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The interaction between the changing agri-food supply chain systems and smallholder farmers of Gauteng, South Africa

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A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration

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ABSTRACT

The research proposes to evaluate the interaction between the “changing agri-food supply chain systems” and smallholder farmers of Gauteng Province and challenges and opportunities for their integration into mainstream agri-industrialized markets.

The objectives of the research were:

- to evaluate perceptions of Gauteng small-holder farmers to the changes in agri-food supply chain systems of South Africa
- to determine challenges and opportunities of Gauteng smallholder farmers `s integration into mainstream agri-industrialized and formal markets such as contract farming

A survey questionnaire was designed utilising a seven-point Likert scale and administered to the targeted respondents for the collection of data. The questionnaire comprised of various questions and statements representing the constructs as well as questions aimed at collecting various demographic data. The data was analysed using descriptive statistics which includes factor analysis and analysis of variance. The results of the analysis were used to answer each research proposition as well as to formulate findings and recommendations.

The main findings of this research showed that 42% of the farmers surveyed had understanding of business strategies comprised of appropriate production plans and marketing plans. 34% of farmers surveyed demonstrated understanding of the changing nature of the agri-food supply chain with regard to technology, globalisation & other factors driving change. 20% of the farmers surveyed had the knowledge and understanding of contract farming and had at least participated in such a contract once. In relation to knowledge of quality assurance pertaining to food safety, traceability and grading standards; only 16% of the farmers surveyed had the knowledge of certification programs such as GlobalGAP and HACCP. The same percentage of farmers was found to have worked with marketing agents in selling their produce.

It was furthermore determined that large proportion of smallholder farmers (62%) preferred to market their products through alternative food supply networks such as farmers markets and 70% believed in community supported agriculture.

Specific recommendations were developed for the smallholder farmers. Additional set of recommendations were developed to specify the role that government and industry can play in contributing to the development of smallholder farmers. Key recommendations are centred on development of various programs which address:

- Business management and entrepreneurial skills development
- Increasing number of smallholder farmers who becomes accredited and compliant with good standards & grades, food safety and quality assurance programs such as GlobalGAP and HACCP.
- Assisting smallholder farmers to exploit their comparative advantage in alternative food supply networks through increased platforms such as farmers markets, building local and regional brands which consumers can associate with geographically.
- Government must facilitate value-chain development with regard to ensuring smallholder farmers participation. State institutions must serve as major market points for produce of small farmers.
- Both supply side and demand-side agro-industry must contribute to assisting farmers with support services (e.g. access to information on improved crops, better pest management practices and products, improved product handling, changes to buyer requirements) to mitigate changes in the food supply chain.
- A program to assist smallholder farmers with increased production infrastructure to attain economies of scale where smallholder farmers are currently producing to maximum capacity is encouraged. This should include post-harvest handling facilities.
- Government must consider tax-incentivising large agro-processing companies and large retailers to source their products from smallholder farmers' co-operatives.

DECLARATION

I, Motlatjo George Makaepea, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

_____
Motlatjo George Makaepea

Signed at_____

On the _____ day of _____2013

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I wish you all countless blessings

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1 INTRODUCTION

1.1 Purpose of the study

The purpose of this research is to evaluate and analyse the interaction and impact of changing agriculture food supply chain on smallholder farmers of Gauteng Province, South Africa. The commercial success of smallholder farmers is perceived to be low due to challenges ranging from low productivity, access to factors of production such as capital, land and entrepreneurial ability. The agri-business sector is increasingly becoming vertically integrated and dominated by large processing and food retailing corporations who have preference to buy produce from large farms. The study aims to determine the business strategies adaptation and strategic choices that can be undertaken by smallholder farmers to remain commercially viable. The perception of challenges that impede smallholder farmers to become integrated in the formal agri-food supply chain as viewed by Gauteng Province smallholder farmers, the food processing and food retail sector would be evaluated.

1.2 Context of the study

South Africa has a dual agriculture system with a well-established medium to large commercial farms dominated by white farmers and a gradually developing smallholder farming sector dominated by the black majority. The Agriculture, Forestry, and Fisheries sectors contribute R66 billion to the economy which is equivalent to 2.7% of the country's Gross Domestic Product (GDP) in 2009 (Department of Agriculture Forestry and Fisheries 2010). The exact contribution of developing farmers to the GDP in many agricultural subsectors has not been clearly defined and continues to be the subject of various agricultural economic studies.

There is no denying the significance and role of smallholder farmers in the local agricultural food supply chain coupled with their linkages to mitigating rural

household poverty and food insecurity. The commercial success of smallholder farmers in South Africa has been the subject of an ongoing debate with speculation of failure rates and causes varying from institutions to institutions. Despite investments of the South African government such as R1.393b in grants from Department of Rural Development and Land Reform (DRDLR Annual Report 2009/10:28) and Provincial Departments of Agriculture (PDAs) through various agricultural development programs aimed at assisting smallholder farmers, there appears to be limited rate of commercial success in many smallholder farming enterprises. This raises the questions as to whether are the smallholder farmers in interacting with the agri-food supply chain in an entrepreneurial approach that would enable them to identify threads and new opportunities as they arise.

The key drivers of change in the agricultural sector in South Africa and globally which the smallholder farmer needs to adapt and the consequences of that change have been outlined by Nell and Napier (2005). They highlight the drivers of change as:

- a strong shift from a production-driven to a market-driven agriculture
- restructuring of world agriculture due to globalisation and growth of Multinational Companies (MNC)
- a volatile situation with changing government policies around the world influencing trade prospects
- a wave of new technologies
- a growing list of consumer demands such as food safety, convenience, etc
- Environmental concerns.

The consequences of the drivers of change are

- Industrialisation of agriculture through contract farming
- The development of alternative food systems to the industrialized model such as traditional foods, farmer`s markets, etc
- Strong pressures leading to a small number of larger farms
- A challenge to add more value to farm products (Nell and Napier 2005)

The nature and extent of the changing structure of agri-food supply chain offer unprecedented opportunities for diversification and value addition in agriculture, particularly in developing countries such as South Africa. According to Da Silva and Baker (2009), the prospects for continued growth in demand for value added food and agricultural products constitute an incentive for increased attention to agro-industries development within the context of economic growth, food security and poverty-fighting strategies.

Da Silva and Baker (2009) furthermore caution that accelerated growth of agro-industries in developing countries also poses risks in terms of equity, sustainability and inclusiveness. They highlight the point that when there is unbalanced market power in agri-food chains, value addition and capture can be concentrated among one or a few chain participants, to the detriment of others. They furthermore points to the fact that establishing and maintaining competitiveness constitute a particular challenge for small and medium-scale agro-industrial enterprises and small-scale farmers. In conclusion, they highlight an additional concern that to the extent that smaller, resources poor farmers are left out of supply chains, the socio-economic benefits of agro-industries are potentially reduced. Therefore, a need exists for policies and strategies that, while promoting agro-industries, take into account issues of competitiveness, equity and inclusiveness (Silva and Baker 2009)

Twyman C, Sporton D, and Thomas D S G (2004) conducted a viability study of smallholder farming on the margins of the Kalahari, Southern Africa and they coined a phrase which says “where is the life in farming” which was a question that was directly posed to them by a smallholder farmer in the Kalahari. It is with this context of a situation where smallholder farmers find themselves competing in a dualistic farming sector with a well established commercial farming sector characterized by economies of scale and vertical integration by large food corporations that this study seeks to explore challenges and market opportunities of the smallholder farmers in this changing agri-food supply chain environment.

The phrase ‘where is the life in farming’ raised a broader question about the sustainability and viability of the future of small-medium scale farming systems in rural areas in Africa (Twyman, Sporton et al. 2004)

1.3 Problem statement

1.3.1 *Main problem*

The research proposes to evaluate the interaction between the “changing agri-food supply chain systems” and smallholder farmers of Gauteng Province and challenges and opportunities for their integration into mainstream agri-industrialized markets.

1.3.2 *Sub-problems*

The first sub-problem is to evaluate perceptions of Gauteng small-holder farmers to the changes in agri-food supply chain systems of South Africa

The second sub-problem is to determine challenges and opportunities of Gauteng smallholder farmers `s integration into mainstream agri-industrialized and formal markets such as contract farming

1.4 Significance of the study

The study fills a gap in the application of available theory towards development of smallholder farmers through mitigating challenges of agri-industrialization and globalization in the local conditions. The local agri-business sector characterised by a dualistic agricultural sector of large historically successful commercial farming enterprises and less successful smallholder farming enterprises is a challenging environment.

The study will provide guidance to the smallholder farmers in terms of appropriate response mechanisms which may include adjustments of business strategies and need to amend operational plans to the changing environment of agri-

industrialization and thereby increasing their own chances of market access and commercial sustainability. Additional guidance will be provided to government in terms of how it can enhance or alter some of its current policies, agricultural development strategies and programmes towards ensuring that the current landscape does not prejudice the smallholder farmers but enhances their chances to succeed in their enterprises. The local food processing and retail sector will gain additional insight in terms of ensuring successful interaction with the smallholder farmers.

1.5 Delimitations of the study

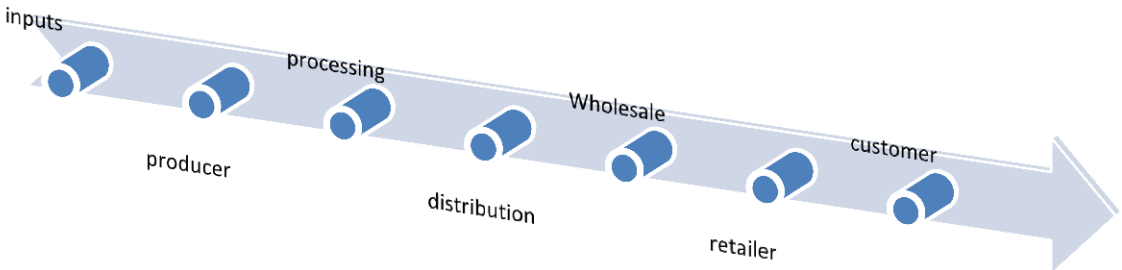


Figure 1: A basic agri-food supply chain system

- The study will predominantly address the demand side of the agri-food supply chain (from farm produce leaving the farm gate to customers) and not the input side of the chain such as access to inputs such as seeds and fertilizers.
- The study will incorporate agri-logistics issues related to marketing, transport as part of transaction costs

- The study will exclude financial analysis of individual smallholder farmers
- The study will not incorporate large-scale commercial farmers
- The study will asses smallholder farmers within the subsectors of grain crops and vegetables only and will exclude animal commodities such as poultry and livestock
- The study will exclude subsistence farmers that produce for home consumption solely but concentrate on those producing for the sake of earning income and livelihoods from food crop production
- The study will only be limited to South Africa `s Gauteng province only.

1.6 Definition of terms

Agri-food system refers to the entire vertical chain of activities: from production on the farm, through processing, distribution, and retailing to the consumer - in other words, the entire spectrum, from farm gate to plate, regardless how it is organized or how it functions (Chen 2004)

Agro-industrial Sector is defined as the subset of the manufacturing sector that processes raw materials and intermediate products derived from agriculture, fisheries and forestry. The agro-industrial sector is taken to include manufactures of food, beverages and tobacco, textiles and clothing, wood products, furniture, paper, paper products and printing, rubber and rubber products. Agro-industry forms part of the broader concept of agribusiness that includes suppliers of inputs to the agricultural, fisheries and forestry sectors and distributors of food and non-food outputs from agro-industry. (Henson and Cranfield 2009)

Contract farming which describes pre-agreed supply agreements between farmers and buyer. The agreements usually specify the purchase price and how it will relate to prevailing market prices, and may also include terms on delivery dates, volumes and quality. In many cases the buyer, which is generally an agri-processing company commits to supply upfront inputs, such as credit, seed,

fertilisers, pesticides and technical advice, all of which may be charged against the final purchase price. In summary, there is a wide range of contract farming deals, from informal verbal purchase agreements through to highly specified outgrower schemes around large estates (Vermeulen and Cotula 2010)

Co-operative is an autonomous association of persons united voluntarily to meet their mutual economic, social and cultural needs and aspirations through a jointly owned and democratically controlled enterprise organized and operated on co-operative principles. An **agricultural co-operative** is a co-operative that produces processes or markets agricultural products and supplies agricultural inputs and services to its members

"Commercial farmer" means a farmer producing primarily for market purpose and makes a living from farming. The farmer is considered commercial when income exceeds the minimum economic size (Department of Agriculture Forestry and Fisheries 2010)

Farm means a portion or portions of agricultural land as defined in the Subdivision of agricultural Land Act, 1970 (Act No. 70 of 1970) of the Republic of South Africa;

Farmer-owned businesses are formally incorporated business structures for farmers to pool their assets to enter into particular types of business (e.g. processing or marketing), gain access to finance, or limit the liability of individual members. Such businesses are often owned by co-operatives in order to facilitate business transactions. (Vermeulen and Cotula 2010)

GlobalGAP is a private sector body that sets voluntary standards for the certification of agricultural products around the world. To gain successful certification growers and producers need to meet high standards in a number of areas from record-keeping to site management, soil management, fertiliser usage, irrigation, crop protection, harvesting, post-harvest treatments, water and pollution management, recycling and re-use, worker health, safety and welfare and environmental issues. Meeting all these comprises Good Agricultural Practice (GAP)(Sutherland 2008)

Hazard Analysis and Critical Control Points (HACCP) is a systematic preventive approach to food safety. It addresses physical, chemical and biological hazards as a means of prevention rather than at the point of a finished product inspection. HACCP is used in the food industry to identify potential food safety hazards, so that key actions, known as Critical Control Points (CCPs) can be taken to eliminate the risk of the hazards being realised. The system is used at all stages of food production and preparation processes. (Sutherland 2008)

High value agricultural commodities are defined as agricultural goods with a high economic value per kilogram, per hectare, or per calorie, including fruits, vegetables, meat, eggs, milk and fish. (Gulati *et al*, 2005)

Joint ventures entail co-ownership of a business venture by two independent market actors, such as agribusiness and a farmers' organization. A joint venture involves sharing of financial risks and benefits and, in most but not all cases, decision-making authority in proportion to the equity share.(Vermeulen and Cotula 2010)

Management contracts refer to the variety of arrangements under which a farmer or farm management company work agricultural land belonging to someone else. Management contracts may take the form of lease or tenancy, but carry the connotation of stewardship, of managing the land on behalf of the owner. To provide incentives for the farm management, the contract often entails some form of profit-sharing rather than a fixed fee. (Vermeulen and Cotula 2010)

Smallholder farmer means a medium sized farmer who produces food markets as well as for home consumption. This category of farmer is intermediate between subsistence and commercial farmer

Subsistence farmer means a farmer who due to resource constraints and limited technology produces food to supplement households' food needs with little or no selling of produce to the market. For the purpose of this scheme, farmers/ projects that benefitted from departmental programmes will be categorized as small scale.

Tenant farming and sharecropping are versions of management contracts in which individual farmers, for example smallholders, work the land of larger-scale businesses or other farmers. In tenant farming the usual arrangement is a fixed rental fee while in sharecropping the landowner and sharecropper split the crop or its proceeds along a pre-agreed percentage. (Vermeulen and Cotula 2010)

Value-added food is used to characterize food products that are converted from raw product through processes that give the resulting product an “incremental value” in the market place. An “incremental value” is realized from either higher price or expanded market. For example, jams, cheeses, and pre-cooked meats are considered “value-added” products

Upstream / Down stream business links is an umbrella expression for the set of business opportunities beyond direct agricultural production that exist for both agribusiness and small holders and small local enterprises.

1.7 Assumptions

The following assumptions have been made regarding the study:

a. That the smallholder farmers and beneficiaries of the agri-business land reform farming enterprises will be available to share their knowledge, as well as their understanding of perceptions and challenges experienced in relation with the changing agri-food supply chain systems
b. That there will be adequate literature on the interaction of smallholder farmers with the changing agri-food supply chain in relation to South African conditions
c. The targeted respondents will be sufficient in the province to provide a fair analysis and representative of the general smallholder farmers in the country
d. That the respondents will respond honestly and truthfully to questions that will be posed to them during interviews.

2 LITERATURE REVIEW

2.1 Introduction

This section of literature review would explore available literature with respect to the current state of smallholder agri-businesses in terms of how it is impacted by the changing nature of the agri-food supply chain. Interaction of smallholder farmers with various concepts such as shifting food consumption, urbanization, globalization and agri-industrialization will be reviewed. This will furthermore include studies on the influence of factors of production and business strategies at farm level and related challenges.

2.2 Characterisation of smallholder farmers within the South African context

'Smallholder farming' is commonly used to describe the size of the landholding or livestock owned. According to Narayanan and Gulati (2002), a smallholder would thus normally derive his/her livelihood from a holding of less than 2 to 5ha and approximately 10 – 20 livestock

The definition of smallholder farmers in South African context has often been associated with race of black farmers more than the size of the landholding and the extent of the agriculture enterprise as it is the case globally. In the same token, Commercial farming has been associated with white farmers irrespective of the size of the landholding or the size of the livestock owned. According to Mmbengwa.V.M., Gundidza, M, Groenewald,J A and H D van Schalkwyk (2009), The classification of agri-business in South Africa is not according to the definitions outlined in the "National Small Business Act 102 of 1996" which classifies business enterprises according to small, micro and medium enterprises (SMME). They argue the fact that current classification system is not based on size and volume. (Mmbengwa, Gundidza et al. 2009)

In accordance with the South African norms, smallholder farming will for the purpose of this research refer to black farmers who are producing for the purpose of selling their produce and earning a living from it. Other names which are still been used to describe black commercial orientated farmers include “developing farmers, resource poor farmers and emerging farmers”.

The concept of smallholder farming should be characterized to suit specific regions more than attempts to seek a universal definition. It should reflect the key characteristics of smallholder farmer as someone practicing a mix of commercial and subsistence production or either where the family provides the majority of labour and the farm providing the principal source of income. In Asian countries, small farms support the needs of 1.3 billion (Narayanan and Gulati 2002)

In examining questions of social and environmental sustainability with regard to smallholder farmers, the binary dualisms of industrial/sustainable and small/large have been useful in analyzing unequal patterns of food access and security, and the processes underlying the globalization of food and agriculture. For advocates of farmland preservation, organic agriculture, community supported agriculture, and small family farms, this conceptual dualism has allowed for a space of self-definition, organization, political advocacy, and educational efforts in response to the dominance of industrialized agriculture within local, national and international food networks (Jarosz 2000)

The debate as to how the smallholder would fare in a liberalized agricultural context has emerged as an important issue in recent times and follows basically two strands. On the one hand, there are those who believe that if prices increase in response to liberalization, it would impact favorably on small farmers since they would benefit from higher producer prices and incomes. On the other hand, there are those who claim that since the rural poor are often net-consumers of food, adjustment programmes that increase the prices of tradable commodities (food) would squeeze real incomes of small farmers who are net-buyers. Still others acknowledge that the impact of adjustment or liberalization cannot be determined

by looking merely at the consumption bundle or their relative prices in isolation. (Narayanan and Gulati 2002)

2.3 Globalization and the "changing nature of agri-food supply chain systems"

Globalization is a multi-dimensional phenomenon – ranging from trade liberalization to cultural and political change (Reardon and Barrett 2002, Narayanan and Gulati 2002). In reality, the process of globalization can impact small farmers in complex ways – both directly and indirectly and can be organized into two broad categories as outlined in Table 1 below:

***Global Drivers*:** These refer to factors that have been the driving forces of globalization, like multilateral trading agreements, etc. These have precipitated fundamental and large-scale changes in policy orientation of hitherto closed economies;

Meta-Trends: These are changes taking place all over the world, independently of the globalization process yet, shaping the very nature of globalization. These include trends in technology, consumption patterns, structure of agri-business, etc, that occur both globally and also as more localized shifts.

Table 1: Global drivers and meta-trends (Narayanan and Gulati, 2002)

Global drivers	Meta-trends
Trade liberalization	Technological change
Intellectual Property rights	Urbanisation, Increasing incomes,
Food Safety & Quality Standards	Population pressure
Foreign Direct Investment	Shifts in food consumption patterns
Scale of Agro-Industry	Environmental degradation

2.3.1 *Typologies of food systems*

McCullough E.B, Pingali P.L and Stamoulis K.G (2008) describes through Figure 2, three different typologies for food systems that correspond roughly with the development process.

- The first is a **traditional food system**, characterized by a dominance of traditional, unorganized supply chains and limited market infrastructure.
- The second is a **structured food system**, still characterized by traditional actors but with more rules and regulations applied to marketplaces and more market infrastructure. In structured food systems, organized chains begin to capture a growing share of the market, but traditional chains are still common.
- The third type is an **industrialized food system**, as observed throughout the developed world, with strong perceptions of safety, a high degree of coordination, a large and consolidated processing sector and organized retailers.

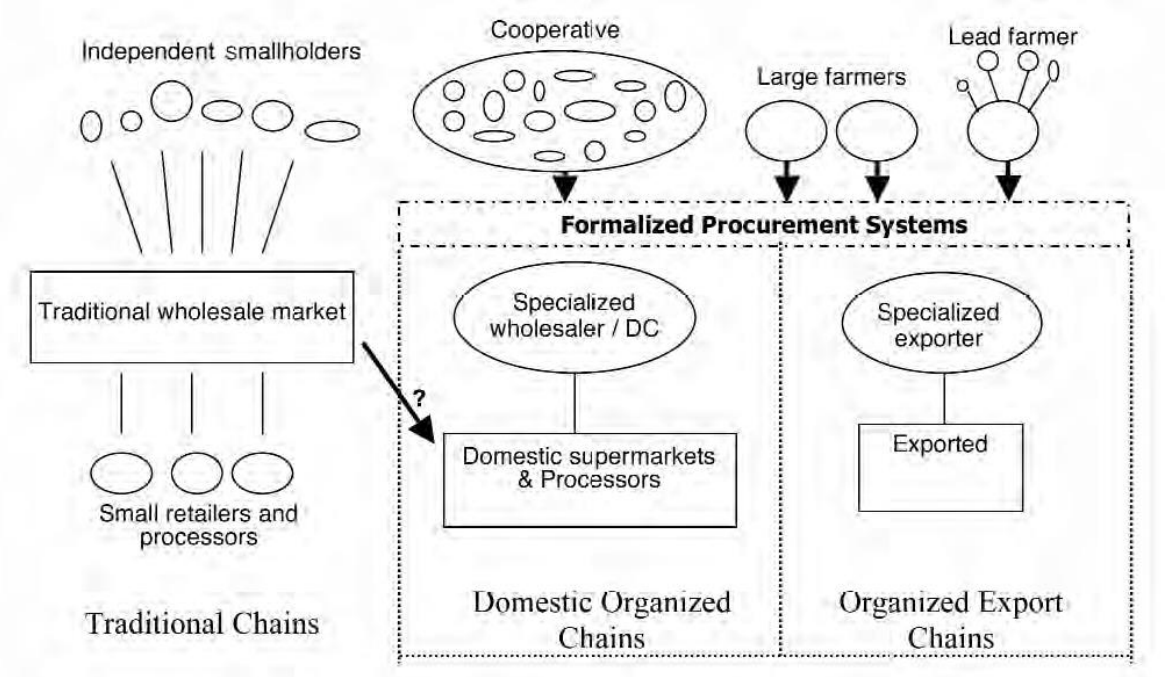


Figure 2: Interactions between traditional and organized chains in modernizing food systems (McCullough *et al*, 2008)

South Africa is a classical case of a structured food system (type two) which still has a large presence of traditional markets but is increasingly drifting towards industrialized food system (Type 3 Agri-industrialization). There is clear and increasingly dominant role being played by highly concentrated agro-industrial firms and retailers.

Chen (2004) raises the fact that most notable change within the Agri-food supply chain is the rapidly changing food distribution systems worldwide. The **key indicators of the change** can be summarized as follows:

- Rising modern retail outlets such as supermarket, fast food and other food services
- Increasing vertical partnerships and horizontal alliances
- Greater market segmentation
- Availability of range of goods at market
- Brand marketing
- Strong presence of Multinational Corporations (MNCs) in processing and retailing
- International purchasers / agents

2.3.2 *Agri-industrialization and its impacts on smallholder farmers*

"Agri-industrialization" is comprised of three related sets of changes:

(1) the growth of agro-processing, distribution, and farm-input provision activities off-farm

(2) Institutional and organizational change in the relation between agri-industrial firms and farms, such as increasing vertical coordination; and

(3) Concomitant changes in the farm sector, such as changes in product composition, technology, and sectoral and market structures (Reardon and Barret 2000)

The 1990s brought relatively rapid and intense agri-industrialization in many low- and middle-income economies. In the face of so recent a phenomenon, there are inevitably many gaps in our understanding of how and why these changes occur, and what agri-industrialization implies for development.

Henson and Cranfield (2009) alludes to the fact that there are technological advances both generally (most notably information and communication technologies) and, specific to the agro-industrial sector, in primary production (e.g. the application of biotechnology) and manufacturing sectors (e.g. new processing methods). These technological advances are serving to create new and unprecedented opportunities for agro-industrial enterprises in terms of product and process innovations, vertical and horizontal linkages with supply chains as well as the functioning of distributional systems. They emphasis the fact that this advances will result with many small agro-industries left behind if they are unable to gain access to these technologies in a timely and cost effective manner.

According to Readon and Barret (2000), Henson and Readon (2005), growth in domestic demand for processed foods provides a viable route towards value addition for agro-industrial enterprises. However, more liberal trade in agro-food products is also exposing domestic agro-industrial enterprises in developing countries to enhanced competition, both domestically and internationally. They argue that successful businesses of the future must have the competencies required to compete in this more dynamic and liberal world. The competencies entails their ability to embrace technological innovations, increased scale of operations, coordination vertically and horizontally through encompassing new governance forms, food safety, grades and quality standards as well as Intellectual Property rights and contracting.

For smallholder farmers to supply an agro-industrial enterprise or any large-scale retailing outlet, they are not exempt with regard to satisfying requirements of food safety, standards and quality. Henson and Reardon (2005) gives an indication that standards are ubiquitous in market economies and play a fundamental role in the organization of supply chains for most products and services including traditional

marketing systems. They also function as instruments of risk management by standardizing product requirements over suppliers, acting to reduce the transaction costs and risks associated with procurement.

Locally, leading agro-processing companies such as McCain Foods and large retailers such as Pick'n Pay chain stores and Shoprite have adopted the use of certification programmes and quality assurance standards of Global Good Agricultural Practices (GlobalGAP) and Hazard Analysis and Critical Control Points (HACCP). Grades and quality standards are the minimum entry requirement for higher-value markets.

Recognising that certification can be an expensive business, GlobalGAP has developed what is known as 'option 2' which aims to assist small producers. This makes provision for group schemes in which a group of farmers working with a joint management plan can join forces and apply for group certification under GlobalGAP. The advantages are that the cost of certification per farm is lower and it also encourages collective action. On the other hand the failure of one grower to adhere to good agricultural practice could result in the entire group losing its certification. (Sutherland 2008)

Opportunities for market access have increased with the introduction of 'option 2' which is helping to ensure that small-scale farmers internationally are able to become compliant with the GlobalGAP standard, and thus reach large and important markets that they would otherwise be excluded from. Sutherland (2008) furthermore cites examples of Thailand, where 'option 2' is bringing large number of small farmers into the export economy. This is seen as a national priority and Thailand is aggressively growing its fresh produce exports.

The impact of supermarkets on small contract farmers in Madagascar was measured utilizing primary data collected by Minten et al (2006).They found that almost 10,000 farmers in the Highlands of Madagascar produce vegetables for supermarkets in Europe on contract basis. The coordinating company Lecofruit was receiving great tax-incentives from government for this effort.

In this global food supply chain, small farmers' micro-contracts are combined with extensive farm assistance and supervision programs to fulfill complex quality requirements and phyto-sanitary standards of supermarkets. Small farmers that participate in these contracts have higher welfare, more income stability and shorter lean periods. They also found significant effects on improved technology adoption, better resource management and spillovers on the productivity of the staple crop rice (Minten, Randrianarison et al. 2006). Such successes of contracting at micro-level are still to be determined with regard to their existence in Gauteng.

Are smallholder farmers in Gauteng Province aware of this certification schemes, are they having the potential and ability to successfully interact with agro-industries locally and internationally. Are they in a position to meet these requirements to supply large retail outlets? These questions are fundamental to the economic viability of smallholder farmers. One self-introspective question by smallholder farmers is that with the continued challenges of limited production capacity, specialized technical competencies and volatile market dynamics due to increased vertical integration, technological advancement and market liberalization. What are their chances of remaining economically viable?

What do smallholder farmers have to do to access the market of specialized wholesalers (e.g. Shoprite Supermarkets `s Freshmark)? And in order to compete with specialized wholesalers, will traditional wholesalers (e.g. Johannesburg Fresh Produce Market) impose standards that lead to exclusion of smallholders? As retailers begin to pull a meaningful share of the wholesale market into distribution centres, what are the implications for smallholder farmers?

The degree of duality between the traditional and specialized wholesale systems will determine, in part, whether the transformation of food systems threatens to squeeze smallholders out of the system altogether or just to prevent them from taking part in the most lucrative opportunities, thus imparting distributional effects. The differences between traditional and specialized wholesalers with respect to

prices and standards will affect farmers' decisions on where to market their produce, along with other aspects of the point of sale that are explored below. There is evidence that specialized wholesalers can offer higher prices than traditional ones for produce that meets their standards but as discussed below, the cost of complying with standards can eat into this price differential for smallholder farmer. Furthermore, the price differential may decrease over time as more and more producers in a location are capable of meeting exacting standards (E B. McCullough, Pingali et al. 2008)

Vorley, Lundy and MacGregor (2009) alludes to the fact that modernization of domestic markets in developing countries has been driven by a wave of investments in emerging economies by domestic and transnational food manufacturers and retailers over the past two decades. They argue that these changes are generating an intense political debate particularly with regard to the opportunities facing small farmers and rural poor. (Vorley, Lundy et al. 2009)

This assertion is supported by the 2008 World Bank Development Report which points to the fact that in many transforming economies, where the majority of the rural poor live, the rising urban-rural income gap accompanied by unfulfilled expectations create political tension. The report further points to the fact that there are risks in opening up markets, where domestic businesses may be by-passed by cheaper imports and where costly market entry requirements favour the better resourced. It highlights that if modernization and globalization are patchy, and do not reach the 'bottom of the pyramid' to deliver a growth and equity 'win-win', then the prospects for meeting the Millennium Development Goals (MDGs) by 2015 are remote. The 2008 WDR calls for action in response to the modernization of procurement systems in integrated supply chains and supermarkets, so that smallholder farmers can share in these growth opportunities (World Bank 2008)

2.3.3 *Research Proposition 1*

The nature of change characterizing global and South African food chain systems and the context in which the smallholder farmers is challenged by this wave of change raises the following research propositions;

- That the smallholder farmers have business strategies to succeed in a commercialized agri-food supply chain environment.
- That the smallholder farmers are aware that the agri-food supply chains is changing to become globalised and more vertically integrated and they need to adapt.

2.4 The challenges and opportunities of smallholder farmer‘s integration into mainstream agricultural markets.

2.4.1 Challenges and dynamics of accessing formal market

A market, broadly defined, is any setting in which sellers exchange goods and services with buyers. Needles to say, actors within the market space interact on the basis of clearly defined rules of exchange which generally entails an agreement on price, quality, quantity, delivery time, and so forth. Society `s well being is positively correlated with the rise and growth of markets.

Jacobs (2008) highlight the point that in order for smallholder farmers to raise the efficiency of their productive activities, they need to integrate into a system of market relations. What drives this result is the competitive pricing mechanism which automatically regulates how markets work. In other words, prices naturally and instantaneously adjust to efficiently allocate resources to the most productive activities and market actors.

Market development is a more flexible concept which stretches across a wider terrain of issues. One part of this concept covers how and why markets became established in specific socio-economic contexts in the past. The transformation of agriculture has arguably been one of the most important outcomes following the creation and expansion of markets in the economic history of countries or regions of the globe. As this market-based system solidified into the foundation of a society, farming also became incorporated into a fully-fledged exchange based activity. Studies that look at market development for smallholders from this historical angle, contribute to our knowledge of markets in at least two ways (Jacobs 2008).

Firstly, these studies counter the idea of the ‘timeless existence of markets’ which is popular in mainstream economic analyses of markets. Furthermore, this perspective of markets is also useful for a second reason, which is closely related to the first. It stresses that real-world markets are far from being agent-neutral institutions but, on the contrary, are arenas in which powerful economic agents can wield considerable control (Jacobs 2008)

Market access for producers to supply chains does not have much to do with classical notions of efficiency’. Rather, market access is a feature of the ability to exploit marketing advantage, meeting large processor and supermarket demands for consistency of supply (reliable, quality), speed of response, compliance with standards, and payment of fees. Coordination by supermarkets of their supply chains raises the requirements for farms and firms to stay in the market. For instance, the example of grape production in Brazil, Vorley (2001) notes that although production costs are lower and quality higher among small-scale producers, marketing advantage accrues to large-scale producers through their better access to postharvest cold storage and refrigerated transport services.

In Latin America, as well as Europe and North America, there is a growing tendency for supermarkets and processors to use this form of coordination to source sub-regionally or regionally, and occasionally extra-regionally rather than locally or nationally. As buyer power increases, so barriers to entry for smallholders to markets other than for basic commodities become more daunting (Vorley 2001).

Small farmers often lack the strong and direct relationship with the market enjoyed by large-scale producers, such as contracts with processors or supermarkets. Buyers preferentially contract with larger farms and firms that can meet these demands, because they deliver lower transaction costs and risk. Smaller farmers with little land and capital see little benefit from the investments needed to achieve the quality and efficiency required to meet the expectations of an agribusiness processor, even in the unlikely event that they can raise the capital. Smaller farmers also present higher per unit costs for contractors, and have greater

problems meeting stringent quality and safety requirements (Reardon and Barrett, 2000).

Smallholder farmers must overcome “real access gap” of being able to cost effectively, transport their produce, before being able to address “market efficiency gap” that revolves around been competitive with better organized, better informed, better capitalized and larger scale producers.

Gulati et al (2005) points to the fact that two instruments appear critical to break this deadlock for the smallholders: physical infrastructure (such as information technology, roads, and ports) that connects smallholders to markets, and a set of accompanying institutions that reduce marketing risk and transaction costs in the process of exchange between producers and consumers. Appropriate policies of investment in infrastructure need to go together with well-functioning market institutions, to take advantage of market opportunities to sustain increased agricultural output and raise rural incomes. This is a critically important for smallholders in countries recently experiencing market liberalization. Even if adequate hard infrastructure exists, farmers capture little of the value that they create when market information and markets themselves are not accessible to the smallholders.

Previous conventional wisdom had it that institutions would improve as a consequence of individuals’ self interest, and therefore take care of the transaction cost problems arising from information asymmetries. The reality is in that the presence of coordination failure, innovation failure, and authority failure, the necessary institutional solutions to overcome high transactions costs facing smallholders fail to emerge. The high risks of production and cycles of over-supply and price depression create financial risks throughout the distribution chain; these inhibit investment and access to capital. The high costs, risks, and “friction” in high-value agricultural markets prevent these markets from achieving sufficient scale for efficiency and similarly prevent the low-cost and reliable supply of production inputs such as seed, fertilizer, and other goods to farmers. Very poor farmers also

lack the political empowerment, market knowledge, and business knowledge to address these market roadblocks (Gulati, Minot et al. 2005)

2.4.2 Business models that allows smallholder participation in contract farming

Vermelulen and Cotula (2010) have outlined models for structuring agricultural investments with specific focus to business models that provide opportunities for smallholder farmers. They classified the business models under six broad headings namely:

- **Contract farming** which describes pre-agreed supply agreements between farmers and buyers
- **Management contracts** which refers to the variety of arrangements under which a farmer or farm management company work agricultural land belonging to someone else.
- **Tenant farming and sharecropping** are versions of management contracts in which individual farmers, for example smallholders, work the land of larger-scale businesses or other farmers.
- **Joint ventures** entail co-ownership of a business venture by two independent market actors, such as agribusiness and a farmers' organization.
- **Farmer-owned businesses** are formally incorporated business structures for farmers to pool their assets to enter into particular types of business
- **Upstream / down stream business links** is an umbrella expression for the set of business opportunities beyond direct agricultural production that exist for both agribusiness and small holders and small local enterprises. (Vermeulen and Cotula 2010)

Vorley et al. (2009) cautions against a perception of high transaction costs and increased risks with purchasing from large numbers of fragmented small farmers. They clearly articulate the fact that while the business case for trading with smallholder producers is being called into question, experience in the field

suggests that a convincing business case for models that are inclusive of small-scale producers can be made beyond efforts to promote corporate social responsibility (CSR), based primarily on securing supply and reducing costs. A diversified supplier base, including smallholder producers, can contribute to improved security of supply. Smallholder producers can also have a comparative advantage in terms of produce quality, innovation, costs and farm management.

Vermeulen and Cotula (2010) found that no single model emerges as the best possible option for smallholders in all circumstances. Rather what works best for smallholders while still being very attractive to investors is context-specific, and is contingent on tenure, policy, culture, history as well as on biophysical and demographic considerations. By their very nature, these arrangements link two sets of players namely agribusiness and smallholders with very different negotiating power, which has direct implications for the design and implementation of the arrangements.

Prowse (2012) reviewed 35 “successful” cases of contract farming compared with 9 “failed” cases globally. The five major findings were that:

- Smallholder farmers tend to be excluded in dualistic agrarian economies, but enjoy greater participation rates when inequality in landholding sizes is low.
- That contract participants display significantly higher incomes than nonparticipants
- Crops that exhibit a high degree of variation in quality, perish easily, are hard to grow, or command a higher price per kg, may well be more likely to be grown on contract terms; however, there is also some evidence to suggest that ordinary and standard commodities can also be grown successfully via contract farming.
- Contract farming arrangements are usually entered into by large firms.
- Contract-farming initiatives are most likely to supply markets in developed countries, and supermarkets within urban centers in developing and emerging economies.

Furthermore, attempts to supplement a typology of contract-farming models derived from the literature and the findings thereof suggested that:

- Centralised models are used for conventional staple crops, in addition to crops with large variations in quality, a high-degree of perishability, technically difficult production, and a high value-bulk ratio.
- Nucleus-estate models tend to stick to crops with large variations in quality, a high-degree of perishability, technically difficult production, and a high value bulk ratio. Such arrangements do not appear suited to fair-trade or organic certification, and are often the preferred model for resettlement or transmigration programmes.
- Tripartite models take the form of a public-private partnership and tend to focus on crops with a national significance. All models of this type appear to focus on products with lower variations in quality, perishability and value-bulk ratios than the two previous models.
- Informal models of contract farming appear to be best-suited to fruit and vegetable crops that require minimal processing , or which are processed on the farm, have limited variations in quality and rely on standard production techniques. Such arrangements appear to provide a limited range of inputs; since firm size tends to be smaller than with the above models, the informal model partly relies on other providers (such as the state and NGOs) to offer inputs, such as extension and credit.
- Intermediary models appear to be particularly suited to staple food crops, and can be run successfully in many different country contexts. Indeed, this model may be particularly suitable for challenging contract-enforcement contexts. Outsourcing the interaction with farmers allows smaller firms to use this approach. A limited range of inputs are provided, and this models appears popular for production requiring fair-trade and organic certification (Prowse 2012).

The last three forms of models (tripartite, informal and Intermediary) seems to be ideal for Gauteng smallholder farmers to can participate effectively, however, their success remains depended on various factors which includes buyer preferences as opposed to supplier preferences.

2.4.3. Opportunities for smallholder farmers in alternative food networks

The term Alternative Food Networks (AFN) is used as a broad embracing term to cover newly emerging networks of producers, consumers, and other actors that embody alternatives to the more standardized industrial mode of food supply. The three categories of alternative food network or short food supply chains (SFSCs) are organic farming, quality production and direct selling. The SFSC concept is more specific than AFNs, and rather, covers (the interrelations between) actors who are directly involved in production, processing, distribution, and consumption of new food products (Renting, Marsden et al. 2003)

Describing and mapping organic, small-scale agricultural practices relationally through food networks and supply chains embeds them in regional communities. Local appellation, quality, and organic methods of production mark local food networks that are made up of small-scale sustainable production systems, organic food, farmers markets, food cooperatives, and community supported agriculture. These networks also bring industrial and organic, large-scale and small-scale food producers, brokers, retailers, and consumers together spatially and socially through their relations and interactions within regional agri-food networks (Jarosz 2000)

In view of the competition that smallholder farmers are exposed to from large scale farming sector as a result of a dualistic farming system, should they limit and focus all their attention on supplying their products through alternative food networks as opposed to making attempts towards accessing formal markets, this research intends to weigh further their options in this particular regard.

2.4.4. Research Proposition 2

It is evident from the literature review that the implications for the vast mass of smallholder farmers in South Africa and many developing countries are due to agri-industrialization sobering. Therefore it can be deduced that for the smallholder

farmers to significantly improve their incomes per capita in the future, they must either be part of the shift to high value agricultural production or increase the share of income they get from non-agricultural sources

In the midst of the challenges already reviewed, are there opportunities for smallholder farmers' integration into mainstream agri-industrialised markets. The study proposes that:

- That Gauteng smallholder farmers should be capacitated to influence buying patterns of large food processors and retailers to become active participants of contract farming
- That Gauteng smallholder farmers should furthermore pursue alternative food supply chain networks (Informal markets) such as farmers markets and direct selling to consumers

2.5 Conclusion of Literature Review

Several studies which have been the subject of literature review of this research report (Reardon and Barrett (2000), Narayanan and Gulati (2002), Twyman *et al* (2004), Jacobs (2008), McCullough *et al* (2008), are all in agreement to the fact that food supply chain systems are changing from been purely traditional to been highly industrialized and subsequently controlled by large processing and retail corporations such Pick`n Pay, Shoprite, Woolworths here in South Africa.

However, there has not been consensus on the benefits and integration of smallholder farmers in this changing food supply chain. Minten et al (2006) have reported a successful case study on integrating large number of smallholder farmers whilst the number of unsuccessful cases and the related causes such as price risks, high transaction costs and poor farmer organisations are more than adequate.

Perceptions of Gauteng smallholder farmers to this changing scenario of food supply chain as well as the need to determine factors which would lead to successful contract farming agreements or active participation in the alternative food supply chain are the focus of this research proposal. The below research

propositions will assist to sought answers to the research problems already identified.

2.5.1 Research Proposition 1:

The nature of change characterizing global and South African food chain systems and the context in which the smallholder farmers is challenged by this wave of change raises a number of propositions which are as follows;

- That the smallholder farmers have business strategies to succeed in a commercialized agri-food supply chain environment.
- That the smallholder farmers are aware that the agri-food supply chains is changing to become globalised and more vertically integrated.

2.5.2 Research Proposition 2:

In the midst of the challenges already reviewed, are there opportunities for smallholder farmers' integration into mainstream agri-industrialised markets. The following research propositions would be tested:

- That Gauteng smallholder farmers should be capacitated to influence buying patterns of large food processors and retailers to become active participants of contract farming
- That Gauteng smallholder farmers should furthermore pursue alternative food supply chain networks (Informal markets) such as farmers markets and direct selling to consumers

3 RESEARCH METHODOLOGY

This section outlines the methodology that was used to conduct this research. The section incorporates discussion of research methodology and design and in particular the research instrument that was utilised to collect primary data from a sample of Gauteng smallholder farmers.

3.1 Research methodology / paradigm

The study used a quantitative research methodology for the purpose of gathering primary data to answer research questions. A survey questionnaire was developed and it is attached as Appendix A. The format and structure of the questionnaire is an adaptation of the research done by McLeay, Martin & Zwart (1996), Hoffman (1999) and Arnold (2005).

A survey is a popular method used to collect primary data, and it is able to evaluate attitudes, perceptions and behaviour. The researcher with the assistance of enumerators posed a series of questions to willing participants.

The responses were summarized with percentages, frequency counts, and further more a more sophisticated statistical index such as Factorial analysis were conducted, inferences about a particular population from the responses of the sample were drawn.

In order to ensure appropriate modification of the variables, questions included in the questionnaire were finalised after a study of the literature review and having identified key strategic dimensions and underlying themes. (McLeay, Martin et al. 1996), (Hoffmann 1999), (Arnold 2005).

Preliminary interviews were conducted with a maximum of four smallholder farmers, and additional inputs to improve the questionnaire were sourced from agricultural managers in the food wholesale sector, processing sector, retailers and government. .

3.2 Research Design

The research design was in the form of a non-experimental design. A survey was undertaken through the completion of a questionnaire attached as Appendix B. The questionnaire was administered to smallholder farmers in the 3 regions of Gauteng province as demarcated by the Gauteng Provincial Department of Agriculture and Rural Development (GDARD). The regions are:

- Randfontein region (includes Tarlton, Westonaria and Carletonville)
- Pretoria Region (includes Bronkhorspruit and Hammanskraal)
- Germiston region (Includes Springs, Heidelberg and Vaal area)

The advantage of this approach was that a high number of inputs were sourced from various smallholder farmers participating in the research. The disadvantage is that farmers were sometimes sensitive to demographic questions such as determining the category of income into which their enterprises can be classified. That is the reason why the item on annual income was subsequently deleted from the questionnaire.

3.3 Population and sample

3.3.1 Population

A population of smallholder farmers in Gauteng is relatively smaller in relation to other provinces of South Africa. The total number of commercially orientated smallholder farmers on the database of Gauteng Provincial Department of Agriculture and Rural Development, (GDARD) was recorded to be 1059 at the time of the study of which 617 (58%) are smallholder farmers' of grain crops and vegetables . The population (N) for this research project was therefore 617.

3.3.2 Sample and sampling method

A purposeful or targeted sampling was deployed with the aim of collecting primary data from the grains crops and vegetable smallholder farmers only. A review of the Krejcie & Morgan (1970) cited by Hoffman (1999) table for determining the sample (s) size for research activities gave a useful parameter in this extract:

Population (N)	**Sample (s) (%)**
700	248 (35%)
750	254 (33%)

The above numbers suggests that the lower the population group the higher the percentage of sampling would be appropriate. Therefore, for this study the sample size appropriate for a population of 617 determined at 35% was found to be 220.

Table 2: Target number of respondents per each region of Gauteng province

Population group (Smallholder farmers in 3 regions of Gauteng Provincial Department of Agriculture)	**Number to be sampled (s=220)**
Randfontein region (includes Tarlton, Westonaria and Carletonville)	70
Pretoria region (includes Bronkhorspruit and Hammanskraal)	70
Germiston region (Includes Springs, Heidelberg, Vaal area)	80

3.4 The research instrument

A survey questionnaire was designed and administered to the targeted respondents. The questionnaire is attached as Appendix B and uses the Seven-point Likert rating scale. The questionnaire was comprised of questions and statements representing the constructs as well as questions aimed at collecting various demographic data.

Table 3: An example of a Seven point Likert Scale used in the questionnaire

A statement that is put as a question to the respondent	Strongly Disagree	Disagree	Partially Disagree	Neutral	Partially Agree	Agree	Strongly Disagree
	1	2	3	4	5	6	7

The strategic dimension of the questionnaire includes:

- planning and production capacity focus,
- farmer awareness of trends in the food supply chain,
- understanding of market practices and dynamics thereof,
- capacity to participate in contract farming,
- vertical integration within own enterprise
- And alternative food supply chain systems.

The questionnaire was piloted to four smallholder farmers first and it was then decided to remove the demographic term for “annual income”. It was observed that farmers were very much uncomfortable with that question.

According to Leedy & Ormond (2001), the use of a pilot study to test the validity and reliability of measurement instrument developed for a specific purpose and never previously tested or used in practice is essential.

3.5 Procedure for data collection

The process of administering the survey required the researcher to utilise the internship learners in the Gauteng Provincial Department of Agriculture and Rural Development as enumerators. The internship learners collected the data during farm visits and farmers study groups meetings that were undertaken with Departmental Agricultural Advisors in the three regions of Gauteng province as described in Table 2 above. It was explained to the farmers that they are not under any obligation to be interviewed and that the objectives and goals of the interview are primarily for study purposes. Data was collected from the farmers who agreeing to be interviewed.

3.6 Data analysis and interpretation

The data from the returned questionnaires was captured using Excel spreadsheet. It was analysed using SPSS statistical software. Controls such as assessing missing values was undertaken to ensure that all the data was captured correctly

Analysis methodologies that were used include:

- The use of descriptive statistics to analyse the profile and characteristics of the respondents' population was undertaken.
- Factor analysis was utilised to examine the strength of the overall association among the variables, and to account for the association with a smaller set of linear objectives (Malhotra 1996A). Furthermore, Malhotra (1996A) points to the fact that in factor analysis, there is no distinction between dependent and independent variables, rather the whole set of interdependent relationships between variables is examined to identify underlying dimensions or factors. The factor analysis programme of SPSS based on the principal component analysis technique was utilised.

3.7 Limitations of the study

- The sampling of up to 70 respondents per each region of Gauteng Department of Agriculture and Rural Development as described in the sampling was not exactly proportioned to the number of farmers in each region.
- The varying education levels of the respondents in relation to the understanding of the questionnaire
- There may have been an element of bias in the responses perceived by the respondents that the researcher may influence the support they receive from government.
- The choice of surveying crop farmers only is a major limitation to the study as there are significant amount of agri-food supply chain dynamics in the animal production sector that would not be covered by the study.

3.8 Validity and reliability

Validity relates to the extent to which the data collection method or research method measures what is supposed to measure (Lancaster 2005). It refers to the "accuracy" meaningfulness and credibility of the research project as a whole (Leedy & Ormond, 2001: 103). The research effort must allow the researcher to draw meaningful and defensible conclusions from the data (Leedy and Ormrod 2001)

It is essential that both internal (the ability to draw conclusions) and external (the ability to draw valid generalisations) validity is achieved in the measurement process. The validity of a measuring instrument is the extent to which the instrument measures what it is supposed to measure (Leedy and Ormrod 2001)

3.8.1 *External validity*

The researcher must have confidence that the conclusions drawn are warranted from the data collected (Leedy and Ormrod 2001)

3.8.2. *Internal validity*

Internal validity refers to a situation where the researcher has confidence that the conclusions drawn are warranted and collected. To insure internal validity with regard to this study, the researcher has engaged with colleagues, peers and the supervisor to ensure that the research questions have been clearly defined and that the research instrument that has been developed measures what it is intended to measure.

3.8.2 *Reliability*

Reliability is the extent to which results are consistent over time and accurate representation of the total population under study. In other words, it relates to the extent to which a particular data collection approach will yield the same results on

different occasions. Golafshani (2003) indicates that if the results of a study can be reproduced under similar methodology, then the research instrument is considered to be reliable. The three types of reliability referred to in quantitative research relate to

- the degree to which a measurement, given repeatedly, remains the same
- The stability of a measurement overtime; and
- The similarity of measurements within a given time period (Golafshani 2003)

The basic assumption associated with reliability is that there are no real changes in what is to be measured or the circumstances of such a measurement.(Lancaster 2005).

4 RESEARCH RESULTS AND ANALYSIS

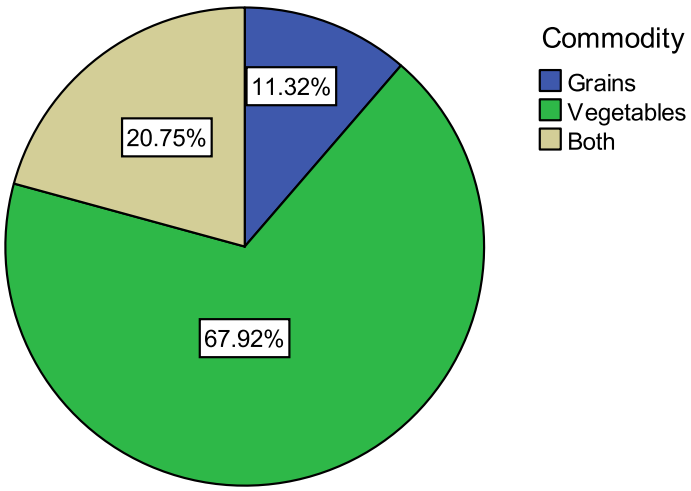
4.1. Introduction

This chapter presents the results of the study and provides summaries to describe the sample for a better perspective. The descriptive statistics, factor analysis and analysis of variance which were the main techniques used to analyse the profiles of the respondent population are described per each parameter measured.

4.2. Sample description

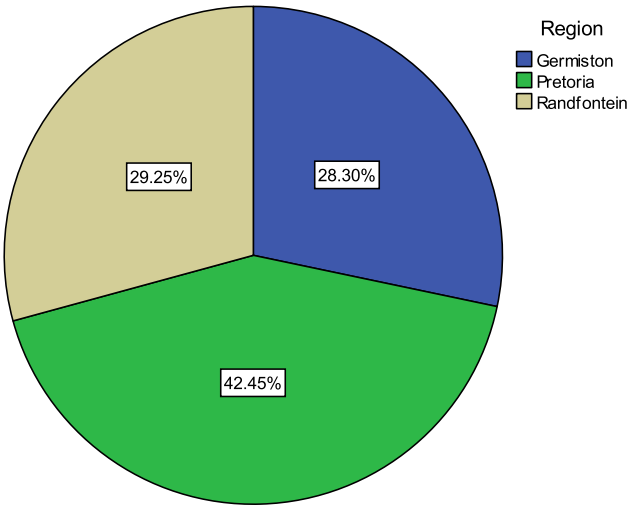
A total of 106 questionnaires were completed representing 48% response rate of the targeted 220 sample. The questionnaire was completed with the assistance of enumerators targeted solely to crop production smallholder farmers in Gauteng province only. The categories included in the respondents `s demographic profiles were commodities, hectares, production systems, gender, age, educational background and region (locality as per Gauteng Department of Agriculture `s description).

Figure 3: Respondents distribution by commodity



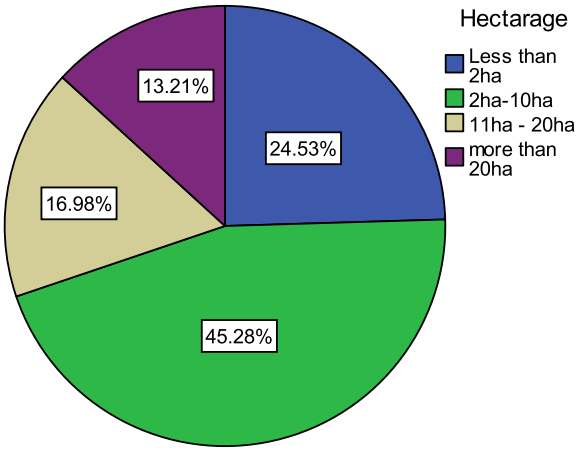
A large proportion of the respondents (67.9%) were producing vegetables followed by farmers who were cultivating a combination of both grains and vegetables (20.75%) and the grain farmers proportion was the smallest (11.32%).

Figure 4: Respondents distribution by locality



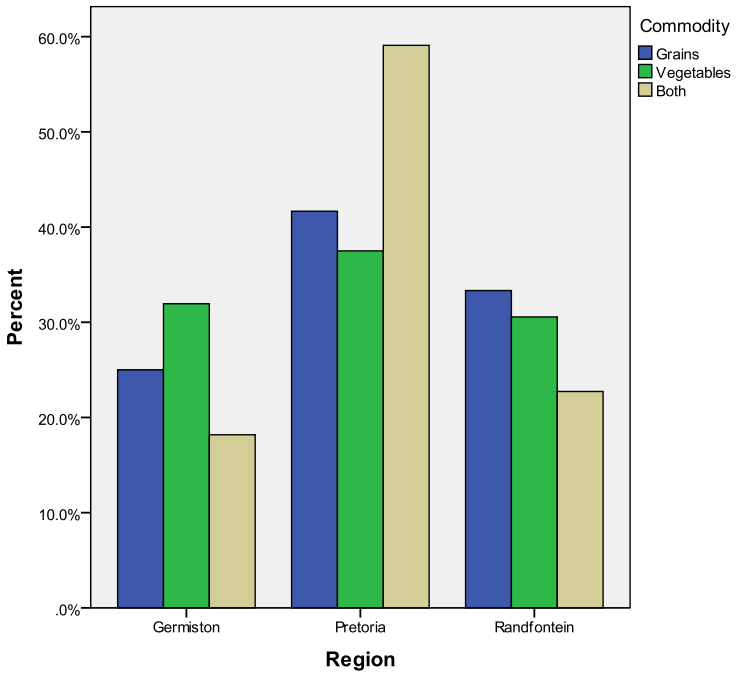
The proportion of farmers who participated in the survey from the Germiston region and Randfontein region were almost equal at 28.3% (count of 30) and 29.25% (count of 31) resulting with less than 1% difference whereas 42.45% (count of 45) of farmers sampled where from the Pretoria region.

Figure 5: Distribution of respondents by hectare of the farm



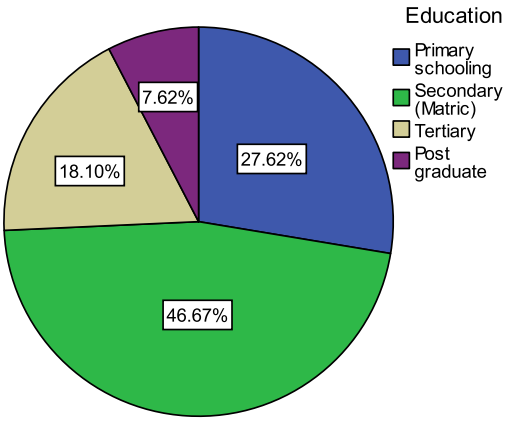
45.28% of the respondents were cultivating in plots of 2–10ha, 24.53% of the farmers were cultivating in plots of less than 2ha. There was only 16.98% of the farmers who were utilising plots of 11-20ha and 13.21% of the plots were greater than 20ha.

Figure 6: Distribution of commodity per area serviced by GDARD



The Germiston region is dominated by smallholder farmers engaged in vegetable production, whereas in the Pretoria region it is farmers who are engaged in both vegetables and grains whilst in Randfontein region there is a slight dominance of smallholder farmers involved with grains.

Figure 7: Distribution of respondents by education



The educational profile of the farmers sampled demonstrated that only 7.62% of the farmers surveyed had postgraduate qualification, 18.1% had a basis tertiary qualification, and 46.67% had some form of secondary education. The proportion of respondents who attained only primary schooling and adult basic education was only 27.62%.

Aggregating undergraduate and postgraduate percentages and rounding off the above results, it is of outmost significance to note that the education levels of farmers who participated in the survey almost take the shape of a normal distribution curve with 28% of primary schooling; 47% secondary and 26% with tertiary education.

4.3. Frequency results and Variable Summary

The questionnaire contained various questions or statements representing the constructs as outlined in Appendix B. The frequency results for the 7 point Likert scale questions are presented in Appendix C due to the volume of data generated by the 7-point Likert Scale.

This appendix shows the count percent for each question or statement presented to 106 respondents. There were no missing values in the responses for all the questions.

The 7 point Likert scale responses were collapsed as follows:

- ‘Strongly disagree’ and ‘disagree’ were combined and titled “Disagree”
- ‘Partially disagree’, ‘neutral’ and ‘partially agreed’ were combined to “Neutral”
- ‘Agree’ and ‘Strongly Agree’ were combined and titled “Agree”

Table 4 below presents the collapsed responses which demonstrate distinct patterns in relation to the three categories.

Table 4: Presentation of 7-point likert scale frequencies collapsed into "Disagree, Neutral and Agree" categories

Variables	Disagree		Neutral		Agree	
	Count	Row N %	Count	Row N %	Count	Row N %
Question 1.1	7	6.6%	55	51.9%	44	41.5%
Question 1.2	10	9.4%	54	50.9%	42	39.6%
Question 1.3	20	18.9%	38	35.8%	48	45.3%
Question 1.4	21	19.8%	31	29.2%	54	50.9%
Question 1.5	11	10.4%	43	40.6%	52	49.1%
Question 1.6	17	16.0%	44	41.5%	45	42.5%
Question 2.1	13	12.3%	47	44.3%	46	43.4%
Question 2.2	18	17.0%	44	41.5%	44	41.5%
Question 2.3	10	9.4%	40	37.7%	56	52.8%
Question 2.4	16	15.1%	54	50.9%	36	34.0%
Question 2.5	22	20.8%	46	43.4%	38	35.8%
Question 2.6	19	17.9%	56	52.8%	31	29.2%
Question 3.1	21	19.8%	43	40.6%	42	39.6%
Question 3.2	28	26.4%	45	42.5%	33	31.1%
Question 3.3	33	31.1%	43	40.6%	30	28.3%
Question 3.4	62	58.5%	27	25.5%	17	16.0%
Question 3.5	58	54.7%	31	29.2%	17	16.0%
Question 3.6	17	16.0%	58	54.7%	31	29.2%
Question 4.1	13	12.3%	27	25.5%	66	62.3%
Question 4.2	6	5.7%	26	24.5%	74	69.8%
Question 4.3	14	13.2%	53	50.0%	39	36.8%
Question 4.4	8	7.5%	32	30.2%	66	62.3%
Question 4.5	6	5.7%	47	44.3%	53	50.0%
Question 4.6	18	17.0%	55	51.9%	33	31.1%

It is evident from the results in Table 4 above that clear patterns emerged on all questions with the frequencies of responses in some cases coming out as higher as 60% for either “agree” or “disagree”. Specific examples of such cases include questions such as 4.1, 4.2 and 4.4. The means scores for these specific questions are assessed and ranked in the next table.

An extract of responses for selected questions is as follows:

- Question 1.1 which dealt with the notion of whether smallholder farmers have a farm management plan with a production plan that is regularly updated highlighted that 41.5% of the smallholder farmers surveyed agreed with the notion, 51.9% were neutral and 6.6% disagreed with the notion.
- Question 2.1 which assessed as to whether smallholder farmers are aware that traditional wholesale markets are now competing with retail supermarkets to supply the same fresh produce, 43.4% indicated that they are aware, 44.4% were in between and 12.3% were not aware.
- Question 3.1 which sought to determine as to whether farmers know and understand what contract-farming is showed that 19.8% of the smallholder farmers surveyed disagreed with the statement, 40.6% were almost in between and 39.6% agreed with the statement.
- Question 4.1 which sought to determine whether smallholder farmers surveyed are involved with direct selling to consumers revealed that 62.3% agreed with the statement, followed by those in between at 25.5% and the proportion of those who disagreed with the statement was only 12.3%.

The means and standard deviations of all the responses were calculated, ranked from high to low and they are presented in Table 5 below. A low standard deviation indicated that observations are clustered around the mean. A high standard deviation indicated that there was high rate of variation in responses.

Table 5: Ranked Means and Standard deviations of each variable measured

Variable	Count	Mean	Standard Deviation
Question 4.2	106	5.75	1.536
Question 4.4	106	5.54	1.519
Question 4.1	106	5.39	1.855
Question 4.5	106	5.18	1.517
Question 2.3	106	5.17	1.726
Question 1.5	106	5.04	1.745
Question 1.1	106	4.9	1.511
Question 1.6	106	4.87	1.773
Question 1.4	106	4.84	1.893
Question 2.1	106	4.79	1.755
Question 1.2	106	4.78	1.58
Question 2.2	106	4.7	1.923
Question 1.3	106	4.67	1.994
Question 4.3	106	4.58	1.761
Question 3.1	106	4.54	1.953
Question 2.4	106	4.53	1.703
Question 2.5	106	4.44	1.938
Question 4.6	106	4.41	1.761
Question 3.6	106	4.36	1.741
Question 2.6	106	4.32	1.676
Question 3.2	106	4.08	1.989
Question 3.3	106	3.85	2.027
Question 3.5	106	2.75	1.985
Question 3.4	106	2.75	2.111

The mean scores of all responses were calculated with the purpose of ranking. In terms of the mean scores presented above, questions with mean scores greater than 5 indicating high proportion of agreement with questionnaire were:

- Question 4.2 with a mean value of 5.75 which indicates that farmers surveyed believe that a community-supported agriculture can assist smallholder farmers to remain viable
- Question 4.4 with a mean value of 5.54 which indicates that farmers perceive “farmers markets’ as the best avenue for selling fresh produce directly to consumers because they develop trust from face to face contact
- Question 4.1 with a mean value of 5.39 which indicates that a large proportion of the farmers surveyed are involved with direct selling to consumers
- Question 4.5 with a mean value of 5.18 which indicated that a proportion of smallholder farmers surveyed believe that they require some level of protected markets to remain viable.
- Question 2.3 with a mean value of 5.17 which indicates that smallholder farmers are aware that food safety and traceability is important for both food retailers and consumers
- Question 1.5 with a mean value of 5.04 which indicates that smallholder farmers believe that they farm on a piece of land with good natural resources such as high potential agricultural land

The questions with the lowest mean scores were question 3.4 and question 3.5 both with a mean score of 2.75.

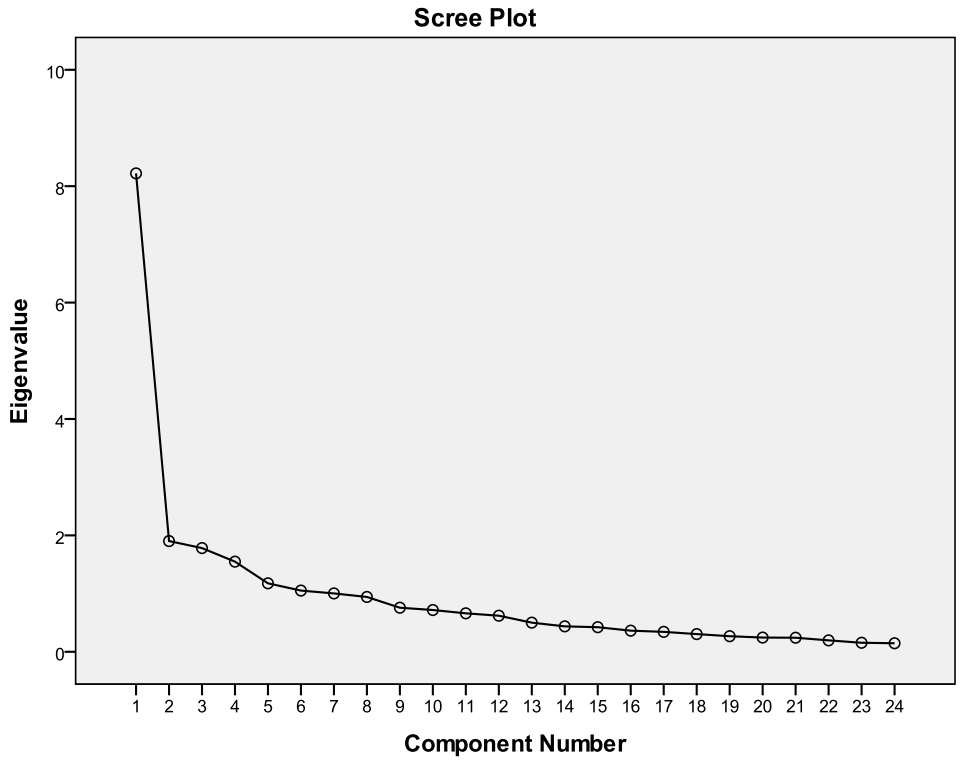
- Question 3.4 indicated that a greater proportion of smallholder farmers surveyed are generally not working with marketing agents to assist them to secure contracts’ for their farm produce

- Question 3.5 indicated that a greater proportion of smallholders farmers surveyed generally indicated that they do not know and understand quality assurance systems such as HACCP and GlobalGap which are required to access large markets contracts

4.4. Summary of Factor Analysis

The 24 items in the questionnaire were subjected to factor analysis with the objective of identifying clusters of highly interrelated variables that may reflect underlying themes. The extraction method utilised was the “Principal Component Analysis” and the rotation method was the “Varimax with Kaiser Normalisation”. The detailed factor analysis output is attached as Appendix 3.

Figure 8: Scree Plot



There are a number of factors that explains variability of any data set. However, the goal is to reduce the number of factors needed to explain the variability in the data. Seven (7) factors were initially identified on the basis that they all had eigenvalues higher than 1 and 69.5% explaining the variability in the data as in Table 6 below.

Table 6: The Eigenvalues after extraction of sums of squared loadings

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.220	34.250	34.250	8.220	34.250	34.250
2	1.903	7.928	42.178	1.903	7.928	42.178
3	1.782	7.424	49.602	1.782	7.424	49.602
4	1.549	6.452	56.054	1.549	6.452	56.054
5	1.176	4.901	60.956	1.176	4.901	60.956
6	1.052	4.382	65.337	1.052	4.382	65.337
7	1.003	4.178	69.515	1.003	4.178	69.515
8	.942	3.925	73.440			
9	.757	3.155	76.595			
10	.718	2.990	79.585			
11	.661	2.753	82.337			
12	.620	2.582	84.920			
13	.500	2.085	87.005			
14	.437	1.819	88.824			
15	.422	1.759	90.584			
16	.363	1.512	92.095			
17	.342	1.426	93.521			
18	.304	1.267	94.788			
19	.267	1.114	95.902			
20	.244	1.018	96.920			
21	.241	1.006	97.926			
22	.196	.817	98.743			
23	.155	.646	99.389			
24	.147	.611	100.000			

Although seven factors were identified with Eigen values of more than 1, the 7th factor would be discussed separately. It was not considered with other factors on the basis that it had only one factor loading and therefore it would present difficulties with regard to analysis of its scores and calculation of its reliability.

The variables for each of the 6 factors identified their factor loadings and Cronbach `s Alpha is indicated in Table 7 - 12 below. On the basis that the 7th factor identified only had one loading, it was considered and discussed individually.

Table 7: Factor 1 with grouped variables, factor loadings and Cronbach `s Alpha

Factor 1 - Naming	Items	Factor Loading
1 - Awareness of trends in agri-food supply chain	(2.5) I am aware that supermarkets and food processing companies have strict specification and standard for the products they buy from farmers	0.738
	(2.2) I am aware that large food retailers and supermarkets are increasingly buying from farmers directly	0.69
	(2.3) I am aware that food safety and traceability are important for both food retailers and consumers	0.675
	(2.6) I have the knowledge of the agri-food supply chain with regard to primary production, agro-processing and distribution channels	0.542
	(2.4) I understand how the crop I produce is marketed, processed / value added and distributed	0.51
	Cranach `s Alpha for Factor 1	**0.817**

The 1st identified factor was titled “Awareness of trends in agri-food supply chain”. This factor demonstrated good reliability with a Cronbach `s Alpha of 0.817

Table 8: Factor 2 with grouped variables, factor loadings and Cronbach `s Alpha

Factor 2 - Naming	Items	Factor Loading
2 – Farming capacity and business strategies	(1.6) I am entrepreneurial in my approach to farming as I implement business management principles	0.775
	(1.4) I have access and knowledge of different production systems	0.74
	(1.1) I have a farm management plan with a production plan that is regularly updated	0.677
	(1.2) I plan my future production decisions by continually monitoring market prices	0.578
	(1.5) I farm on a piece of land with good natural resources such as high potential agricultural land	0.511
	Cronbach `s Alpha for Factor 2	**0.808**

The 2nd identified factor was titled “Farming capacity and business strategies”. This factor demonstrated good reliability with a Cronbach `s Alpha of 0.808

Table 9: Factor 3 with grouped variables, factor loadings and Cronbach `s Alpha

Factor 3 - Naming	Items	Factor Loading
3 – Awareness and interaction with formal markets (such contract farming)	(3.2) I understand what an off-take agreement is	0.746
	(3.1) I know and understand what contract-farming is	0.734
	(3.3) I have access to information about the required volumes and specification by agricultural food processing companies and supermarkets for their contract farming	0.665
	(2.1) I am aware that traditional wholesale markets (e.g. JHB Fresh produce Market) are now competing with supermarkets to supply fresh produce	0.555
	Cronbach `s Alpha for Factor 3	**0.837**

The 3rd identified factor was titled “Awareness and interaction with formal markets such as contract farming”. This factor demonstrated good reliability with a Cronbach `s Alpha of 0.837

Table 10: Factor 4 with grouped variables, factor loadings and Cronbach `s Alpha

Factor 4 - Naming	Variable (Question)	Factor Loading
4 – Awareness and interaction with informal markets (alternative agri-food supply chain)	(4.2) I believe that a community-supported agriculture can assist smallholder farmers to remain viable	0.779
	(4.1) I am involved with direct-marketing or direct selling to consumers	0.752
	(4.4) I believe that farmers markets are the best avenue for selling fresh produce directly to consumers because they develop trust from face to face contact	0.577
	Cronbach `s Alpha for Factor 4	**0.682**

The 4th identified factor was titled “Awareness and interaction with informal markets (alternative agri-food supply chain)”. This factor demonstrated acceptable reliability with a Cronbach `s Alpha of 0.682

Table 11: Factor 5 with grouped variables, factor loadings and Cronbach `s Alpha

Factor 5 - Naming	Items	Factor Loading
5 – Perception on barriers to market access and regulatory issues	(4.5) I believe that smallholder farmers require some level of protected markets to remain viable	0.857
	(3.6) I believe that contract farming is not ideal for smallholder farmers due to the fact that supermarkets and processing companies determines the price they want to pay (price squeeze)	0.588
	(4.3) I believe that alternative markets such as organic farming are difficult to access due to certification requirements	0.576
	Cronbach `s Alpha for Factor 5	**0.636**

The 5th identified factor was titled “Perception on barriers to market access and regulatory issues. This factor also demonstrated acceptable reliability with a Cronbach `s Alpha of 0.636

Table 12: Factor 6 with grouped variables, factor loadings and Cronbach `s Alpha

Factor 6 - Naming	Items	Factor Loading
6 – Awareness of Quality assurance and marketing agents	(3.4) I work with marketing agents that assist me to secure contracts for my farm produce	0.717
	(4.6) I have the knowledge of alternative food supply chain networks or Short Food Supply Chain	0.574
	(3.5) I know and understand quality assurance systems such as HACCP and GlobalGap which are required to access large market contracts	0.564
	Cronbach `s Alpha for Factor 6	**0.634**

The 6th identified factor was titled “Awareness of quality assurance and marketing agents. This factor also demonstrated acceptable reliability with a Cronbach `s Alpha of 0.634

The 7th factor was unique in the sense that it addresses the variable related to knowledge and access to production inputs. This is an important factor in any economic sector as inputs are the basis and ingredients of production. This factor had only one loading of 0.709

4.5. Summary of Descriptive statistics

The first exercise of descriptive statistics for the identified 6 factors was in relation to the calculation and ranking of their mean scores. The results indicated that Factor 4 titled “Awareness and interaction with informal markets (alternative agri-food supply chain) ranked the highest of all the other 5 factors.

Factor 6 ranked lowest with a mean score of 3.3019 which indicated that a large proportion of the farmers surveyed were not aware of quality assurance processes such as HACCP and GlobalGap and neither were they working with marketing agents that would have assisted them to comply with this requirements

Table 13: Descriptive Statistics of the identified 6 factors

	N	Min	Max	Mean	Std. Dev
Factor 4 - Awareness and interaction with informal markets (alternative agri-food supply chain)	106	2.00	7.00	5.5597	1.28528
Factor 2 - Farming capacity and business strategies	106	2.00	7.00	4.8849	1.28284
Factor 5 - Perception on barriers to market access and regulatory issues	106	1.33	7.00	4.7075	1.27549
Factor 1 - Awareness of trends in agri-food supply chain	106	1.00	7.00	4.6321	1.36518
Factor 3 - Awareness and interaction with formal markets (such as contract farming)	106	1.00	7.00	4.3137	1.58455
Factor 6 - Awareness of Quality assurance and marketing agents	106	1.00	6.67	3.3019	1.48753

4.6. Summary of Analysis of Variance

The purpose of undertaking a one way analysis of variance was primarily to test for significant differences in the mean values between the various groups for a demographic term for each factor and establish if there are different views across group types.

Table 14: Demographic terms analysed against each of the 6 factors

Demographic Term / Characteristics	Group
Production system utilised	Irrigation open field
	Dry-land
	Hydroponics (tunnels)
Land size (Hectare)	less than 2ha
	2- 10ha
	11 -20ha
	more than 20ha
Education	No Schooling
	Primary
	Secondary
	Tertiary
	Post Grad
Region (Location)	Germiston
	Pretoria
	Randfontein

The above table represents a selected set of demographic factors which were evaluated against the identified 6 factors. The analysis of variance was conducted in relation to assessing the overall probability as well as the post-hoc probability value.

Table 15: Results indicating one-way analysis of variance for Factor 1 Awareness of trends in the Agri-Food Supply Chain

Factor	Demographic Term	Probability level*	Group	Different from group	Mean Difference	Post Hoc P-Value
1	Production Systems	0.024	Irrigated, open-field	Hydroponics, Tunnels	0.83838	0.038
			Dry land	Hydroponics, Tunnels	0.94727	0.034
1	Education	0.0000	Primary Education	Tertiary Education	-1.7265	0.0000
			Secondary Education	Tertiary Education	-1.05328	0.009

Analysis of variance for Factor 1 named Awareness of changes in the Agri-food supply chain compared to Production System means showed an overall significant difference of $P<0.024$. An analysis utilising Post Hoc tests for multiple comparisons furthermore indicated that there was no difference between the means of open-field irrigated production system and dry-land rain-fed production systems of which the results thereof are not presented in the table.

There was however significant difference of $P<0.038$ between the means of tunnels (hydroponic production system users) and the means of open-field irrigated production system users. The tunnels production system means differed significantly at a $P<0.034$ with the means for dryland rain-fed production system.

Factor 1 analysis of variance between the means for the demographic term education indicated an overall significant difference of $P<0.0000$. Multiple comparisons of means using Post Hoc test indicated a highly significant difference in terms of $P<00001$ between farmer groups with primary education and those with tertiary education. The farmer groups with tertiary education tier demonstrated high level of awareness with regard to trends in agri-food supply chain.

Table 16: Results indicating one-way analysis of variance for Factor 2: Farming capacity and business strategies

Factor	Demographic Term	Probability level*	Group	Different from group	Mean Difference	Post Hoc P-Value
2	Land size (Hectares)	0.002	Less than 2 ha	2 -10ha	0.85449	0.024
			Less than 2 ha	more than 20ha	1.4033	0.004
2	Education	0.0000	Primary Education	Secondary Education	-0.85742	0.014
			Secondary Education	Tertiary Education	-1.52595	0.000

A one way analysis for Factor 2 named Farming capacity and business strategies compared with land sizes in hectares as a demographic factor indicated an overall significant difference of P<0.002. Further analysis with Post Hoc tests for multiple comparison showed that there was a significant difference in capacity and farming business strategies between the groups with land sizes less than 2ha and the groups with 2 -10ha at a probability value of P< 024.

In comparison to Education as a demographic factor, there was a highly significant difference between means of Factor 2 and the demographic factor of education with an overall P<0.0000. The group with Primary education differed significantly at P<0.014 with the group with Secondary education. The group with Secondary education differed furthermore with those qualified with Tertiary education at a P<0.0000.

Table 17: Results indicating one-way analysis of variance for Factor 3: Capacity and farming business strategies

Factor	Demographic Term	Probability level*	Group	Different from group	Mean Difference	Post Hoc P-Value
3	Region (locality)	0.033	Randfontein	Germiston	0.85449	0.046
3	Education	0.001	Primary Education	Tertiary Education	1.75590	0.001

A one way analysis for Factor 3 named Awareness of contract farming and its requirements showed that there was there was significant difference at P<0.033 in comparison with locality. The variation was further determined through Post Hoc analysis for multiple comparisons demonstrating that there is a significant difference between groups in Randfontein and those in Germiston with a P<0.046.

In comparison to Education as a demographic factor analysed against Factor 3 of Awareness of contract farming and its requirements, there was a highly significant difference with an overall P<0.001. The group with Primary education differed significantly at P<0.001 with the group with Tertiary education. There was no significant difference between the Primary education group with the Secondary education group or with that group of farmers who had post graduate qualification.

Factor 4 and Factor 5 did not show any significant differences when compared to all of the demographic factors. Factor 6 showed a significant difference when compared with the demographic term for Gender at a P<0.018. Post hoc tests were not performed for this analysis because there were fewer than three groups.

4.7. Conclusion

Chapter 4 presented the results which are interpreted and analysed in the next Chapter. The analysis takes the dimension of aligning the results with the research propositions for this study as well as formulating the recommendations.

5 DISCUSSION AND INTERPRETATION OF RESULTS

5.1. Introduction

The purpose of this chapter is to interpret through a discussion the results that were presented in the previous Chapter. The research results were analysed with an attempt of drawing a linkage with the literature review as well as the research propositions that the study intended to answer.

5.2. Research Proposition One

Research proposition 1.1: *That smallholders farmer have capacity and business strategies to succeed in a commercialised agri-food supply chain system*

It has been demonstrated by Nell and Napier, 2005; Tywman, Sporton et al, 2004 that the pace of the changing agri-food supply chain is continuously leaving out the smallholder farmers. Increasing amount of smallholder farmers are in turn posing the question of “where is life in farming?” Whilst this question in the context of Gauteng and South Africa is often posed to government in general, this study attempted to understand the smallholder farmers `s perception and understanding of their own capacities as well business strategies to remain viable and integrated in this environment of highly commercialised agri-food supply chains.

From the ranked mean scores analysis, Question 1.1 with a mean score of 4.9 dealt with the notion of whether smallholder farmers have a farm management plan with a production plan that is regularly updated. The responses highlighted that 41.5% of the smallholder farmers surveyed agreed with the notion, 51.9% were neutral and 6.6% disagreed with the notion. The high percentage in relation to the number of respondents of “neutral” in terms of having a proper and updated farm management plan was a cause for concern. On the one hand with regard to

assessing capacity in terms of natural resources as a factor of production, question 1.5 had a high mean value of 5.04 which indicates that smallholder farmers believe that they farm on a piece of land with good natural resources such as high potential agricultural land.

From the factor analysis results, Factor 2 had a mean score of 4.8849 and it was titled “farming capacity and business strategies”. The reliability for this factor measured using the Cronbach `s Alpha was 0.808 which is considered to be a very good reliability. In accordance with high levels of neutrality and mean scores of 4.9, this study demonstrated that smallholder farmers surveyed believe that they have basic farming skills and management capacity. It became apparently clear during interactions that they require further training and capacitating in terms of business management aspects especially with regard to marketing. Business incubation services are therefore essential taking into cognisance that majority of smallholder farmers do not lack production related technical capacity. This is confirmed by Neves (2010) who asserts that it is a mistake for smallholder farmers to insist on producing and processing when they have no understanding of the behaviour of consumers, both quantitatively and qualitatively. He concludes by saying that all investments in smallholder farming especially those funded by both provincial and national governments must have a very strong, world-class project analysis. (Neves 2010)

Research proposition 1.2: *That the smallholder farmers are aware that the agri-food supply chains is changing to become globalised and more vertically integrated.*

Substantial literature reviewed has eluded to the fact that globalisation and meta-trends are influencing and contributing to the change in agri-food supply chain. According to McCullough, E. B; Pingali et al, 2008; Vorley, Lundy and McGregor (2009), smallholder farmer`s decision on where to market their produce are heavily impacted by these changes. They have argued that smallholder farmers may in some cases be aware of the changes in the agri-food supply chain systems. However, due to inadequate production capacity and the cost of complying with

standards of large retail markets which can eat into the price differential, they may consciously and voluntarily choose not to participate in such markets.

Furthermore, the 2008 World Bank Development Report pointed to the risks in opening up markets, where domestic businesses may be by-passed by cheaper imports and where costly market entry requirements favour the better resourced. This is typical of the dualistic agricultural system of Gauteng and South Africa where smallholder farmers who are less resourced are overtaken in terms of dealings with large processing and retailing organisations. The reports further called for action in response to the modernization of procurement systems in integrated supply chains and supermarkets, so that smallholder farmers can share in these growth opportunities (World Bank 2008)

The research proposition in this context sought to understand awareness of Gauteng smallholder farmers to these changes in the agri-food supply chain. The response to Question 2.2 asking whether smallholder farmers are aware that large food retailers are increasingly buying from farmers directly showed equal percentage of 41.5% for both “neutral” and “agree” responses. Only 17% disagreed with this question. In responding to question 2.4 which asked smallholder farmers as to whether they have the understanding of how the commodity they produce is marketed, processed, value-added and distributed? 50.9% of the farmers were neutral, 34% agreed whilst 15.1% disagreed. Both questions had the mean scores of 4.7. and 4.53 which were relatively low in relation to the highest ranked mean of 5.75. This result implied that smallholder farmers surveyed were not very confident in their understanding of the supply chains for the commodities they were produced. By implication, understanding of the changes in the supply chain of that specific commodity therefore becomes a tall order.

The first identified factor from the Factor analysis results was titled “awareness of trends in agri-food supply chain”. The Cronbach `s Alpha for Factor 1 was 0.817 which demonstrated very good reliability of the analysis. The mean score for factor 1 came at 4.6321 and it ranked 4th in relation to all the other six identified factors. This mean score confirms the high level of neutrality with regard to the levels of confidence demonstrated by the surveyed farmers in relation to understanding of

the changes in the food supply chain of their respective commodities. Results of the one-way analysis for Factor 1 indicated that there was a significant difference between farmers who utilised open-field irrigated systems and hydroponic tunnels at P<0.038. There was also significant difference between the dry-land farmers and hydroponic tunnels at P<0.034.

Another differentiator from the results of factor 1 analysis of variance was the demographic factor of education. There was a significant difference (P<0.0000) between the farmers with primary education to those with tertiary education. There was also a significant difference (P<0.009) between the farmers with secondary education to those with tertiary education.

Figure 9: Production systems utilised compared to education of the farmers

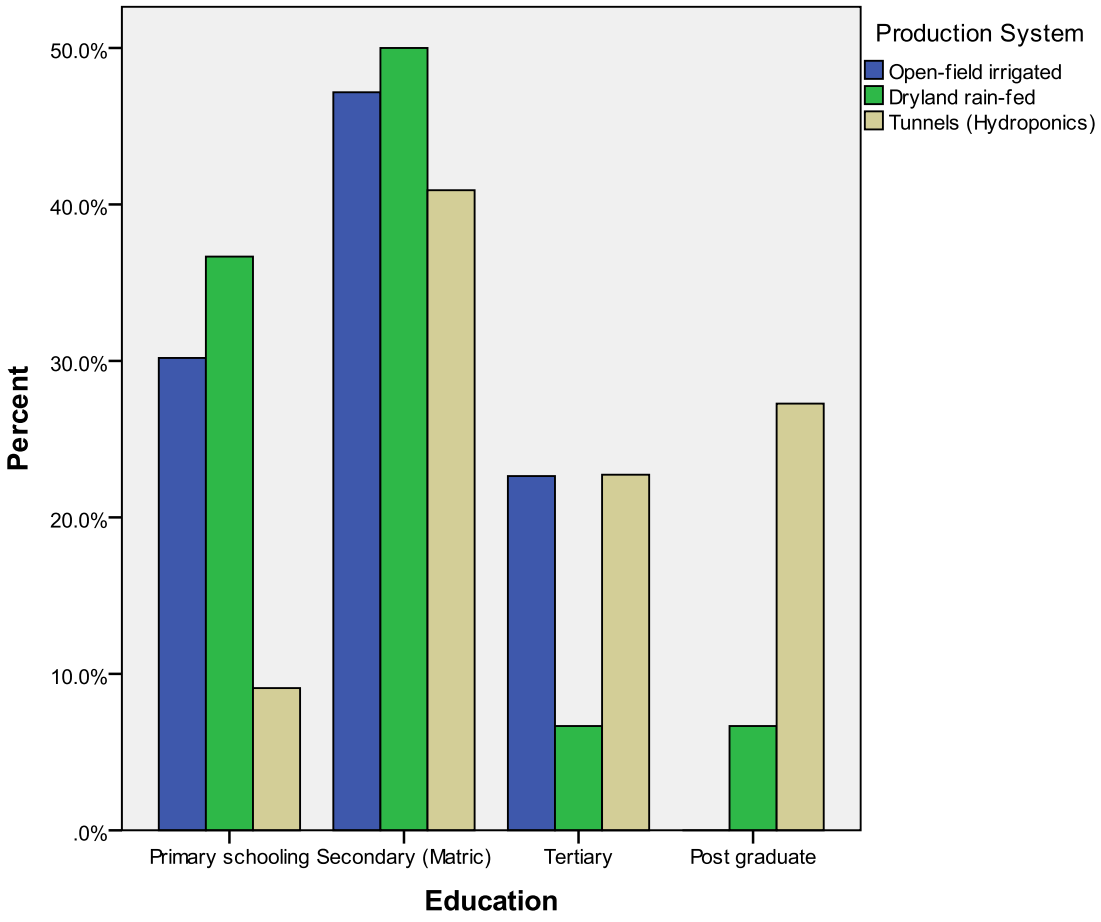


Figure 9 above demonstrates the link between education and the production system utilised by the farmers. The distribution of education levels of farmers

utilising dry-land production systems and irrigated open-field irrigated system was highly concentrated on primary and secondary education as opposed to those utilising hydroponic farming systems which had high concentration of tertiary education.

It can therefore be deduced from the above that hydroponic farmers had a better understanding of the food supply chain by virtue of their higher educational levels. That education as a demographic factor was playing a significant role in terms of the awareness and understanding of the farmers to the changes that are occurring in the agri-food supply chain. Finally that it is therefore significant that government plays a significant role in relation to ensuring further education and training of smallholder farmers with regard to the specific food value chains of the commodities the farmers are producing as the core of their enterprises.

5.3. Research proposition two

Research proposition 2.1: *That the Gauteng smallholder farmer should be capacitated to influence buying patterns of large food processors and retailers to become active participants of contract farming*

The challenges of smallholder farmers to access contract farming markets were discussed earlier in the literature review. Some of the reasons cited were related to capacity and Question 3.1 sought to determine as to whether farmers know and understand what contract-farming is. The results showed that 19.8% of the smallholder farmers surveyed disagreed with the statement, 40.6% were almost in between and 39.6% agreed with the statement. Question 3.5 sought to understand if the farmers understood the linkages of contract farming with regard to quality assurance systems such as HACCP and GlobalGap. The responses demonstrated that 54.7% of the farmers surveyed were not aware of the required quality assurance systems, 29.2% were not sure and only 16% agreed to be fully aware of the quality assurance systems.

In relation to factor analysis, the 3rd identified factor was titled “Awareness and interaction with formal markets such as contract farming”. This factor demonstrated very good reliability with a Cronbach `s Alpha of 0.837. The mean score of Factor 3 was 4.3137 and it was ranked the second lowest in relation to the mean scores of the other six factors.

Factor 6 titled “Awareness of Quality assurance and marketing agents” ranked lowest with a mean score of 3.3019. This confirmed the earliest observation that a large proportion of the farmers surveyed were not aware of quality assurance certification programs such as HACCP and GlobalGap and neither were they working with marketing agents that would have assisted them to comply with these requirements.

There were significant differences in the one-way analysis of variance for Factor 3 compared to the demographic term of region (locality). The farmers in Randfontein significantly differed with the farmers in Germiston ($P<0.046$). In terms of the demographic factor of education, there was significant difference for farmers with primary education and those with tertiary education in terms of their interactions with the formal markets. The influence of the agricultural sub-sector and the commodity which farmers are producing would have played a significant role in this particular regard.

Factor 3 and factor 6 are important for successful integration of smallholder farmers in formal markets such contract farming. The fact that these two factors ranked the lowest indicates the challenge of knowledge, access to information in terms of smallholder farmers `s potential to participate meaningfully in contract farming. It is therefore an area of intervention by the government and agencies working with the development of smallholder farmers to ensure that they are better capacitated to understand formal markets requirements such quality assurance system. The government may in turn furthermore consider the hiring of more marketing agents to work with smallholder farmers to assist them to penetrate the markets more successfully. Another option may be to consider collaborations and in addition provide additional training to Extension officers to become more business orientated with the ability of assisting farmers to succeed commercially.

Research proposition 2.2*: That Gauteng smallholder farmers should furthermore pursue alternative food supply chain networks (Informal markets) such as farmers markets and direct selling to consumers*

In light of the challenges that continue to plague smallholder farmers with regard to accessing the formal markets due to their inability to meet certification requirements and economies of scale, some literature reviewed argued that smallholder farmers are best focusing on the Alternative Food Networks (AFN) or in other words informal markets

Alternative Food networks is used as a broad embracing term to cover newly emerging networks of producers, consumers, and other actors that embody alternatives to the more standardized industrial mode of food supply chains. The three categories of alternative food network or short food supply chains (SFSCs) are organic farming, quality production and direct selling. The SFSC concept is more specific than AFNs, and rather, covers (the interrelations between) actors who are directly involved in production, processing, distribution, and consumption of new food products (Renting, Marsden et al. 2003)

Question 4.2 which sought to understand whether farmers believed that community supported agriculture can assist smallholder farmers to remain viable was individually ranked the highest of all the questions with a mean of 5.75. In terms of responses 69.8% of the smallholder farmers indicated that they agreed with the notion, 24.5% of the farmers were not sure and only 5.7% disagreed. On the contrary to the inclusion of organic markets as part of the alternative food networks, smallholder farmers surveyed in Gauteng did not agree with this assertion on the basis that it is was observed as an elite and inaccessible food market system with certification system as the main barrier to entry. 36.8% of the smallholder farmers surveyed agreed to the fact that organic farming was inaccessible due to certification system, 50% of the respondents were not sure on the basis that they have never attempted to enter organic farming as a regulated market even though some mentioned that they were producing organically without enjoying the commercial benefits.

The smallholder farmers surveyed affirmed their believe that farmers' markets are the best avenue for selling fresh produce from farmers directly to consumers because they develop trust from face to face contact. This question was ranked second overall with a mean score of 5.54 and in terms of the proportion of responses, 62.3% of the farmers agreed with this notion, 30.2% of the farmers were not sure and 7.5% did not agree.

The 4th identified factor was titled "Awareness and interaction with informal markets (alternative agri-food supply chain)". This factor demonstrated acceptable reliability with a Cronbach `s Alpha of 0.682

In terms of the mean scores, factor 4 ranked the highest with a mean score of 5.5597. In addition when subjected to factor analysis, factor 4 did not show and significant differences for any of the demographic terms assessed. It can be deduced from the above analysis that more than 60% of the smallholder farmers surveyed preferred to interact with informal markets due to the challenges they have with satisfying the requirements of the formal markets. In some cases farmers opted for this marketing channels on the basis that they were not subjected to stringent standards and quality checks which heavily eroded their profits considering that their production capacity does not make them stand-out with a competitive advantage. It came out through this interaction with the farmers that majority of this farmers were utilising the marketing channels which included direct selling to hawkers and street vendors who then sell directly to consumers. The interaction and improvement that government may assist smallholder farmers with regard to this informal markets factor is to provide capacity and training to enable them to produce more affordable and safer food for the community.

6 CONCLUSION AND RECOMMENDATION

6.1 Major findings

The study intended to understand the interaction of smallholder farmers with the changing agric-food supply chain. This was undertaken through assessing of perceptions and experiences of farmers through four propositions which dealt with capacity and business strategies, understanding of trends in the agricultural value chain, formal market access especially through contract farming and their preference for informal markets or alternative agri-food supply chain.

The smallholder farmers surveyed believe that they have fair basic farming skills and management capacity. It became apparently clear during interactions that they have adequate technical capacity to be productive and they require further training and capacitating in terms of business management aspects especially with regard to market linkages for their goods. The Department of Agriculture must in its programmes enhance business incubation services aimed at ensuring that farmers are well capacitated to understand the sector and the supply chain for their specific commodities, and thereby augmenting their capacity and ability in terms of planning, producing and securing markets.

It also became apparently clear that farmers who had a better understanding of the changes in the food supply chain had higher educational levels with at least a tertiary qualification. Therefore education as a demographic factor was playing a significant role in terms of the awareness and understanding of the farmers to the changes that are occurring in the agri-food supply chain. This therefore implies that it is critical for the government to identify farmers according to commodity groups and ensure that they receive further education and training with regard to their specific food value chains and the dynamics thereof. One of the tools that smallholder farmers must be trained to understand is the Porter `s five forces which shape any industry. Training them through this tool will assist them to understand the rivalry among the major sector players, the barriers to entry, the power of suppliers, the power of buyers and threat of substitute products.

In terms of access to formal markets especially contract farming, it was evident that this is a road less travelled by the smallholder farmers. Challenges entailed access to information with regard to requirements such as volume and quality assurance system. Interventions for the government to assist smallholder farmers in this regard includes hiring marketing agents that would assist them to understand the requirements, assist them to negotiate and secure markets and facilitate transactions. Of outmost importance is that smallholder farmers who are interested to collectively access formal markets must work towards accreditation with regard to certification programs such as GlobalGAP. Provincial Departments of Agriculture have a significant role to facilitate accreditation and compliance and it is recommended that “an increase in the number of farmers who are accredited by certification program” should be considered as a performance indicator for the department of agriculture. Another option may be to consider collaborations and in addition provide additional training to Extension officers to become more business orientated with the ability of assisting farmers to succeed commercially.

It was evident that again that smallholder farmers surveyed preferred to interact with informal markets also called Alternative Food Networks due to the challenges they have with satisfying the requirements of the formal markets. In some cases farmers opted for this marketing channels on the basis that they were not subjected to stringent standards and quality checks which heavily eroded their profits considering that their production capacity does not make them stand-out with a competitive advantage. It came out through this interaction with the farmers that majority of this farmers were utilising the marketing channels which included direct selling to hawkers and street vendors who then sell directly to consumers. The interaction and improvement that government may assist smallholder farmers with regard to this informal markets factor is to provide capacity and training to enable them to produce more affordable and safer food for the community. The farmers acknowledged that food safety was an important factor which should not be ignored.

The summarised findings against the research proposition and recommendations are summarised in Table 18 below.

Table 18: Summarised findings and recommendation per research proposition

Research Proposition	Major findings from smallholder farmers	Recommendations		
		Farmers	**Government**	**Industry**
Business strategy and production capacity	42% of the farmers surveyed demonstrated appropriate business strategies comprised of production plans and marketing plans with adequate production capacity	Farmers must seek to increase their production capacity, business management skill through attending appropriate entrepreneurial training courses.	Assistance with provision of capacity building in terms of business management and entrepreneurship skills development. Farming is purely business Assistance with production infrastructure for economies of scale to farmers who demonstrate success through proper business management.	Contribute to business skills development through their outreach programs.
Awareness of changing food supply chain	34% of farmers demonstrated knowledge and understanding of the food supply chain and related changes with regard to technology, globalisation & other factors driving change A pattern of farmers with high education level (tertiary) choosing to be engaged in intensive production systems such as hydroponics was observed	Farmers must seek to understand supply chain of their preferred commodities and focus on producing enough volumes to build consistent supply and improve quality of such products. Farmers must understand that too much diversification does not assist their businesses to develop, to be renowned for specific products and to perfect the quality of such commodities.	Government must facilitate value-chain development with regard to ensuring smallholder farmers participation. State institutions must serve as major market points for produce of small farmers. Government must assist with further education and training of farmers especially to understand the food supply chain and impact of global factors such as cheap imports. It must consider tariffs and levies to invest in the development of vulnerable small farmers	Both supply side and demand-side industry must contribute to assisting farmers with support services (e.g. access to information on improved crops, better pest management practices and products, improved product handling, changes to buyer requirements) to mitigate changes in the food supply chain.

Research Proposition	Major findings from smallholder farmers	Recommendations		
		Farmers	**Government**	**Industry**
Market access with reference to contract farming	20% of the farmers surveyed were confident with their knowledge and understanding of contract farming 16% knew of quality assurance certification programs such as GlobalGAP and HACCP 16% worked with marketing agents to sell their produce	Farmers must understand that to access formal markets they must invest in their ability to comply with requirements for formal markets pertaining to quality assurance, food safety and standards of product handling facilities. Farmers must consider value-addition and branding of their product unless where they supply contracts Farmers must learn negotiating skills	Government must assist smallholder farmers with product handling facilities and assist with training programs for farmers to comply with GlobalGAP and HACCP. Government must consider a tax-incentive scheme for large –agro-processing companies and retailers that procure products from groups of smallholder farmers. Government must consider hiring marketing agents with product handling facilities to assist farmers	Agro-processing and retail Industry must adjust their programs to increase the number of smallholder farmers they are buying from with minimal increase in transaction costs Industry must adopt the principles of corporate shared value more than seeing small farmers as corporate social responsibility beneficiaries.
Alternative food supply chain networks / informal markets	62% of the farmers preferred marketing their products through farmers markets 70% believed in community supported agriculture	Farmers must consider developing niche localised brands of their products so that they can gain more support from consumers who prefers local produce & local and regional brands. They must capitalise on community goodwill	Government must enhance the program of market days and farmers markets in various suburbs and townships as it is a viable market channel for many smallholder farmers.	Institutions can create avenues for farmers markets to take place in their own premises on selected days as a mechanism to assist with their development.

6.2 Recommendations for further research

The following area requires further research:

- Government tax-incentives to stimulate agro-processing corporations and large retail corporations to buy from large numbers of smallholder farmers as opposed to buying from few individual large commercial farms.

- Determining mechanisms of training smallholder farmers with limited education to be assisted to comply with various quality assurance and certification programs such as GlobalGAP and HACCP

- Novel mechanisms and means of assisting smallholder farmers to exploit their comparative advantages pertaining to low input cost, produce of premium quality which does not accrue to appropriate market returns.

- Determination of ways of refocusing private sector innovation and incentives on sourcing sustainable supply from smallholder farmers with limited increase in transactional costs.

- Tax-incentive schemes for medium to large agricultural co-operations which successfully integrate the smallholder farmers in their supply chain.

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APPENDICES

(ATTACHED OVERLEAF)

APPENDIX A: Consistency Matrix

Evaluation of the interaction between 'changing agri-food supply chain systems' and smallholder farmers of Gauteng Province, South Africa					
Sub-problem	**Literature Review**	**Research Propositions**	**Source of data**	**Type of data**	**Analysis**
The first sub-problem is to evaluate the perception of Gauteng smallholder farmers to the changes in agri-food supply chains of South Africa and globally	Jacobs (2008), Twyman *et al* (2004), McCullough *et al* (2008), Narayanan and Gulati (2002), Nell and Napier (2005) , Reardon and Barrett (2000)	• That the smallholder farmers have business strategies to succeed in a commercialized agri-food supply chain environment. • That the smallholder farmers are aware that the agri-food supply chains is changing to become globalised and more vertically integrated.	Administer a survey to Gauteng Smallholder farmers utilizing a questionnaire	Quantitative data	Descriptive statistics Factor analysis ANOVA
The second sub-problem is to determine challenges and opportunities of smallholder farmers `s integration into mainstream agri-industrialized markets such as contract farming	Renting et al (2003), Vorley (2001), Nell and Napier (2005), Minten et al (2006), Smith et al (2009), Anim (2010), Jacobs (2008)	• That Gauteng smallholder farmers should be capacitated to influence buying patterns of large food processors and retailers to become active participants of contract farming • That Gauteng smallholder farmers should furthermore pursue alternative food supply chain networks (Informal markets) such as farmers markets and direct selling to consumers	Administer a survey to Gauteng Smallholder farmers utilizing a questionnaire	Quantitative data	Descriptive statistics Factor analysis ANOVA

APPENDIX B: QUESTIONNAIRE

Please indicate whether you agree with the following statements on a scale from 1 (strongly disagree) to 5 (strongly agree)	**Strongly Disagree**	**Disagree**	**Partially Disagree**	**Neutral**	**Partially Agree**	**Agree**	**Strongly Agree**
1. Capacity and business strategies							
1.1. I have a farm management plan with a production plan that is regularly updated	1	2	3	4	5	6	7
1.2. I plan my future production decisions by continually monitoring market prices	1	2	3	4	5	6	7
1.3. I have access to inputs (e.g. fertilizers, seeds, etc) that can enable me to produce quality food crops	1	2	3	4	5	6	7
1.4. I have access and knowledge of different production systems and irrigation systems	1	2	3	4	5	6	7
1.5. I farm on a piece of land with good natural resources such as high potential agricultural land	1	2	3	4	5	6	7
1.6. I am entrepreneurial in my approach to farming because I implement basic business management principles	1	2	3	4	5	6	7
2. The changing Agri-Food Supply chain							
2.1. I am aware that traditional wholesale markets (e.g. JHB Fresh Produce Market) are now competing with supermarkets (e.g. Pick' n Pay, Spar, etc) to supply the same fresh produce	1	2	3	4	5	6	7
2.2. I am aware that large food retailers / supermarkets are increasingly buying from farmers directly	1	2	3	4	5	6	7
2.3. I am aware that food safety and traceability is important for both food retailers and consumers	1	2	3	4	5	6	7
2.4. I understand how the crop I produce is marketed, processed / value-added and distributed	1	2	3	4	5	6	7
2.5. I am aware that supermarkets and food processing companies have strict specifications and standards for the products they buy from farmers	1	2	3	4	5	6	7
2.6. I have knowledge of the agri-food supply chain with regard to primary production, agro-processing and the	1	2	3	4	5	6	7

distribution channels							
3. Contract farming challenges							
3.1. I know and understand what contract-farming is about	1	2	3	4	5	6	7
3.2. I understand what an off-take agreement entails	1	2	3	4	5	6	7
3.3. I have access to information about the required volumes and specifications by agricultural food processing companies and supermarkets for their contract farming agreements	1	2	3	4	5	6	7
3.4. I work with marketing agents that assist me to secure contracts for my farm produce	1	2	3	4	5	6	7
3.5. I know and understand quality assurance systems such as HACCP and GlobalGap which are required to access large market contracts	1	2	3	4	5	6	7
3.6. I believe that contract farming is not ideal for smallholder farmers due to the fact that supermarkets and processing companies determines the price they want to pay (price-squeeze)	1	2	3	4	5	6	7
4. Alternative Food Supply chain systems							
4.1. I am involved with direct marketing or direct selling to consumers	1	2	3	4	5	6	7
4.2. I believe that a community-supported agriculture can assist smallholder farmers to remain viable	1	2	3	4	5	6	7
4.3. I believe that alternative markets such as organic farming are difficult to access due to certification requirements	1	2	3	4	5	6	7
4.4. I believe that farmers markets are the best avenue for selling fresh produce directly to consumers because they develop trust from face to face contact	1	2	3	4	5	6	7
4.5. I believe that smallholders require some level of protected markets to remain viable	1	2	3	4	5	6	7
4.6. I have the knowledge of alternative food supply chain networks or Short Food Supply Chain	1	2	3	4	5	6	7

Demographics

Which crop commodities are you producing	Grains (Maize / Sunflower)	Vegetables	Both		
	1	2	3		
what is the hectarage you cultivate	less than 2ha	2ha- 10ha	11ha-20ha	more than 20ha	
	1	2	3	4	
Production Systems	Irrigation	Dryland	Tunnels (Hydroponics)		
	1	2	3		
What is your Gender	Male	Female			
	1	2			
What is your age	18 - 24	25-44	45-64	Over 64	Unresponsive
	1	2	3	4	5
What is your educational background?	No schooling	Primary School	Matric	Tertiary education	post graduate
	1	2	3	4	5
Region	Germiston	Pretoria	Randfontein		
Name					
Contact Phone Number					
Plot Farm No.					

APPENDIX C: 7 –POINT LIKERT SCALE RESULTS IN % COUNT

Variable	Strongly disagree	Disagree	Partially disagree	Neutral	Partially agree	Agree	Strongly agree
	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %
Question1.1	3.8%	2.8%	11.3%	17.9%	22.6%	29.2%	12.3%
Question 1.2	2.8%	6.6%	12.3%	18.9%	19.8%	26.4%	13.2%
Question 1.3	14.2%	4.7%	9.4%	4.7%	21.7%	29.2%	16.0%
Question 1.4	6.6%	13.2%	6.6%	4.7%	17.9%	34.0%	17.0%
Question 1.5	6.6%	3.8%	7.5%	15.1%	17.9%	26.4%	22.6%
Question 1.6	4.7%	11.3%	3.8%	16.0%	21.7%	21.7%	20.8%
Question 2.1	6.6%	5.7%	12.3%	12.3%	19.8%	27.4%	16.0%
Question 2.2	6.6%	10.4%	15.1%	6.6%	19.8%	18.9%	22.6%
Question 2.3	3.8%	5.7%	10.4%	10.4%	17.0%	25.5%	27.4%
Question 2.4	5.7%	9.4%	12.3%	17.0%	21.7%	22.6%	11.3%
Question 2.5	7.5%	13.2%	15.1%	10.4%	17.9%	17.0%	18.9%
Question 2.6	3.8%	14.2%	13.2%	23.6%	16.0%	18.9%	10.4%
Question 3.1	9.4%	10.4%	13.2%	8.5%	18.9%	21.7%	17.9%
Question 3.2	13.2%	13.2%	16.0%	12.3%	14.2%	17.9%	13.2%
Question 3.3	19.8%	11.3%	12.3%	15.1%	13.2%	18.9%	9.4%
Question 3.4	46.2%	12.3%	13.2%	2.8%	9.4%	6.6%	9.4%
Question 3.5	43.4%	11.3%	15.1%	7.5%	6.6%	11.3%	4.7%
Question 3.6	7.5%	8.5%	17.9%	12.3%	24.5%	18.9%	10.4%
Question 4.1	8.5%	3.8%	2.8%	7.5%	15.1%	27.4%	34.9%
Question 4.2	3.8%	1.9%	3.8%	6.6%	14.2%	29.2%	40.6%
Question 4.3	4.7%	8.5%	17.0%	17.0%	16.0%	19.8%	17.0%
Question 4.4	2.8%	4.7%	1.9%	9.4%	18.9%	32.1%	30.2%
Question 4.5	2.8%	2.8%	7.5%	17.9%	18.9%	29.2%	20.8%
Question 4.6	8.5%	8.5%	13.2%	15.1%	23.6%	20.8%	10.4%

APPENDIX D: FACTOR ANALYSIS OUTPUT

[DataSet1] C:\Documents and Settings\My Documents\Thesis AgriFood Supply chain and smallholder interaction.sav

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.844
Bartlett's Test of Sphericity	Approx. Chi-Square	1231.446
	df	276
	Sig.	.000

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
1.1	4.90	1.511	106
1.2	4.78	1.580	106
1.3	4.67	1.994	106
1.4	4.84	1.893	106
1.5	5.04	1.745	106
1.6	4.87	1.773	106
2.1	4.79	1.755	106
2.2	4.70	1.923	106
2.3	5.17	1.726	106
2.4	4.53	1.703	106
2.5	4.44	1.938	106
2.6	4.32	1.676	106
3.1	4.54	1.953	106
3.2	4.08	1.989	106
3.3	3.85	2.027	106
3.4	2.75	2.111	106
3.5	2.75	1.985	106
3.6	4.36	1.741	106
4.1	5.39	1.855	106
4.2	5.75	1.536	106
4.3	4.58	1.761	106
4.4	5.54	1.519	106
4.5	5.18	1.517	106
4.6	4.41	1.761	106

Communalities

	Initial	Extraction
1.1	1.000	.666
1.2	1.000	.757
1.3	1.000	.785
1.4	1.000	.685
1.5	1.000	.563
1.6	1.000	.761
2.1	1.000	.729
2.2	1.000	.620
2.3	1.000	.614
2.4	1.000	.621
2.5	1.000	.727
2.6	1.000	.627
3.1	1.000	.750
3.2	1.000	.714
3.3	1.000	.774
3.4	1.000	.636
3.5	1.000	.748
3.6	1.000	.754
4.1	1.000	.738
4.2	1.000	.772
4.3	1.000	.525
4.4	1.000	.679
4.5	1.000	.773
4.6	1.000	.666

Extraction Method: Principal Component Analysis.

Total Variance Explained

Comp	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Var	Cum%	Total	% of Var	Cum %	Total	% of Var	Cum%
1	8.220	34.250	34.250	8.220	34.250	34.250	3.560	14.835	14.835
2	1.903	7.928	42.178	1.903	7.928	42.178	3.199	13.331	28.166
3	1.782	7.424	49.602	1.782	7.424	49.602	2.671	11.131	39.297
4	1.549	6.452	56.054	1.549	6.452	56.054	2.023	8.430	47.727
5	1.176	4.901	60.956	1.176	4.901	60.956	1.953	8.139	55.866
6	1.052	4.382	65.337	1.052	4.382	65.337	1.943	8.097	63.963
7	1.003	4.178	69.515	1.003	4.178	69.515	1.333	5.552	69.515
8	.942	3.925	73.440						
9	.757	3.155	76.595						
10	.718	2.990	79.585						
11	.661	2.753	82.337						
12	.620	2.582	84.920						
13	.500	2.085	87.005						
14	.437	1.819	88.824						
15	.422	1.759	90.584						
16	.363	1.512	92.095						
17	.342	1.426	93.521						
18	.304	1.267	94.788						
19	.267	1.114	95.902						
20	.244	1.018	96.920						
21	.241	1.006	97.926						
22	.196	.817	98.743						
23	.155	.646	99.389						
24	.147	.611	100.000						

Extraction Method: Principal Component Analysis.

Component Transformation Mix

Component	1	2	3	4	5	6	7
1	.552	.505	.455	.223	.236	.303	.189
2	-.168	-.445	.091	.523	.691	-.071	.096
3	-.288	.410	-.274	.719	-.346	-.106	.159
4	-.669	.047	.375	-.122	-.049	.606	.157
5	.360	-.502	-.297	.178	-.317	.551	.306
6	-.019	.270	-.556	-.013	.371	.463	-.515
7	-.078	.226	-.414	-.337	.325	-.081	.739

Component Matrix[a]

	Component						
	1	2	3	4	5	6	7
2.4	.750	-.118	-.032	-.068	.095	-.033	.171
3.1	.726	.086	-.112	.182	-.269	-.246	-.193
1.2	.717	-.267	-.015	-.237	-.013	.146	.307
3.3	.714	-.144	-.330	.198	-.039	-.306	-.016
2.6	.686	-.299	-.032	-.051	.148	.017	-.203
2.1	.681	.105	-.224	-.245	-.150	-.340	-.079
1.6	.676	-.362	.315	.063	-.160	.208	.016
1.1	.643	-.275	.300	-.210	-.153	.039	.130
2.5	.640	-.046	-.427	-.244	.214	-.063	-.152
2.3	.635	-.065	.020	-.333	.264	.150	-.049
3.2	.625	.121	-.165	.362	-.065	-.218	-.313
1.4	.617	-.243	.141	.046	-.443	.001	.163
3.5	.617	-.057	-.386	.158	.134	.385	.156
2.2	.601	.030	.009	-.476	.100	-.073	-.123
1.3	.532	-.079	.389	.174	.098	-.338	.436
4.3	.498	.402	-.225	.155	-.054	.174	.088
4.4	.493	.412	.220	-.296	-.210	.070	-.285
1.5	.477	-.022	.247	.328	-.235	.264	-.203
4.5	.240	.626	-.241	-.128	-.372	.291	.162
3.6	.385	.569	-.184	.047	.189	-.112	.445
4.1	.276	.421	.581	.034	.264	-.276	-.020
4.2	.482	.382	.511	-.141	.207	.212	-.158
4.6	.485	.122	.165	.612	.068	.095	-.003
3.4	.469	-.090	-.108	.293	.503	.198	-.133

Extraction Method: Principal Component Analysis.

a. 7 components extracted.

Rotated Component Matrix[a]

	Component						
	1	2	3	4	5	6	7
2.5	.738	-.002	.348	-.069	.138	.195	-.004
2.2	.690	.173	.157	.275	.084	-.078	.021
2.3	.675	.239	.012	.224	.070	.212	.033
2.6	.542	.348	.306	.074	-.138	.307	-.025
2.4	.510	.396	.234	.051	.123	.221	.287
1.6	.239	.775	.137	.144	-.070	.243	.009
1.4	.138	.740	.301	-.028	.120	-.039	.107
1.1	.390	.677	.077	.169	-.026	-.022	.140
1.2	.572	.578	.012	-.069	.160	.130	.218
1.5	-.097	.511	.277	.256	.102	.328	-.179
3.2	.135	.114	.746	.137	.108	.307	.022
3.1	.219	.316	.734	.124	.191	.089	.058
3.3	.374	.232	.665	-.175	.067	.220	.234
2.1	.545	.159	.555	.080	.219	-.159	.136
4.2	.232	.194	-.053	.779	.169	.204	.024
4.1	-.007	-.020	.101	.752	-.039	.032	.399
4.4	.283	.201	.232	.577	.339	-.143	-.189
4.5	.030	.040	.066	.098	.857	-.107	-.097
3.6	.174	-.157	.118	.131	.588	.141	.550
4.3	.139	.082	.265	.099	.576	.284	.081
3.4	.297	.017	.140	.076	-.058	.717	.063
4.6	-.186	.278	.344	.228	.124	.574	.196
3.5	.385	.258	.122	-.222	.383	.567	.033
1.3	.086	.430	.173	.210	-.087	.094	.709

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 13 iterations.

APPENDIX E: OUTPUT OF ONE-WAY ANALYSIS OF VARIANCE FOR FACTOR 1

Descriptives

Factor1 vs. Education Demographic Item

	N	Mean	Std. Dev	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Primary schooling	29	3.9310	1.34300	.24939	3.4202	4.4419	1.00	6.60
Secondary (Matric)	49	4.6204	1.07257	.15322	4.3123	4.9285	2.40	6.80
Tertiary	19	5.6737	1.21328	.27835	5.0889	6.2585	2.00	7.00
Post graduate	8	5.1750	1.50214	.53109	3.9192	6.4308	2.80	7.00
Total	105	4.6629	1.33426	.13021	4.4046	4.9211	1.00	7.00

Test of Homogeneity of Variances

Factor1

Levene Statistic	df1	df2	Sig.
1.054	3	101	.372

ANOVA

Factor1

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	37.132	3	12.377	8.446	.000
Within Groups	148.014	101	1.465		
Total	185.145	104			

POST HOC TESTS

Multiple Comparisons

Dependent Variable: Factor1

	(I) Education	(J) Education	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Primary schooling	Secondary (Matric)	-.68937	.28362	.078	-1.4303	.0515
		Tertiary	-1.74265*	.35730	.000	-2.6760	-.8093
		Post graduate	-1.24397	.48344	.055	-2.5069	.0189
	Secondary (Matric)	Primary schooling	.68937	.28362	.078	-.0515	1.4303
		Tertiary	-1.05328*	.32717	.009	-1.9079	-.1986
		Post graduate	-.55459	.46162	.627	-1.7605	.6513
	Tertiary	Primary schooling	1.74265*	.35730	.000	.8093	2.6760
		Secondary (Matric)	1.05328*	.32717	.009	.1986	1.9079
		Post graduate	.49868	.51021	.763	-.8342	1.8315
	Post graduate	Primary schooling	1.24397	.48344	.055	-.0189	2.5069
		Secondary (Matric)	.55459	.46162	.627	-.6513	1.7605
		Tertiary	-.49868	.51021	.763	-1.8315	.8342
Bonferroni	Primary schooling	Secondary (Matric)	-.68937	.28362	.101	-1.4527	.0739
		Tertiary	-1.74265*	.35730	.000	-2.7042	-.7811
		Post graduate	-1.24397	.48344	.069	-2.5450	.0571
	Secondary (Matric)	Primary schooling	.68937	.28362	.101	-.0739	1.4527
		Tertiary	-1.05328*	.32717	.010	-1.9338	-.1728
		Post graduate	-.55459	.46162	1.000	-1.7969	.6877
	Tertiary	Primary schooling	1.74265*	.35730	.000	.7811	2.7042
		Secondary (Matric)	1.05328*	.32717	.010	.1728	1.9338
		Post graduate	.49868	.51021	1.000	-.8744	1.8718
	Post graduate	Primary schooling	1.24397	.48344	.069	-.0571	2.5450
		Secondary (Matric)	.55459	.46162	1.000	-.6877	1.7969
		Tertiary	-.49868	.51021	1.000	-1.8718	.8744

*. The mean difference is significant at the 0.05 level.

Descriptives

Factor1 vs Production system demographic item

	N	Mean	Std. Dev	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
Open-field irrigated	54	4.4889	1.50203	.20440	4.0789	4.8989	1.00	6.80
Dryland rain-fed	30	4.3800	1.13180	.20664	3.9574	4.8026	2.60	7.00
Tunnels (Hydroponics)	22	5.3273	1.09813	.23412	4.8404	5.8142	3.60	7.00
Total	106	4.6321	1.36518	.13260	4.3692	4.8950	1.00	7.00

Test of Homogeneity of Variances

Factor1

Levene Statistic	df1	df2	Sig.
2.907	2	103	.059

ANOVA

Factor1

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	13.646	2	6.823	3.860	.024
Within Groups	182.045	103	1.767		
Total	195.691	105			

Robust Tests of Equality of Means

Factor1

	Statistic[a]	df1	df2	Sig.
Welch	5.251	2	57.123	.008

a. Asymptotically F distributed.

Post Hoc Tests

Multiple Comparisons

Dependent Variable:Factor1

	(I) Production System	(J) Production System	Mean Diff (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Open-field irrigated	Dryland rain-fed	.10889	.30273	.931	-.6110	.8288
		Tunnels (Hydroponics)	-.83838*	.33626	.038	-1.6380	-.0387
	Dryland rain-fed	Open-field irrigated	-.10889	.30273	.931	-.8288	.6110
		Tunnels (Hydroponics)	-.94727*	.37316	.034	-1.8347	-.0599
	Tunnels (Hydroponics)	Open-field irrigated	.83838*	.33626	.038	.0387	1.6380
		Dryland rain-fed	.94727*	.37316	.034	.0599	1.8347
Bonferroni	Open-field irrigated	Dryland rain-fed	.10889	.30273	1.000	-.6279	.8456
		Tunnels (Hydroponics)	-.83838*	.33626	.043	-1.6567	-.0200
	Dryland rain-fed	Open-field irrigated	-.10889	.30273	1.000	-.8456	.6279
		Tunnels (Hydroponics)	-.94727*	.37316	.038	-1.8554	-.0391
	Tunnels (Hydroponics)	Open-field irrigated	.83838*	.33626	.043	.0200	1.6567
		Dryland rain-fed	.94727*	.37316	.038	.0391	1.8554

*. The mean difference is significant at the 0.05 level.

APPENDIX F: OUTPUT OF ONE-WAY ANALYSIS OF VARIANCE FOR FACTOR 2

Descriptives

Factor2 vs. Land size (hectares)

	N	Mean	Std. Dev	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
Less than 2ha	26	4.2538	1.39549	.27368	3.6902	4.8175	2.20	6.80
2ha-10ha	48	5.1083	1.24999	.18042	4.7454	5.4713	2.80	7.00
11ha - 20ha	18	4.6000	1.11038	.26172	4.0478	5.1522	2.00	6.00
more than 20ha	14	5.6571	.74184	.19827	5.2288	6.0855	4.00	6.60
Total	106	4.8849	1.28284	.12460	4.6378	5.1320	2.00	7.00

Test of Homogeneity of Variances

Factor2

Levene Statistic	df1	df2	Sig.
2.387	3	102	.073

ANOVA

Factor2

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	22.560	3	7.520	5.106	.002
Within Groups	150.236	102	1.473		
Total	172.796	105			

Robust Tests of Equality of Means

Factor2

	Statistic[a]	df1	df2	Sig.
Welch	6.761	3	43.673	.001

a. Asymptotically F distributed.

Post hoc tests

Multiple Comparisons

Dependent Variable:Factor2

	(I) Hectarage	(J) Hectarage	Mean Diff (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Less than 2ha	2ha-10ha	-.85449*	.29553	.024	-1.6264	-.0826
		11ha - 20ha	-.34615	.37213	.789	-1.3181	.6258
		more than 20ha	-1.40330*	.40231	.004	-2.4541	-.3525
	2ha-10ha	Less than 2ha	.85449*	.29553	.024	.0826	1.6264
		11ha - 20ha	.50833	.33543	.432	-.3678	1.3844
		more than 20ha	-.54881	.36864	.448	-1.5116	.4140
	11ha - 20ha	Less than 2ha	.34615	.37213	.789	-.6258	1.3181
		2ha-10ha	-.50833	.33543	.432	-1.3844	.3678
		more than 20ha	-1.05714	.43248	.075	-2.1867	.0724
	more than 20ha	Less than 2ha	1.40330*	.40231	.004	.3525	2.4541
		2ha-10ha	.54881	.36864	.448	-.4140	1.5116
		11ha - 20ha	1.05714	.43248	.075	-.0724	2.1867
Bonferroni	Less than 2ha	2ha-10ha	-.85449*	.29553	.028	-1.6497	-.0593
		11ha - 20ha	-.34615	.37213	1.000	-1.3474	.6551
		more than 20ha	-1.40330*	.40231	.004	-2.4858	-.3208
	2ha-10ha	Less than 2ha	.85449*	.29553	.028	.0593	1.6497
		11ha - 20ha	.50833	.33543	.796	-.3942	1.4109
		more than 20ha	-.54881	.36864	.838	-1.5407	.4431
	11ha - 20ha	Less than 2ha	.34615	.37213	1.000	-.6551	1.3474
		2ha-10ha	-.50833	.33543	.796	-1.4109	.3942
		more than 20ha	-1.05714	.43248	.097	-2.2208	.1065
	more than 20ha	Less than 2ha	1.40330*	.40231	.004	.3208	2.4858
		2ha-10ha	.54881	.36864	.838	-.4431	1.5407
		11ha - 20ha	1.05714	.43248	.097	-.1065	2.2208

*. The mean difference is significant at the 0.05 level.

Descriptives

Factor 2 vs Education

	N	Mean	Std. Dev	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
Primary schooling	29	4.1793	1.18122	.21935	3.7300	4.6286	2.20	6.20
Secondary (Matric)	49	5.0367	1.28561	.18366	4.6675	5.4060	2.00	7.00
Tertiary	19	5.7053	.94132	.21595	5.2516	6.1590	4.00	7.00
Post graduate	8	4.7000	1.11098	.39279	3.7712	5.6288	2.80	6.40
Total	105	4.8952	1.28455	.12536	4.6466	5.1438	2.00	7.00

Test of Homogeneity of Variances

Factor2

Levene Statistic	df1	df2	Sig.
.788	3	101	.503

ANOVA

Factor2

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	28.617	3	9.539	6.738	.000
Within Groups	142.991	101	1.416		
Total	171.608	104			

Robust Tests of Equality of Means

Factor2

	Statistic[a]	df1	df2	Sig.
Welch	8.018	3	28.274	.001

a. Asymptotically F distributed.

Post Hoc Tests

Multiple Comparisons

Dependent Variable:Factor2

	(I) Education	(J) Education	Mean Diff (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Primary schooling	Secondary (Matric)	-.85742*	.27877	.014	-1.5857	-.1292
		Tertiary	-1.52595*	.35119	.000	-2.4434	-.6085
		Post graduate	-.52069	.47517	.693	-1.7620	.7206
	Secondary (Matric)	Primary schooling	.85742*	.27877	.014	.1292	1.5857
		Tertiary	-.66853	.32157	.167	-1.5086	.1715
		Post graduate	.33673	.45372	.880	-.8485	1.5220
	Tertiary	Primary schooling	1.52595*	.35119	.000	.6085	2.4434
		Secondary (Matric)	.66853	.32157	.167	-.1715	1.5086
		Post graduate	1.00526	.50148	.193	-.3048	2.3153
	Post graduate	Primary schooling	.52069	.47517	.693	-.7206	1.7620
		Secondary (Matric)	-.33673	.45372	.880	-1.5220	.8485
		Tertiary	-1.00526	.50148	.193	-2.3153	.3048
Bonferroni	Primary schooling	Secondary (Matric)	-.85742*	.27877	.016	-1.6077	-.1072
		Tertiary	-1.52595*	.35119	.000	-2.4711	-.5808
		Post graduate	-.52069	.47517	1.000	-1.7995	.7581
	Secondary (Matric)	Primary schooling	.85742*	.27877	.016	.1072	1.6077
		Tertiary	-.66853	.32157	.241	-1.5339	.1969
		Post graduate	.33673	.45372	1.000	-.8843	1.5578
	Tertiary	Primary schooling	1.52595*	.35119	.000	.5808	2.4711
		Secondary (Matric)	.66853	.32157	.241	-.1969	1.5339
		Post graduate	1.00526	.50148	.286	-.3443	2.3549
	Post graduate	Primary schooling	.52069	.47517	1.000	-.7581	1.7995
		Secondary (Matric)	-.33673	.45372	1.000	-1.5578	.8843
		Tertiary	-1.00526	.50148	.286	-2.3549	.3443

*. The mean difference is significant at the 0.05 level.

APPENDIX G: OUTPUT OF ONE-WAY ANALYSIS OF VARIANCE FOR FACTOR 3

Descriptives

Factor3 vs. Education

	N	Mean	Std. Dev	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
Primary schooling	29	3.5862	1.37301	.25496	3.0639	4.1085	1.00	6.00
Secondary (Matric)	49	4.3878	1.57872	.22553	3.9343	4.8412	1.00	7.00
Tertiary	19	5.3421	1.27533	.29258	4.7274	5.9568	1.25	7.00
Post graduate	8	4.4688	1.46652	.51849	3.2427	5.6948	2.50	7.00
Total	105	4.3452	1.55831	.15208	4.0437	4.6468	1.00	7.00

Test of Homogeneity of Variances

Factor3

Levene Statistic	df1	df2	Sig.
1.322	3	101	.272

ANOVA

Factor3

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	35.799	3	11.933	5.561	.001
Within Groups	216.748	101	2.146		
Total	252.548	104			

Robust Tests of Equality of Means

Factor3

	Statistic[a]	df1	df2	Sig.
Welch	6.530	3	27.719	.002

a. Asymptotically F distributed.

Post Hoc Tests

Multiple Comparisons

Dependent Variable:Factor3

	(I) Education	(J) Education	Mean Diff (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Primary schooling	Secondary (Matric)	-.80155	.34322	.097	-1.6981	.0950
		Tertiary	-1.75590*	.43238	.001	-2.8854	-.6264
		Post graduate	-.88254	.58502	.436	-2.4108	.6457
	Secondary (Matric)	Primary schooling	.80155	.34322	.097	-.0950	1.6981
		Tertiary	-.95435	.39591	.082	-1.9886	.0799
		Post graduate	-.08099	.55861	.999	-1.5403	1.3783
	Tertiary	Primary schooling	1.75590*	.43238	.001	.6264	2.8854
		Secondary (Matric)	.95435	.39591	.082	-.0799	1.9886
		Post graduate	.87336	.61741	.493	-.7395	2.4862
	Post graduate	Primary schooling	.88254	.58502	.436	-.6457	2.4108
		Secondary (Matric)	.08099	.55861	.999	-1.3783	1.5403
		Tertiary	-.87336	.61741	.493	-2.4862	.7395
Bonferroni	Primary schooling	Secondary (Matric)	-.80155	.34322	.129	-1.7252	.1221
		Tertiary	-1.75590*	.43238	.001	-2.9195	-.5923
		Post graduate	-.88254	.58502	.807	-2.4570	.6919
	Secondary (Matric)	Primary schooling	.80155	.34322	.129	-.1221	1.7252
		Tertiary	-.95435	.39591	.106	-2.0198	.1111
		Post graduate	-.08099	.55861	1.000	-1.5843	1.4224
	Tertiary	Primary schooling	1.75590*	.43238	.001	.5923	2.9195
		Secondary (Matric)	.95435	.39591	.106	-.1111	2.0198
		Post graduate	.87336	.61741	.962	-.7882	2.5350
	Post graduate	Primary schooling	.88254	.58502	.807	-.6919	2.4570
		Secondary (Matric)	.08099	.55861	1.000	-1.4224	1.5843
		Tertiary	-.87336	.61741	.962	-2.5350	.7882

*. The mean difference is significant at the 0.05 level.

Descriptives

Factor3 vs. Region (Locality)

	N	Mean	Std. Dev	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Germiston	30	4.9417	1.53365	.28000	4.3690	5.5143	2.00	7.00
Pretoria	45	4.1222	1.60045	.23858	3.6414	4.6030	1.00	6.75
Randfontein	31	3.9839	1.48174	.26613	3.4404	4.5274	1.00	6.25
Total	106	4.3137	1.58455	.15390	4.0085	4.6188	1.00	7.00

Test of Homogeneity of Variances

Factor3

Levene Statistic	df1	df2	Sig.
.053	2	103	.949

ANOVA

Factor3

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	16.853	2	8.426	3.517	.033
Within Groups	246.780	103	2.396		
Total	263.633	105			

Robust Tests of Equality of Means

Factor3

	Statistic[a]	df1	df2	Sig.
Welch	3.568	2	64.477	.034

a. Asymptotically F distributed.

Post Hoc Tests

Multiple Comparisons

Dependent Variable:Factor3

						95% Confidence Interval	
	(I) Region	(J) Region	Mean Diff (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Tukey HSD	Germiston	Pretoria	.81944	.36484	.068	-.0482	1.6871
		Randfontein	.95780*	.39642	.046	.0151	1.9005
	Pretoria	Germiston	-.81944	.36484	.068	-1.6871	.0482
		Randfontein	.13835	.36129	.922	-.7208	.9975
	Randfontein	Germiston	-.95780*	.39642	.046	-1.9005	-.0151
		Pretoria	-.13835	.36129	.922	-.9975	.7208
Bonferroni	Germiston	Pretoria	.81944	.36484	.081	-.0685	1.7074
		Randfontein	.95780	.39642	.052	-.0070	1.9226
	Pretoria	Germiston	-.81944	.36484	.081	-1.7074	.0685
		Randfontein	.13835	.36129	1.000	-.7409	1.0176
	Randfontein	Germiston	-.95780	.39642	.052	-1.9226	.0070
		Pretoria	-.13835	.36129	1.000	-1.0176	.7409

*. The mean difference is significant at the 0.05 level.