. Policies that facilitate access to markets and resources required for effective production must be implemented. Interaction of institutions and policies must facilitate skills development to address employment opportunities in off-farm job positions such as manufacturing and maintenance industries developed to support new technologies adopted in agriculture.

5.4 CONCLUSION

The researcher sought out to explore how institutions, policies, innovation attributes and the demand environment influence the transfer and diffusion of agricultural innovations. A qualitative exploratory approach was used to collect data from twelve professionals from various levels of the agricultural value chain. Data collection was done through semi-structured interviews. The results revealed that social context and upbringing, family and learning institutions influence individuals in pursuing agriculture as a career choice. Whilst family and upbringing expose individuals to agriculture, the passion to participate in agriculture is sparked by learning institutions that offer agricultural courses. There are many career opportunities in research and skills development, consultancy and advisory as well as farm management. The results are expected as this is aligned to this research study. Literature on the lack of participation of young people in agriculture cites lack of information about agriculture as one of the reasons why young people shy away from the sector. The participants were able to identify career opportunities only when exposed to agriculture at school.

The second research question sought to unveil the role played by the various institutions interacting with policies and the demand environment in the agriculture value chain in facilitating technology transfer and diffusion of agricultural innovations. The findings revealed the various institutions encompassing public sector and private sector

institutions. Input suppliers, finance providers, learning institutions, research institutions as well as workers' unions are some of the institutions identified. The interaction of these institutions creates an institutional environment that serves as an enabler or barrier to technology transfer and innovation diffusion. The findings revealed some of the mechanisms that facilitate diffusion of innovations. These include knowledge sharing platforms, research and development platforms, strategies implemented for reducing drudgery in farming operations and the facilitation of exposure to agriculture and skills development.

The findings on policies revealed how good policies are on paper but institutions fail to implement them to successfully transform agriculture. One example that was highlighted in the findings relates to policies of rolling out agricultural innovations to small scale farmers are not aligned with the goals of transforming agriculture. Innovations are made available to farmers through government support initiatives. However, the gap between the provision of technology in agriculture and the actual capability of the farmer is inadequately addressed. The policy environment has more barriers than enablers of innovation diffusion and adoption.

The results show that there are more barriers than enablers of technology transfer in the demand environment. The findings explained how social media platforms such as Facebook serves as a platform for question and answer sessions on topics related to agriculture. The gaps identified in the demand environment are knowledge gaps, limited access to factors of production, inadequate innovation platforms and stereotypes and perceptions.

Findings of the third research question revealed activities that must be undertaken to create an institutional environment that enables diffusion and adoption of agricultural innovations. A concerted effort must be made to make agriculture more visible to those outside the sector. Participants were of the view that institutions must take an active role in career expos in schools, review and update the education curriculum to align it with skills required business, facilitate mentoring programs that aim at promoting enterprise development, facilitate exposure of graduates to agricultural value chain to promote skills development. To close off knowledge gaps, farmers must be equipped with the knowledge required for them to successfully implement agricultural technologies. To increase adoption, research and development focus must be geared towards

development of technologies that can adapt to local conditions of the recipients. Policies relating to infrastructure development projects in agriculture must take a participatory approach instead of giving handouts. Policies implemented must promote young people to engage in agriculture. Policies must prioritize facilitation of access to factors of production as well as factors that improve the functioning of value chains such as markets. Agricultural innovations that are labour saving in nature have reduced employment especially of unskilled labour. Interaction of institutions and policies must create an institutional environment that can reconfigure skills by developing manufacturing and maintenance industries to support new technologies adopted in agriculture.

CHAPTER 6: DISCUSSION OF RESULTS

6.1 INTRODUCTION

This chapter will discuss the findings of the research. The aim of the discussion is to find out how much the interpretation of findings presented in chapter 5 is linked to the literature from various authors whose work was presented in chapter 2. The researcher used coding and analysis to deduce findings that either support or oppose the research questions posed in chapter 3. The discussion in this section will link these findings to the overall objective of this research study. For ease of reference, the aim of this research study is to explore key strategies and policy options that can be applied to promote transformation of the agricultural sector so as to attract youth participation in the agricultural value chain.

6.2 RESEARCH QUESTION 1

Do observations of agricultural innovations incite young people to participate in agriculture?

The first research question sought to find out whether exposure to innovations in agriculture had an influence in individuals choosing to pursue a career or start a business in the agriculture sector. As long as young people do not know about how much agriculture has evolved into a modern and complex field with multidisciplinary and diverse career opportunities, their perceptions of agriculture will not change (Turner and Hawkins, 2014). This study proposes that when young people are aware of the positive aspects of agriculture and the related career opportunities, they will consider pursuing agriculture as a career choice. The positive aspects of agriculture can be built by modernizing agriculture through technology transfer and diffusion of agricultural innovations.

6.2.1 Determinants of agriculture as a career choice

This research question was posed in light of the perceptions that young people have about agriculture. Perceptions and attitudes towards the agricultural sector are as a result of lack of information and exposure to the industry (Abdullah and Sulaiman, 2013). The question sought to understand how perceived abilities, expected outcomes and interests developed within this negative environment to influence one into choosing a career in agriculture.

The results revealed that exposure to agriculture was facilitated by family, learning institutions and one's upbringing as well as the social context they grew up in. The knowledge of agricultural innovations came later when the individuals had enrolled for agricultural studies. The findings visually represented in **figure 5** show that the learning experiences that influenced perceived abilities and expected outcomes in participants were developed through educational experience when they took up agriculture as a subject at school, work exposure derived from farming on family fields and peer groups such as family members.

These findings agree with Lent's et al., (1994) social cognitive career theory that posits that learning experiences can emanate from an individual's environment, their context, exposure to various career activities as well as interacting with role models (Turner and Hawkins, 2014). It is important to note that none of the participants chose agriculture because of innovations being used in the sector. This points out to the view that agriculture is less visible to those outside of the sector

6.2.2 Knowledge of career opportunities in agriculture

The perceptions of youth on agriculture are as a result of lack of knowledge on agricultural value chains. Participants were able to identify career opportunities only after they started pursuing careers in agriculture. This brings out the knowledge gap highlighted by Proctor and Lucchesi (2012) that most youths have little knowledge of career opportunities in agricultural value chains. There are careers in on-farm activities (farm management) and off-farm activities (agricultural engineering, agricultural advisor and research scientist). Showcasing career opportunities to young people can contribute to their learning experiences and influence them in choosing careers in agriculture.

6.2.3 Conclusive findings for research question 1

This question sought to find out what sparks one's interest into pursuing a career or starting a business in the agriculture sector. The question asked whether the knowledge of agricultural innovations attracted individuals to choose careers or start businesses in the agriculture value chain. In summary, based on the findings in section 5.3.1.3 and discussion presented in the previous section, the following conclusions can be drawn;

The learning experiences that influenced perceived abilities and expected outcomes in participants were developed through learning institutions when they took up agriculture as a subject at school, upbringing and social context derived from farming on family fields and peer groups such as family members. Innovations in agriculture did not incite any of the participants to pursue careers in agriculture. They did not know about career opportunities in agriculture until they joined the sector.

6.3. RESEARCH QUESTION 2

What are the enablers of agricultural innovation diffusion that can contribute to transformation of the agriculture sector?

The research question examined the institutional, policy and demand environment in SA agriculture. In so doing, factors of institutions, policies, attributes of agricultural innovations and the demand environment that can enable modernization of agriculture were identified.

6.3.1 Innovation attributes

Agricultural innovations are developed to address pain points faced by producers. Senyolo, Long, Blok and Omta, (2018) reported that innovations impact on agriculture by increasing productivity, allowing adaptation and or mitigation to adverse conditions. The findings of this study revealed the following about innovation attributes;

Mechanisation (planters, harvesters) increases efficiency of operations. Drip irrigation is less labour-intensive, increases water utilisation efficiency and reduces labour costs. Controlled environment agriculture mitigates adverse climatic conditions. Automation allows flexibility of operations, reduces labour and energy costs and reduces losses associated with maintenance downtime. Centre pivots are less labour intensive. Soil moisture probes assist with decision making with regard to irrigation scheduling. This increases water utilisation efficiency.

However, these innovations require a huge initial capital outlay to adopt them. In addition, the innovations require technical skills to operate them. Whilst the innovations are less labour intensive, they are more management-intensive. They require effective management to derive the best results out of their implementation. These characteristics of innovations determine the ease of transferability, diffusion and adoption.

These findings revealed how affordability is reducing rate of adoption of agricultural innovations. This finding is supported by Long et al., (2016) who reported that if the cost of the technology is beyond the reach of those that are meant to use the technology, then the transfer and diffusion of such technology is inhibited. This is evident in the findings revealed by participant 8. In the subsistence sector, small scale farmers still use old traditional methods of irrigation because they lack the resources to adopt new water saving technology systems such as drip irrigation system. Farmers who are unable to access funding are unlikely to adopt high-cost technologies (Senyolo, Long, Blok and Omta, 2018).

Farm sizes for small-scale farmers are very small therefore they are less likely to adopt innovations that require large area of land such as centre pivots or combine harvesters. Technologies that require vast pieces of land are less likely to be adopted by recipients who lack such resources (Senyolo, Long, Blok and Omta, 2018). This is a concern if land reform policies will continue to fragment land into small plots. This calls for client orientated research that drives development of innovations suitable for the new conditions. The adoption of innovations that require large area of land such as centre pivots, mechanical planters and harvesters is likely to decrease.

6.3.2 Institutions and the institutional environment

Drawing from the contingent effectiveness model of technology transfer, institutions are the transfer agents whose role is to enable the transfer object (agricultural innovations) to move from technology developers to transfer recipients (other actors within the value chain) through transfer media (mechanisms of innovation diffusion).

Section 5.3.2.3 comprises of various institutions interacting and forming institutional arrangements create an institutional environment that enable the diffusion and adoption of agricultural innovations. The institutions identified are multi-stakeholders involved in agriculture.

The private sector, highlighted by participant 1, is aimed at removing drudgery in farming operations; “It is important that we have embarked on adopting new technologies for production. The aim is to simplify the farm-work for all general employees. We are trying to move away from old dragline irrigation systems in favour of new systems such as drip,

centre pivots and semi-permanent systems so as to make the work much lighter".

The benefits of removing old methods out of agriculture are highlighted by Irungu et al. (2015) who reported on farming programs in Kenya that are spearheaded by young and educated community members who use the radio and social media platforms for sharing knowledge on production technologies, marketing information. On these platforms, peers discuss relevant topics related to agriculture. This has attracted more young people to participate in agriculture value chains

When research institutions and farmers interact and form institutional arrangements aimed at developing client-orientated technologies, the innovations developed will be compatible with local conditions and farmers are more likely to adopt such technologies. Participant 12 reported on breeding programs taking place to develop technologies that will assist fruit producers in improving the quality of their produce.

When institutions actively participate in research and development, an institutional environment that enables development of innovations is created. Providing platforms for development of innovations is another way in which institutions are facilitating diffusion of agricultural innovations. It takes a fruit farmer 3 -5 years to start generating revenues after establishing orchards. Participant 12 highlighted efforts being made by research institutions working with small scale farmers to plant income generating crops in between fruit trees as a way of generating income before fruit trees start bearing fruit.

Value chain development is another mechanism of enabling diffusion of agricultural innovations. The example given by participant 12 focuses on improving the functioning of markets. When institutions find ways of promoting the formation of synergies in small businesses, this enables transfer of skills and solutions that address the pain points faced by such small businesses.

Some institutions are involved in the development of infrastructure that facilitates diffusion and adoption of innovations in agriculture.

An institutional environment that facilitates enterprise development amongst small-scale farmers is a step towards commercialisation and value chain development. This promotes the creation of more off-farm career opportunities in agriculture. This is

important for transforming the sector.

When institutions form alliances to create an institutional environment that facilitate the transfer of technologies, agricultural transformation is enhanced. The findings highlighted collaboration between the research institution and department of social development. Participant 12 commented; "…we can give out fruit trees in addition to the ones given out by social development department". This enables diffusion of fruit tree cultivars that can improve farmers' yields.

Private sector institutions are collaborating with learning institutions to expose university students to agriculture value chains. This promotes skills development. Another example of institutional environment that enables diffusion of innovations is the creation of knowledge sharing platforms. Participant 7 commented that they formed a forum aimed at disseminating agricultural information. When institutions come together to form alliances, this can also facilitate access to resources.

6.3.3 Policies

The results revealed that policies in agriculture are lacking in enhancing agricultural transformation. The dual economy within the SA agriculture sector is highlighted in the responses. The findings revealed that the government has well designed policies on paper but implementation fails to enable transformation of the sector. Participant 12 commented on how government policies push towards giving land to people and not equipping them with skills to work that land.

Policies that promote research and development of technologies that will enhance production in the subsistence sector are inadequate. Sharma (2012) reported that investment in research and development and infrastructure are economic factors that enable innovation that brings continuous technological change to agriculture. Aye, Gupta and Wanke, (2018) assessed the efficiency of agriculture in SA. Their findings revealed that the efficiency of agriculture in SA is enhanced by increasing expenditure in research and development of genetically modified seeds, improvement in fertilizers as well as mechanization and extension support services. Participant 12 reported on research projects undertaken by institutions working together with fruit farmers to develop technologies that enhance quality of their produce. Such an institutional arrangement creates an environment that enables diffusion and adoption of the developed

technologies.

When government implements projects, sustainability of projects is not incorporated into the project implementation plan. Participant 12 highlighted the value derived from using participatory approach when rolling out infrastructure projects to communities. Participant 8 highlighted the downside of giving water saving technologies to farmers who lack the capabilities to successfully implement such technologies on their own. Participant 9 highlighted how government policies overlook young people in promoting development of agricultural value chains. The models used by government to facilitate access to resources create a barrier towards agricultural transformation.

The co-op model highlighted by participant 12 is one such example. A cooperative made up of individuals seeking government funding to pursue agriculture but without the necessary skills required to run farming as a business is less likely to succeed. Participant 6 highlighted government strategy of providing grants to young people as a hindrance to development of agriculture projects. This was echoed by participant 11 whose views disagreed with the objectives of government grants to young people

6.3.4 Demand environment

As technology continues to improve agricultural operations, the knowledge gap continues to widen between skilled and unskilled labour. Agriculture in SA employs unskilled labour to work in menial jobs in the value chain. Increased mechanization and automation have forced many businesses to reduce the number of people employed. Current policies are lacking in developing industry sector to absorb and upskill those coming out of on-farm jobs to be able to work in manufacturing or maintenance of technologies used in agriculture.

Limited access to resources required for meaningful production is hindering agricultural transformation.

Knowledge sharing and innovation platforms are inadequate resulting in minimal dissemination of agriculture information amongst peers. In addition, culture and social context of transfer recipients is hindering innovation diffusion and adoption.

The demand environment is reaping the fruits of immense ICT development and mobile phone penetration through use of social media platforms to share agriculture related

information.

6.3.5 Conclusive findings for research question 2

This research question sought to bring out enablers and barriers of dissemination of agricultural innovations in South Africa by examining the institutional, policy and demand environment.

In summary, the following conclusions can be drawn from the findings presented in section 5.3.2.6 and the discussion of result and literature in the previous section;

Affordability is a barrier to adoption of agricultural innovations. The development of ICT and mobile phone penetration has facilitated knowledge sharing through use of social media platforms to share agriculture related information. The knowledge gap between skilled and unskilled labour continue to increase with as farming operations become more mechanized and automated. This has created opportunities to reconfigure the skills capacity in agricultural value chains.

There are policies developed to focus on agricultural transformation. However, effective implementation of the policies is lacking.

6.4 RESEARCH QUESTION 3

In what ways can enablers of diffusion of agricultural innovations be enhanced to transform the agriculture sector?

The first research question unveiled the determinants that influenced individuals to choose careers in agriculture. The second research question unveiled the factors of institutions, policies, attributes of agricultural innovations and the demand environment that can enable technology transfer and diffusion of agricultural innovations. The third research question sought to examine how the factors raised in question two can be enhanced so as to contribute towards the determinants that influence agriculture career choice indicated in research question one. The question sought to unveil ways that enhance the activities undertaken by various stakeholders in the agricultural value chain to promote youth participation in agriculture.

6.4.1 Role of institutions in technology transfer and diffusion of innovations

A major finding of this study is the need to change the image of agriculture so as to build positive agricultural learning experiences for young people. The image of agriculture is not appealing to young people. Some schools have used agricultural tasks as punishment for pupils that misbehave (Chinsinga and Chasukwa, 2018). Such an experience will deter individuals from considering agriculture as a career choice.

It was revealed in the findings of this study that the sector lacks role models to inspire other people outside of the agriculture sector. Eleven participants agreed that there are no role models in agriculture. One participant acknowledged the presence of role models but highlighted that they are few and not in the limelight. Role models inspire and mould young people into choosing careers. Learning experiences can emanate from interacting with role models (Turner and Hawkins, 2014). Njeru et al. (2015) reported that the average age of an African farmer is between 55 and 70 years old. In South Africa, the average age is 62 years old (Sihlobo, 2015). These are very old people. They lack enthusiasm and capabilities especially in the face of new agricultural innovations. This is why young people perceive agriculture as a profession for the older generation. It is therefore challenging for the older generation to inspire young people to pursue careers in agriculture.

It was revealed in the findings of this study that policies in SA do not really promote participation of young people in agriculture value chains. Young people are tech-savvy and enthusiastic about technology, efficiency and innovations. In the face of evidence from literature on benefits of ICT utilization in agriculture documented by Chavula (2014) and Irungu et al., (2015), policy makers in SA can harness the power of ICT in transforming industries and enhance the utilization of ICT in diffusion of agricultural innovations.

Information communication technology (ICT) serves as the vehicle that facilitates the development and dissemination of technologies used to transform industries (Irungu et al., 2015). For example, Kenya has utilized ICT for agricultural production and marketing and this has changed the perceptions of young people about agriculture (Irungu et al., 2015). The findings for the second research question revealed how social media

platforms are facilitating knowledge sharing amongst peers in agriculture through question and answer sessions.

The findings of this study revealed that the agriculture sector is less visible to those that are not participating in the sector. Kusis, Miltovica,and Feldmane, (2014) reported that some of the perceptions that the youth have about agriculture stem from stereotypes that are reinforced by the media as well as cultural beliefs. Media marketing channels that paint a gloomy picture about agriculture can take advantage of information communication technologies (ICT) to showcase agricultural innovations. This will assist in increasing the prestige of young people taking part in agricultural value chains for example. This view is echoed by Tchamyou, (2017) who reported that effective processing, communication and diffusion of knowledge is facilitated by an adequate and modern information and communication infrastructure.

The participation of private institutions that facilitate experiential learning to university graduates was revealed in this study as an enabler of technology transfer. Furthermore, the findings of this study revealed that agricultural graduates are not equipped with the skills required by industry. Collaboration of private institutions with learning institutions creates an institutional environment that enables diffusion of agricultural innovations. This is one way of addressing gaps in dissemination of knowledge and skills capacity development, as well as addressing the finding on mis-match of skills.

The findings of this study revealed how the education curriculum is not aligned with the skills required by industry. The importance of education in transforming industries was highlighted in the literature review. White (2012) highlighted the gap in dissemination of knowledge resulting from a weak and outdated education curriculum. In their study on determinants of career choice of agricultural professions, Adebo and Sekumade (2013) identified previous educational experience as one of the variables that significantly influenced individuals to pursue careers in agriculture. Snodgrass (2014) posited the concept of the multiplier effect as a necessity for transforming agriculture in sub-Saharan Africa (SSA). His concept considers investment in education and skills training as an income stimulus required to boost producer income and expand productive capacity. Riboud (2015) reported that investing in education and health will assist a nation in building a workforce that can facilitate innovation through research and development and ultimately facilitate the dissemination of knowledge.

Ali, Bashir and Kiani (2015) identified ability and knowledge as enablers of technology diffusion. Their findings revealed the significance of education, research and development and innovation on socio-economic growth and industrial development. Irungu et al. (2015) reported on how education influenced young farmers into participating in value chains of specialty crops with a niche market. Uneducated farmers engaged in traditional crops and methods of farming. Level of education and experience is one of the factors that influence a recipient to decide whether to adopt an innovation or not (Long et al., 2016).

Mellor (2017) identified education as one of the key drivers of transforming agriculture. Education facilitates adoption of new technologies by providing the understanding that is needed to assimilate technical issues. Extension workers and researchers are able to disseminate agricultural technologies to people who can understand and assimilate technical issues (Mellor, 2017). This view is echoed by Tchamyou (2017) who reported that to continuously adapt and upgrade skills necessary for the efficient creation and use of knowledge, a nation requires a skilled and educated work force. In their research on adoption of technologies in aquaculture, Kumar, Engle, and Tucker (2018) reported that educated farmers were early adopters and they efficiently implemented the adopted technologies into their production processes.

Reviewing and updating the curriculum will improve the quality of graduates. The findings of this study revealed how poor the quality of extension services is in the sector. This stems from the skills that the extension workers are equipped with during training in leaning institutions. Some of the graduates assume roles in off-farm jobs such as extension services while others get on-farm jobs such as farm management. If the capabilities of the graduates are aligned to the various innovations used in agriculture, they are able to further promote dissemination of agricultural knowledge. When these graduates become successful in their various roles, this will portray agriculture as an attractive career choice.

The findings of this study revealed that the policies of agriculture in SA focus on giving potential farmers and emerging farmers grants and farming inputs but not skills on how to effectively run their agribusinesses. The findings revealed that some of government's infrastructure developments projects lack sustainability. One example given is the roll

out of irrigation systems to assist farmers with efficient water management technologies. However, due to the management-intensive nature of the technologies, farmers lack the capabilities to effectively run these irrigation systems. Sharma (2012) argues that investing in agricultural research and development, education and infrastructure is more effective in increasing agricultural growth than providing input subsidies. This view is supported by literature highlighted in the previous section on significance of education in transforming industries.

6.4.2 Role of policies in technology transfer and diffusion of innovations

Education on its own is not enough. There is need to promote entrepreneurship in agriculture. This was revealed in the findings of this study. Getting exposure on various activities taking place in the agricultural value chain did not really equip the graduates with entrepreneurial skills. The findings revealed that graduates prefer to be employed in agriculture than to start their own business ventures. This puts pressure on employment opportunities in the agriculture sector. Mentoring and enterprise development were highlighted in the results as some of the ways of imparting entrepreneurial skills to graduates.

Government must be heavily invested in research and development of innovations that address the pain points that the small-scale farmer is facing. The findings of this study revealed the need for research and development focus that is geared towards locally developed technologies that can adapt to farmer's local conditions. Affordability was highlighted as a barrier of diffusion and adoption of agricultural innovations.

Policies must implement research and development that is focused on locally developed technologies that can adapt to farmer's local conditions. Inadequate funding and lack of government involvement in research are some of the issues raised regarding research and development. The dual economy nature of the SA agriculture landscape was highlighted with regards to research. Even when technologies are developed by research scientists, the subsistence sub-sector and other emerging farmers cannot access these technologies due to financial constraints. Private institutions and the commercial sector access these technologies and patent them. Public policies must chip in on this regard.

6.4.4 Conclusive findings for research question 3

This question sought to examine enablers of diffusion of agricultural innovations that can be enhanced to transform the agriculture sector. Based on the findings and discussions presented in chapter five, the third research question sought to examine how the factors raised in question two can be enhanced so as to contribute towards the determinants that influence agriculture career choice indicated in research question one.

Therefore, the results indicate the integration of model of constructs presented in **figure 1.** The interaction of institutions, policies, innovation attributes and the demand environment can create conditions that enable transfer and diffusion of agricultural innovations. The institutional environment created will promote transformation of the agricultural sector and attract young people to engage in agricultural career opportunities presented in the value chain. The policies in agriculture lack effective implementation to transform agriculture. There is a mis-match of skills between graduates coming out of learning institutions and skills require by industry.

6.5 CONCLUSION

In chapter one of this study, a business problem in terms of lack of transformation of agriculture was presented. The agriculture industry is portrayed as backward and labour intensive with traditional methods of farming. Young people have a negative attitude towards the sector. Agriculture has evolved into a complex field with multidisciplinary and diverse career opportunities. However, agriculture as a sector has failed to adequately promote itself. As long as young people do not know about how modern agriculture has become, their perceptions of agriculture will not change. This study went on to examine how the institutional environment created by the interaction of institutions, innovation attributes, demand environment and policies is enabling technology transfer and diffusion of innovations as a means to transform agriculture.

At the beginning of the research study, the researcher presented in figure 1 a model of interaction of constructs. The proposition suggested the interaction of institutions, demand environment, policies and innovation attributes to facilitate technology transfer and diffusion of agricultural innovations so as to bring about agricultural transformation. This study defined a transformed agricultural sector as a sector that attracts participation of young people in agricultural value chains either as knowledge workers or entrepreneurs.

Firstly, the research study unveiled the determinants that influenced individuals to choose careers in agriculture. The image of the agriculture sector is negative and unattractive. There are modern agricultural technologies in use by private sector institutions. However, the agriculture sector is not visible to people who are not participating in the sector. The findings of this research study revealed that people are not influenced to pursue careers in agriculture because of the exciting technologies in agriculture. Instead, they lack of knowledge of agricultural innovations used in the sector until they start participating in agricultural value chains. The results supported the view that learning experiences have an impact on an individual's perceived abilities and expected outcomes thereby influencing their career choice. The findings of this study revealed that learning experiences were derived from family, learning institutions and social context during upbringing.

Secondly, the study unveiled the barriers and enablers of technology transfer and diffusion of agricultural innovations by examining the interaction of institutions, policies, attributes of agricultural innovations and the demand environment.

The enablers of innovation diffusion and adoption are; education, role models, mentoring, public-private collaboration, ICT development, participatory infrastructure development, policies that promote research and enterprise development and institutions that facilitate effective extension, financial, technical and research support services.

The barriers that restrict innovation diffusion adoption are; skills-mismatch, policies that give grants, inadequate funding to research institutions, lack of policies geared towards agricultural youth programs and working in silos.

The development of ICT coupled with penetration of mobile smart devices has led to creation of social media knowledge sharing platforms. However, knowledge sharing is hampered by institutions that work in silos. Innovations increase the rate at which operations are completed.

The latest agricultural innovations require less labour, allow flexibility in management, mitigate risk associated with erratic climatic conditions, reduce labour costs and reduce

response time to downtime. However, initial capital investment to acquire most of the agricultural innovations is high. Therefore, innovation diffusion and adoption rates are low amongst financially constrained farmers. Some government policies have addressed this barrier by procuring the innovations of behalf of the farmers. However, this has not solved the problem of promoting effective adoption of the innovations. The recipients of these technologies lack the capabilities required to effectively implement the adopted technologies into their production processes.

Some private institutions have formed alliances with learning institutions to facilitate exposure to activities taking place in the agricultural value chain. These institutions offer hands-on experiential training to university students. Whilst this has been hailed as an enabler of technology transfer, the experience has failed to cultivate an entrepreneurial mindset in the students. The graduates want to be absorbed into career opportunities in public and private institutions rather than starting their own agribusinesses and alleviate the pressure on employment opportunities. There is inadequate mentoring and entrepreneurial skills development to promote commercialisation and enterprise development.

Learning institutions contribute towards development of human capital necessary for the effective diffusion and adoption of technologies. However, learning institutions churn out graduates annually who are not adequately equipped with skills required in the industry. The agricultural courses offered to students are based on curriculum material that is not aligned with the agricultural innovations used in the industry. The quality of extension workers is poor and this means they cannot successfully serve the needs of a farmer. This contributes to the negative perceptions that farmers have about the capabilities of extension workers.

There is inadequate research and development taking place especially in the subsistence sub-sector. Research institutions are inadequately funded. Research scientists work with farmers to develop new technologies meant to solve problems faced by farmers. This ensures that adaptation of the innovation to the local environment. However, due to cost involved in research, only the resourceful commercial farmers are able to access these technologies and patent them to their advantage. This creates a barrier for the financially constrained farmers.

Finally, the research study sought to examine how the factors raised in the second research question can be enhanced so as to contribute towards diffusion and adoption of agricultural innovations. This would lead to a transformed agricultural sector and contribute towards the determinants that influence agriculture career choice indicated in research question one.

To dispel the negative perceptions that young people have about agriculture, there is need to expose them to agriculture in schools and communities that they live. This can be done through career expos and platforms that showcase modern technologies used in agriculture.

The findings of this study revealed public and private institutions mandated to promote agricultural development. Such institutions must collaborate with research institutions to identify the type of innovations required and then fund research into the development of the innovations required. The same institutions can also fund entrepreneurs to build manufacturing businesses locally to bring down the high cost of innovations as well as reconfigure skills to cater for those displaced by mechanisation in on-farm jobs. This promotes commercialisation and enterprise development.

The mismatch of skills resulting from agriculture courses offered by learning institutions curriculum that are not aligned with skills require in the industry can be addressed by reviewing and updating the curriculum. Learning institutions can collaborate with the private sector in designing a comprehensive curriculum that is up to date with technologies used in the industry. This can also be used as a mechanism to drive research and development. The collaboration of private and public institutions can also be used as a mechanism to foster mentoring and entrepreneurial skills development.

Chapter 7: Conclusion and Recommendations

7.1 Introduction

A discussion of the major findings of this study will be given in this chapter. Furthermore, the contribution of this study to literature and implications for management will be discussed. Finally, conclusion and recommendations for further research will be given.

7.2 Principal Findings

This study examined the institutional environment created by the interaction of institutions, policies, innovation attributes and demand environment in facilitating the transfer, diffusion and adoption of agricultural innovations. The main objective was to determine the enablers and barriers of effective transfer, diffusion and adoption of agricultural innovations.

In section 1.3 of this study, a description of past studies that revealed findings on young people's negative perceptions about agriculture was presented. Past research revealed findings that point towards young people's perceptions about the industry being time consuming (Ahaibwe, Mbowa and Lwanga, 2013; Anyidoho, Leavy and Asenso-Okyere, 2012; Leavy and Hossain, 2014; Ivanic and Martin, 2018; Naamwintome and Bagson, 2013). Some youth perceive agriculture jobs as physical and back-breaking industry (Chinsinga and Chasukwa, 2018; Eissler and Brennan, 2015; Naamwintome and Bagson, 2013). Other young people view agriculture careers as financially unrewarding (Abdullah and Sulaiman, 2013; Chinsinga and Chasukwa, 2018; Leavy and Hossain, 2014).

The reasons for the negative perceptions of young people on the agricultural sector are derived from traditional farming methods used, the stereotypical image portrayed by media, and the outdated education curriculum in learning institutions that offer agricultural science courses (Chinsinga and Chasukwa, 2018; Eissler and Brennan, 2015; Kusis, Miltovica, and Feldmane, 2014; White, 2012).

Tiraieyari and Krauss, (2018) recommended the need for policies that promote investment in modern technologies to reduce drudgery and increase agricultural productivity. The provision of training that matches the skills demanded in the job market will improve the image of the sector (Leavy and Hossain, 2014). Douglas, Singh, and

Zvenyika (2017) recommended policy makers to promote extensive use of modern technology and infrastructure in agriculture so as to make the sector attractive to young people. Literature had not addressed the determinants of effective transfer, diffusion and adoption of agricultural innovations. This study helped fill that gap by exploring factors of the agricultural institutional environment that enable or restrict effective transfer, diffusion and adoption of agricultural innovations.

7.2.1 Synthesis of research findings

The findings of this research resonate with those found in literature that; a) learning experiences that influence agricultural career choice are derived from an individual's environment, their social and economic context, exposure to various career activities or interaction with role models; b) the development of technology on its own is not sufficient to address the constraints identified in industries. The creation of an enabling institutional context will enhance diffusion and adoption of technologies.

This study aimed to unveil factors that influenced individuals to participate in the agriculture value chain either as entrepreneurs or as knowledge workers. The researcher's model of construct interactions was developed on the premise that knowledge of agricultural innovations used in the agriculture sector incites young people to pursue careers in agriculture.

The findings of this study revealed that people lack knowledge of career opportunities in agriculture. The industry is not visible to people who are not involved with any agricultural activities. However, learning experiences acquired from agricultural studies at school and interacting with peers that are participating in agriculture influenced individuals to choose careers in agriculture. In addition, upbringing in farming environment influenced individuals to choose careers in agriculture.

Another objective of this study was to examine factors of institutions, demand environment, innovation attributes and policies that enable or restrict the transfer, diffusion and adoption of agricultural innovations. The enablers of innovation diffusion and adoption are; education, role models, mentoring, public-private collaboration, ICT development, participatory infrastructure development, policies that promote research and enterprise development and institutions that facilitate effective extension, financial, technical and research support services.

The barriers that restrict innovation diffusion adoption are; skills-mismatch, policies that give grants, inadequate funding to research institutions, lack of policies geared towards agricultural youth programs and working in silos.
The findings resonate with findings presented in literature on the role played by an institutional environment in facilitating diffusion and adoption of technologies.

Another objective of this study was to use the identified enablers and barriers to derive a recommendation for creating an institutional environment that facilitates the transfer, diffusion and adoption of agricultural innovations. Facilitating career expos and platforms that showcase modern technologies used in agriculture can enhance the image of agriculture and dispel the negative perceptions that young people have about agriculture.

Collaboration of research institutions and private institutions mandated to promote agricultural development can enhance client orientated research and development of innovations. This will address the problems of inadequate funding in research institutions. Focus of financial support services should be directed towards funding entrepreneurs to build manufacturing businesses locally to bring down the high cost of innovations as well as reconfigure skills to cater for those displaced by mechanisation in on-farm jobs. This promotes commercialisation and enterprise development.

Mismatch of skills can be addressed by reviewing and updating the curriculum. Collaboration of learning institutions with the private sector in designing a comprehensive curriculum that is up to date with technologies used in the industry can address this problem. Such alliances are instrumental in driving research and development, as well as fostering mentoring and entrepreneurial skills development.

7.2.2 Contribution to literature

Based on the principal findings presented in section 7.2.1, the first part of this research drew from social cognitive career theory to gain an understanding of factors that influenced individuals to pursue careers in agriculture. The findings of this research have added to literature on determinants of agricultural career choice and social cognitive career theory. The second part of this study drew from Bozeman's contingence model of effective technology transfer. The findings revealed that the effective transfer, diffusion and adoption of agricultural innovations requires the interaction of institutions with

policies, demand environment and taking innovation attributes into consideration to create an enabling institutional environment.

7.3 IMPLICATIONS AND RECOMMENDATIONS FOR MANAGEMENT

7.3.1 Implications

This study offers insights into enablers of transfer, diffusion and adoption of agricultural innovations as a means to transform agriculture. The findings of this study can assist the business fraternity in developing policies and interventions that can promote youth involvement in the agricultural sector thereby improving the economic competitiveness of the sector.

The most important implication of this study is the need to build positive agricultural learning experiences for young people. This means that as young people interact with family, go through learning institutions or get agricultural work exposure in their communities, they must be able to draw positive and successful narratives about modern agriculture.

The current policies focus on involving young people in farming activities. A typical agricultural value chain broadly illustrates other career opportunities in agriculture besides primary production. Policy reforms should be drawn to reflect and support the development of skills beyond primary production. Policy reforms must aim at facilitating infrastructure development through participatory approach and not give handouts. There must be infrastructure that develops manufacturing of innovations closer to the recipients so as to promote industrialization in the sector. Locally made innovations are more likely to be compatible with local conditions of the farmer and therefore increases not only the cost of technologies but the adoption rate too (Long et al., 2016)

Recipients must be equipped with adequate skills and knowledge that allows them to successfully implement technologies transferred to them.

7.3.2 Recommendations

This research study focused on dimensions of the institutional environment as constructs to explore enablers of diffusion and adoption of agricultural innovations as a means to transform agriculture. These dimensions can be further broken down to increase depth

of analysis. For example, an in-depth analysis of the curriculum content of institutions offering agriculture courses and compare to skills required in the industry. This could enhance the finding on skills mismatch in agriculture labour market.

The SA agricultural landscape was described as a dual economy. Further research can make a comparative study on institutional environment between subsistence and commercial sector. The study can examine the institutional environment in the commercial subsector and compare it to the institutional environment in the subsistence sector. This could enhance findings on the factors affecting the effective transfer, diffusion and adoption of agricultural innovations.

The model of construct interaction presented in this study was built on the premise that transforming the agriculture sector will attract young people to pursue careers in agriculture. There is no study to confirm that modernizing agriculture will promote youth engagement in agriculture. The basis of this proposition is the research findings on reasons for negative perceptions. Further research could investigate this phenomenon.

One of the findings of this study is that agricultural skills imparted onto young people do not promote an entrepreneurial mindset. Future research could investigate what drives individuals engaged in agriculture to stay in a profession as an employee versus advancing into entrepreneurship.

7.3.3 Limitations

Data for this study was collected from five participants from Mpumalanga, four participants in Gauteng, two participants from KwaZulu Natal and one participant from Limpopo. The other five provinces of South Africa were not represented. Whilst the institutions might be the same across the provinces (Government, research and private businesses), the institutional environment created in the various geographical locations might differ. To address this, the accuracy of the self-reported data can be verified through objective methods of data collection or models developed from past research of similar studies (O'Keeffe, Buytaert, Mijic, Brozović and Sinha, 2016). This can be achieved by undertaking further research that focuses on a sample representative of all levels of the agriculture value chain and from all regions of South Africa.

Whilst the information collected through the semi-structured interviews is useful to policy

makers involved in the development of the agriculture sector, the information is more applicable to the scale at which it was collected. This is because of the differences in the social and economic contexts of different nations (O'Keeffe, Buytaert, Mijic, Brozović and Sinha, 2016). This means the information collected is useful to agriculture as a whole but more applicable to the South African context.

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Appendices

Appendix 1: Informed Consent Form

INFORMED PARTICIPANT CONSENT LETTER

Changing youth perceptions: Exploring the enablers of transfer, diffusion and adoption of agricultural innovations in South Africa

Dear Participant

My name is Olynne M'zara. I am currently registered for a Master's in Business Administration with the University of Pretoria, Gordon Institute of Business School (GIBS) and am presently working on my final year research project. I am conducting research on entrepreneurs and knowledge workers in the agricultural sector. My research aims to get an in-depth understanding of how agricultural innovations can be transferred and diffused in a bid to transform the agricultural sector. The purpose of this research study is to look into how the enablers of diffusion of agricultural innovations can be scaled so as to make the agriculture sector attractive thereby promoting youth participation in the sector. Our interview is expected to take approximately an hour. If you agree, the interview will be held face to face or through the use of web conferencing services (such as Skype) in the case were a face to face interview is not possible. The interview will be audio recorded and transcribed.

Your participation is voluntary and can be withdrawn at any time without any penalty.

All data collected will be reported and stored without identifiers and will be secured according to the highest standards of data security. Should you have any queries, please note that you may either contact the researcher or supervisor. Our details are provided below:

Researcher:	Supervisor:
Olynne M'zara	Wynand Herbst
Email: 17410356@mygibs.co.za	Email: wyherbst@gmail.com

Gordon Institute of Business Science
University of Pretoria

Tel: Tel:

Name of participant:

_____

Signature of participant: _____

Date: _____

Name of researcher:

_____

Signature of researcher: _____

Date: _____

Gordon Institute of Business Science
University of Pretoria

Appendix 2: Interview Guide

Interview Guide

Participant number: Start time:

Date: End Time:

Job Title:

Thank you for agreeing to this interview, I appreciate your input into my MBA research study.

My research is on entrepreneurs and knowledge workers in the agricultural sector. My research aims to get an in-depth understanding of how agricultural innovations can be transferred and diffused in a bid to transform the agricultural sector. The purpose of this research study is to look into how the enablers of diffusion of agricultural innovations can be scaled so as to make the agriculture sector attractive thereby promoting youth participation in the sector. I would like to encourage you to speak freely. All data would be kept confidential. Neither the identity of yourself, nor your company will be recorded. Would you please sign the consent form and also confirm that you are happy for me to record the interview?

Questions

1. Could you give some detail on how you got exposed to agriculture as a career choice?

- Family background
- Studies
- Side Hustle
- Relationships
- Interest evoked by exposure to agriculture and the various innovations

2.1 Where along the agricultural value chain are you placed?

- Producer
- Trader
- Processor
- Retailer
- Research and Support services

2.2 Who do you interact directly with in the value chain? What projects are you working on? /What do you do?

2.3 What are the various roles played by the actors in the value chain towards the transfer and adoption of agricultural technology?

- Provision of credit/investment loans/Institutional, productivity and natural resource management innovations
- Provision of skills training/experiential training

2.4 How does your organisation/business support or get involved in development and transfer of agricultural innovations?

3.1 In what way has the agriculture sector changed over the years since your career/business in agriculture began?

- Demographics-diversity in race, gender and age
- Drudgery-R and D, new agricultural innovations
- Resource allocation-access to finance, land, investments, markets

3.2 How do these changes impact on supply and demand for skills and opportunities for young people?

- Education and skills gap
- Public-Private Partnerships

4.1 How far is South Africa from achieving an agriculture sector that can create decent employment and rural community development? **OR** What do you consider as the main problems affecting young people's abilities to get good jobs in agriculture or to start /run their own agri-businesses? An analysis of the following;

- Institutions
- Policies
- Markets
- Attributes of agricultural innovations

5. In what ways are various players in the Agriculture sector contributing towards the transformation of the sector in a bid to promote enterprise development and participation of the youth? Contribution of the following;

- Institutions
- Policies
- Markets

Appendix 3: Ethics clearance letter

Gordon
Institute
of Business
Science
University
of Pretoria

26 October 2018

M'zara Olynne

Dear Olynne

Please be advised that your application for Ethical Clearance has been approved.

You are therefore allowed to continue collecting your data.

Please note that approval is granted based on the methodology and research instruments provided in the application. If there is any deviation change or addition to the research method or tools, a supplementary application for approval must be obtained

We wish you everything of the best for the rest of the project.

Kind Regards

GIBS MBA Research Ethical Clearance Committee

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Appendix 4: Final Codes

Code	Code Groups
Policy environment	Agric Innovation adoption gaps
Perceptions	Agric Innovation adoption gaps
Culture	Agric Innovation adoption gaps
Access to resources	Agric Innovation adoption gaps
Institutional environment	Agric Innovation adoption gaps
Institutional arrangements	Agric Innovation Diffusion mechanisms
Knowledge sharing platforms	Agric Innovation Diffusion mechanisms
Infrastructure development	Agric Innovation Diffusion mechanisms
Stakeholder alliances	Agric Innovation Diffusion mechanisms
Incentives, rewards and recognition	Agric Innovation Diffusion mechanisms
Gaps in modernization of agriculture	Agricultural Transformation
Outcomes of effective technology transfer	Agricultural Transformation
Demystify Agriculture	Agricultural Transformation
Commercialisation and enterprise development	Agricultural Transformation
Skills capacity development	Agricultural Transformation
dual economy existence	Agricultural Transformation
Education curriculum development	Agricultural Transformation
career opportunities available	Agricultural value chain
Knowledge Sources of exposure to agriculture	Agricultural value chain
Knowledge development gaps	Agricultural value chain
Knowledge Lack of exposure and knowledge about agriculture	Agricultural value chain
Efficiency improvement between value chain players	Agricultural value chain
Value chain development	Agricultural value chain
Agriculture value chain exposure	Agricultural value chain
Development of technologies to solve pain points	Innovation
Attributes of the innovation	Innovation
Entrepreneurial orientation	Innovation
Research & Development, Innovation platforms	Innovation
Object types of agricultural innovations	Technology transfer
Skills dissemination Private sector institutions	Technology transfer
Skills dissemination Collaboration of Institutions	Technology transfer
Skills dissemination Public institution	Technology transfer
Mentoring	Technology transfer
Barriers	Technology transfer
Knowledge dissemination institutions	Technology transfer
Education Institutions	Technology transfer