

**ANALYSIS INTO THE EFFECTIVENESS OF THE PROVINCIAL
AGRICULTURAL RESEARCH SYSTEMS OF KWAZULU
NATAL AND THE WESTERN CAPE**



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DECLARATION

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and has not previously been submitted in its entirety or in part at any university for a degree.

ABSTRACT

**ANALYSIS INTO THE EFFECTIVENESS OF THE PROVINCIAL
AGRICULTURAL RESEARCH SYSTEMS OF KWAZULU NATAL AND THE
WESTERN CAPE**

by

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With the advent of Globalisation, the need for improved competitiveness in agriculture, as in all sectors, has become increasingly important in obtaining satisfactory levels of growth and development. International producers are competing for South African markets while local producers must not only defend these markets, but also seek out opportunities globally. Agricultural research has been identified as one of the more important agricultural support services contributing towards the goal of increased competitiveness. Innovation and new technology are central towards achieving satisfactory competitiveness, and in order for these to be adequately available, the agricultural research system in place must be effective and efficient in its tasks and responsibilities.

The objective of this study was to determine whether or not the agricultural research systems of KwaZulu Natal and the Western Cape conform to the current challenges presented by the market, technology and economic environments. The effectiveness and efficiency of these systems regarding structural interactions, research investments and the involvement of the private sector was critically analysed with regard to the stakeholders within the system, namely: producers, co-operatives, private sector agribusiness companies and agricultural research institutes. The findings are discussed in terms of their implications for the agricultural sectors concerned and recommendations made for potential improvements and future areas of

research.

It was found that most of the structural interactions between the various stakeholders investigated were conducted inefficiently and have thus resulted in a lack of cooperation, poor relationship building, and sub-optimum productivity and growth. Furthermore, it was established that investment in agricultural research is too low. Although research expenditure growth rates and expenditure per fulltime researcher are high, most of the growth rates are on the decline and most of the organizations do not employ fulltime researchers, while the actual total amounts invested are low. Investment in market research for current products is satisfactory, while investment in market research prior to conducting research is poor. Finally, increased private sector involvement has not been realized. Incentives for greater private sector involvement based on profitability, have not been adequately developed. Of those companies who have recognized the need for increased commitment to research, all but one have predicted zero to low increases in research expenditure for the future, while current research expenditures are also low.

There are many areas in which the agricultural research systems of the two provinces concerned must improve. A culture inductive of greater research spending and private sector participation should be fostered to overcome the causes and motives behind these problem areas. Currently, the research systems investigated seem incapable of effectively and efficiently supplying the agricultural sectors concerned with the much needed new technologies, innovations and research management necessary to adequately increase competitiveness. However, if all the shortcomings of the system are recognized and a new demand driven orientation adopted, the research systems of South Africa will in the future be more likely to promote increased productivity and growth in agriculture through greater competitiveness.

SAMEVATTING

ONTLEDING VAN DIE DOELTREFFENDHEID VAN DIE PROVINSIALE LANDBOU-NAVORSINGSTELSELS VAN KWAZULU/NATAL EN DIE WES-KAAP

deur

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Met die koms van 'n verenigde wêreldmark, het dit noodsaaklik geword dat die landbou - net soos ander bedryfssektore - mededingend moet wees vir bevredigende groei en ontwikkeling in dié sektor. Internasionale produsente ding mee om Suid-Afrikaanse markte, terwyl plaaslike produsente nie net hierdie markte moet verdedig nie, maar ook nuwe geleenthede in die buiteland moet soek. Landbounavorsing is as een van die belangrikste landbou-ondersteuningsdienste geïdentifiseer om mededingendheid te verhoog. Om voldoende mededingend te wees, is vernuwing en nuwe tegnologie van wesenlike belang. Vir dié doel moet die bestaande landbounavorsingstelsel doeltreffend funksioneer en sy take en verantwoordelikhede behoorlik nakom.


Die doel van hierdie studie is om te bepaal of die landbounavorsingstelsels van KwaZulu/Natal en die Wes-Kaap die uitdagings van die huidige mark-, tegnologiese en ekonomiese omgewings die hoof kan bied. Die doeltreffendheid van strukturele interaksies, beleggings in navorsing en die betrokkenheid van die privaatsektor is krities ontleed aan die hand van die belangegroep binne die stelsel, te wete produsente, koöperasies, private maatskappye en landbounavorsingsinstitute. Die implikasies van die resultate is vervolgens bespreek en aanbevelings is gedoen vir moontlike verbeterings en toekomstige navorsingsgebiede.

Daar is bevind dat die meeste strukturele interaksies tussen die onderskeie belangegroepes wat bestudeer is, ondoeltreffend is. Daar is te min samewerking, weinig sprake van verhoudings bou, produktiwiteit is te laag en daar is te min groei. Daar is verder vasgestel dat daar te min in landbou-navorsing belê word. Alhoewel die groeikoerse van navorsingsuitgawes en uitgawes per voltydse navorser hoog is, is die meeste groeikoerse aan die daal, die meeste organisasies neem geen voltydse navorsers in diens nie en die totale besteding is laag. Belegging in marknavorsing vir bestaande produkte is bevredigend, maar belegging in marknavorsing voor navorsing aangepak word, is onbevredigend. Laastens is die privaatsektor nog nie voldoende betrokke nie. Daar bestaan egter nie genoeg aansporingsmaatreëls om die privaatsektor se betrokkenheid te verhoog nie. Van dié maatskappye wat wel die noodsaaklikheid van 'n groter verbintenis tot navorsing erken het, het almal behalwe een, nul tot lae verhogings in navorsingsuitgawes vir die toekoms voorsien, terwyl hulle huidige navorsingsuitgawes alreeds laag is.

Daar is baie opsigte waarin die landbounavorsingstelsels van die twee betrokke provinsies moet verbeter. Daar moet 'n kultuur ontstaan waar meer bestee word aan navorsing. Verder moet die privaatsektor meer betrokke raak om die omstandighede wat aanleiding gee tot die probleme, die hoof te help bied. Tans wil dit voorkom of die navorsingstelsels wat ondersoek is, nie daarin slaag om die betrokke landbousektore van die nuwe tegnologie, vernuwings en navorsingsbestuur te voorsien wat noodsaaklik is om mededingendheid te verhoog nie. Indien al die tekortkominge van die stelsel erken word en die korrekte aanpassings gemaak word, sal die navorsingstelsels van Suid Afrika in die toekoms 'n groter bydrae kan lewer om produktiwiteit te laat styg en groei in die landbou teweeg te bring.

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ACRONYMS

- ADI** - Agricultural Development Institute
ARC - Agricultural Research Council
ARC1 - ARC – Nietvoorbij-Infruitech centre for Fruit, Vine and Wine
ARC2 - ARC – Small Grain Institute
ARI - Agricultural research intensities
BNK - Bredasdorp-Napiers Ko-operasie
CFB - Co-operative Farmers' Butchery (Dalton)
CRK - Caledon-Riversdal Ko-operasie
CTC - Central Timber Co-operative (Pietermaritzburg)
DOA - Department of Agriculture
FTE - Full Time Equivalent
GATT - General Agreements on Tariffs and Trade
GCI - Grain Crops Institutes
GDP - Gross Domestic Product
ISNAR - International Service for National Agricultural Research
NARS - National Agricultural Research System
OECD - Organization of Economic Cooperation and Development
R&D - Research and Development
SAAU - South African Agricultural Union
SAES - State Agricultural Experiment Stations
SASA - South African Sugar Association
SASEX - South African Sugar Experiment Station
SOC - Stock Owners Co-operative (Durban)
SSK - Sentraal-Suid Ko-operasie
UCL - Union Co-operative Limited
USDA - United States Department of Agriculture
WPK - Westelike Provinsie Ko-operasie (Malmesbury)
WTO - World Trade Organization

Chapter One

INTRODUCTION

1.1 Background

During the early nineties, South African political, social and economic changes and adjustments stirred agriculture, and the economy as a whole, at both regional and national levels. Achieving higher levels of efficiency in agricultural production is becoming increasingly critical in light of the trends evident in the agricultural sectors of the world. Trends in global agriculture to some extent reflect those observed in the world economy, namely, the need for productivity and low cost production, and thus a shift from resource-based to science-based industries, political evolution and the ever present issue of globalization - the movement towards a truly global economy (Baharsjah, 1992). Agricultural industries will have to devise strategies that will improve their international competitiveness within this deregulated environment while developing a thorough understanding of global issues and trends (van der Merwe and Otto, 1997).

Under these circumstances South African agriculture is rapidly being incorporated into a borderless society characterized by advances in technology, political restructuring and changes in the global marketing environment. The role of market forces and the reduction of government intervention has received considerable attention in recent times (Pardey and Alston, 1996). Similarly, South Africa has experienced a substantial reduction in government intervention in agricultural marketing, as well as reductions in government expenditure aimed at supporting commercial agriculture (Groenewald, 1996). The question now facing agricultural producers and agricultural organizations alike is how do they overcome the challenges presented by these changes.

The history of economic development shows that few countries have achieved sustained economic growth without first, or simultaneously, developing their agricultural sector (Huffmann and Just, 1994).

Agricultural support services, such as agricultural research and development (R&D)¹, have long been identified as the tools necessary to assist in achieving sustainable growth in the present agricultural environment and can significantly influence the sector's level of productivity (Umali, 1992). Agricultural R&D has also been identified as being the key to increased competitiveness for the agricultural sector during, and after, transformation. Nevertheless, it is widely held that the returns from investment in agricultural research are high, while investment in research is low (Mullen and Cox, 1995). In South Africa total investment in public agricultural research has stagnated or declined since the sixties and seventies (Pardey et al., 1997), creating the need for increased private sector participation. In the past, many of the benefits of agricultural R&D were unclear. However, with the advancement of scientific methodologies these benefits have become clearer and thus under-investment heavily criticized (Masters et al., 1998).

This under-investment, despite high research returns, can often be blamed on inefficient policies lending themselves to inappropriate research system structures (Donovan, 1995). The question of whether agricultural R&D policies and priorities are appropriate for the new political and economic conditions in South Africa is pertinent and urgent (Donovan, 1995). For R&D to be effective it must not only reflect market conditions and trends, but also prove suitable for local conditions and circumstances. A functional and suitable agricultural research system must be in place in order to facilitate this type of research. With this need for an effective agricultural research system in mind, this study focused on the research systems of the agricultural sector of the KwaZulu Natal and Western Cape provinces.

1.2 The problem

It is necessary to determine whether or not the present National Agricultural Research System (NARS) in South Africa is suited to the new deregulated environment and is able to deliver appropriate technologies necessary to push the South African

¹For this study the term 'research' means the identification and confirmation of relationships, through experimentation and investigation, that create knowledge on physical, biological and social patterns and relationships. 'Development' of a product/technique entails the application of knowledge generated by research directed towards the creation of the product /technique, and the adoption thereof to local conditions. 'R&D' refers to all the activities of research, development and extension.

agricultural sector forward on the world stage (Donovan, 1995). In order to provide a representative picture of the present NARS in South Africa, the agricultural research systems of KwaZulu Natal and the Western Cape were investigated. The aim of this study was, therefore, to ascertain the current status of the agricultural research systems in the two provinces with regard to certain aspects of their suitability in supplying appropriate technologies and increasing the competitiveness of producers and agribusiness, for which they are responsible.

The problem statement for this study thus reads:

'The agricultural research systems operating in KwaZulu Natal and the Western Cape have not been sufficiently adapted to conform with current market dispensations. These research systems are thus unsuited for the task of supplying the agricultural sectors of these provinces with the relevant technologies and research management necessary to promote satisfactory growth while maximizing global competitiveness.'

1.3 Objectives of the study

The research systems of the two provinces will be critically analyzed in terms of their structure, investment trends and the role of the private sector. All stakeholders from producers to the researchers themselves will be included to ensure that the whole research system is reviewed.

The purpose of the structural analysis was to investigate the interactions between producers, research institutes and the more prominent agribusiness organizations present in the system. The research investment trends were analyzed in terms of internationally accepted and recognized investment indicators. Special attention was given to the market relatedness of these investments in order to determine how far the various stakeholders have progressed in becoming market orientated. The increasingly important role of the private sector was also investigated, specifically, how this trend

has evolved in the provinces concerned in terms of recognition thereof and implementation thereof.

These aspects of the study form the main objective which was to investigate the awareness of top and middle management of agribusiness institutions of the strategic importance of R&D and also their efforts to implement this awareness; and furthermore the degree to which the operating functions and structures of the agricultural research systems of KwaZulu Natal and the Western Cape have been altered to suit the new dispensation.

Once the review regarding the various aspects of the functioning of the agricultural research systems of KwaZulu Natal and the Western Cape was completed, the implications of the findings were analyzed. Recommendations with regard to possible improvements in the respective systems and additional fields of study for the future completed the study.

A BACKGROUND ON AGRICULTURAL RESEARCH

2.1 Introduction

It is common knowledge that South African agriculture is facing an environment that has changed and is likely to change even more in the future (Groenewald, 1996). The advancement of technology has significantly negated the distance factor (van der Merwe and Otto, 1997), government intervention has been reduced significantly (Groenewald, 1996), wide-ranging policy changes have occurred (van Zyl et al., 1997), and competition has become global in nature (Hough, 1996). These developments have resulted in international organizations, such as the World Trade Organization (WTO), putting pressure on countries to liberalize their respective agricultural sectors in order to create opportunities for trade in agricultural products (van der Merwe and Otto, 1997). South Africa is no exception and the far-reaching effects of these trends have become a reality.

International marketing developments, especially the Uruguay Round Agreements of the General Agreement on Tariffs and Trade (GATT) and fundamental changes in government policy, have resulted in a relatively free South African agricultural market (van der Merwe and Otto, 1997). South African policy moved from a fully regulated marketing environment towards an open system, where market forces determine prices and a demand-driven orientation demands precedence (Groenewald, 1996).

The impact of global agricultural price changes on the welfare of individual countries is substantially effected by their structure of distortions² (Anderson, 1997). The changes in economic and social policies that took place in South Africa had a greater effect on agriculture since 1994 than changes in the international system (van der Merwe and Otto, 1997). However, the effects of international changes have been amplified since government intervention ceased. The consequences of former market distortions are now being felt with the sudden loss of protective

²Distortions of trade and of domestic production and consumption through subsidy and tax policies.

policies, resulting in an exposed and vulnerable agricultural sector (van der Merwe et al., 1997).

Differential tariff levels within a very complex tariff system have led to the circumvention of import tariffs, which led to severe disruptions of internal markets (van der Merwe and Otto, 1997). Grain farming, for example, has been hard hit with production levels and profitability predicted to drop to previously unknown low levels in the absence of tariff protection (van Zyl et al., 1997). The meat industry suffered under the imports of spiced meat at very low tariffs, thus losing out on market share (Vorwerk, 1999). The dairy industry experienced similar difficulties where cheddar cheese, at a tariff of R6.60 per kilogram, was at one stage cleared as cured cheese at a tariff of 20 percent ad valorem (van der Merwe and Otto, 1997).

Regarding market access, it is unfortunate that the agricultural sector has been liberalized without having gained much market access for producers. The Uruguay Round has failed to open up international markets for many South African agricultural products. The fruit and wine industries, however, have benefited significantly (van der Merwe et al., 1997). Overseas markets, especially the European Union - South Africa's main importer of agricultural products, still have high tariffs in place, while governments still heavily subsidize producer exports. It was estimated that South Africa's percentage producer subsidy equivalents would be the lowest of all developed countries by the end of the nineties (Swart, 1997).

International marketing developments have thus had little effect on domestic agricultural production (van der Merwe and Otto, 1997). Local policies, or lack thereof, are more likely to affect agricultural production over the short term than changes in international marketing developments (van der Merwe and Otto, 1997). The difficulties experienced in the grain industries is a case in point.

All agribusiness organizations in South Africa have felt the burden of policy changes and trade liberalization. Companies will have to distribute their products more widely and quickly, reduce costs and increase their market share in order to cope with the environmental changes and increased competition (Hough, 1996). Value adding and product positioning will become critical if a company is to survive (Hough, 1996).

Both local and international forces will be working in on the domestic agricultural sector which includes agricultural research and technology development (SAAU, 1998). It is imperative for policy makers, producers and agribusiness to understand these changes and adapt accordingly (van der Merwe and Otto., 1997). It is the responsibility of these parties to promote prosperity within the South African agricultural sector by altering their business approach to not only overcome the difficulties of the new marketing environment, but also to seek out the opportunities presented by it.

2.2 The changing focus of agribusiness

Since deregulation, economic rules have dictated agricultural production and marketing and not political ones (van Niekerk, 1996). The implications thereof for the agribusiness sector have unfortunately not always been clear and many organizations have as yet not adopted a new strategic orientation. Agribusiness has no alternative but to adapt to the new circumstances posed by the government and South Africa's re-entry into world markets (van Niekerk, 1996).

Since the sweeping changes in South Africa's economy took place, commercial agriculture has had to realign itself in terms of what markets to serve, identifying its strengths and weaknesses and redefining its business objectives. This points towards applying management science to determine objectives and to formulate plans to reach these new objectives (Groenewald, 1996). Given the continuing and accelerating globalization of agricultural markets, the focus of South African commercial agriculture should be widened to include scopes not previously regarded as important such as competitiveness and innovation (Groenewald, 1996). However, in order to do this effectively, agribusiness must be in possession of the right 'tools' (Fenyés, 1996).

One such 'tool' is a research and information service for strategic management and policy analysis in the agricultural sector, which will assist agricultural organizations, producers, food processors and suppliers in their strategic management tasks (Spies, 1996, as quoted by van der Merwe and Otto, 1997). Another is market information services that will carry out data collection, processing, transformation, dissemination and utilization tasks with the aim of making it available to businesses within the

agricultural sector (Shepherd, 1996). With these services in hand, the agricultural sector is in a position to overcome the economic challenges facing it and create new opportunities for trade in agricultural products (van der Merwe et al., 1997).

Future strategies should be built on strengths, while threats and weaknesses must be eliminated and opportunities pursued (Groenewald, 1996). Once commercial agriculture has concentrated its strengths and identified its weaknesses, it can start implementing these strategies for the future. Some of the more important areas that need to be addressed are listed below (Groenewald, 1996).

- *Public image and approach* that reflects political neutrality. It should be the guiding principle of commercial agriculture to argue matters on their merits, to improve its image and to retain this image in negotiations with government, consumer groups and industrialists.
- *Marketing and trade*. It is in the interests of commercial agriculture to carry out its own search and analysis of global and domestic markets. As South Africa is a rather small player in the international arena, it may have a better opportunity than most in developing niche markets, particularly considering the new opportunities in the Pacific Rim, China, India, and the Arab World.
- *Labor relations*. South African commercial agriculture must urgently update its labor management and its general relationship with its labor force. This may require special training.
- *Small scale agriculture*. If wisdom prevails, commercial agriculture will strengthen its ties with the small farmer sector. Good relations and sound advice can assist in creating a modern commercial sector out of the present small sector.
- *Knowledge, information, research and extension*. Producers will have to improve their managerial knowledge, production techniques and marketing skills. The demise of control boards means a drop in market information, something the agricultural sector can ill afford at this stage. Efforts will have to come from

within to support and stimulate agencies that will supply relevant and pertinent information and technology.

It is this last issue of knowledge, information, research and extension, described as fundamental to strategic planning (van der Merwe and Otto, 1997), which was the focal point of this study. Deemed critical to the success of any agricultural endeavor by most, a proper functioning research system is necessary, with competent administrators at the helm operating within every provincial agricultural sector. The changing roles of the research system in South Africa, as well as the dynamics of its supporting structure will be discussed throughout this study.

2.2.1 The focus on innovation and research in agribusiness

Trade liberalization and a shift in policies have redefined the role of the agribusiness sector in South Africa as an international player (Hough, 1996). This change in priorities must be directed towards increasing the effectiveness of the total system (Nilsson, 1993). Firstly, the organizations in question must adapt better to the market environment in order to survive competition with other private firms. Secondly, agribusiness organizations must accept that their operations must become more market orientated, in order to improve their competitive position against other firms, whereby the efficient ones will prosper and the inefficient ones will do worse (Nilsson, 1993).

How to adapt and survive in a marketing intensive environment becomes the key issue. Entrepreneurship, renewal and growth are central to effective strategic management in a hostile environment (Schendel et al., 1979, as quoted by Hough, 1996). In order for these three components to be realized the organization concerned must investigate the need for innovation, research and development as improved management, although imperative, is hardly ever enough to ensure success (Baldwin, 1995).

Innovation is consistently found to be a major contributor to the success levels of all firms (Moro, 1993). A study aimed at investigating the various components that led to success amongst smaller firms determined that innovation was the most important characteristic associated with success (Baldwin, 1995). New technologies in

production, marketing and business organization appear to be creating many new opportunities, especially in the form of niche markets (Groenewald, 1996). Farmers and agribusiness organizations concentrating on innovation thus stand to gain the most (Groenewald, 1996).

Internationally, organizations have turned to institutional changes, commercialization, cost recovery initiatives and privatization in the process of successfully shifting resources towards innovation and R&D in order to stay ahead of the pack (Dinar, 1996). South African commercial agriculture would benefit from studying these international developments and develop its own unique models (Groenewald, 1996). The existence of research and extension departments in some organizations, as well as some producer associations with their own research stations, will help to facilitate the process, but cost recovery and lack of funds in general are still a major problem (Groenewald, 1996).

Most of the responsibility for providing new technologies and information for all industries within the agricultural sectors of the country will rest with the research institutions under the jurisdiction of the Agricultural Research Council. The role of the private sector in this regard is also important and will be discussed later. Traditionally, research priorities have always been set in a top-down manner, resulting in inefficiencies and mismanagement of resources (Donovan, 1995). In order to develop the appropriate technologies, research should be conducted from the bottom-up as determined by producers and local conditions (Donovan, 1995). Furthermore, research will need to become more sensitive to global trends, both economic and scientific in nature.

2.3 The role and contributions of research in agriculture

Methods for measuring the returns to agricultural research have been widely documented by authors such as Thirtle (1992), Echeveria (1990), Khatri et al. (1996), Townsend et al. (1997), and Elbasha (1997). The methodologies involved are rather complicated and are not relevant to this study. However, discussing the nature of the contributions of R&D, especially in the South African context, is still pertinent.

Amongst scientists there are various views on what the role and contribution of R&D are towards agricultural production. Some acknowledge the presence of potential benefits, while others demand action based on the certainty of their convictions that R&D is central to growth in any industry. Generation of new technologies creates conditions for investment and growth (Tollini, 1995). Conversely, failure to understand the need for R&D hinders growth. There is little doubt that in industrialized countries - the widely enjoyed standards of living being proof - the majority of the people have benefited from the results of agricultural research (Bonte Friedheim, 1991). Schimmelpfennig and Thirtle, (1994), suggest that R&D and productivity are cointegrated, while Rukuni (1996), argues that in developing countries, agricultural research must assist in safeguarding the future and protect natural resources. The fundamental issue in developing countries is poverty alleviation (Baharsjah, 1992).

The role of R&D is clearly multi-dimensional and each facet is as justified as the next in terms of the contributions that it makes. The South African Agricultural Union (now called AGRI-SA) believes it is commonly accepted that the performance and welfare levels of all agricultural sectors throughout the world are dependent on the continued commitment towards demand driven R&D and extension (SAAU, 1998). Agricultural research can contribute in the following ways (Tollini, 1995):

- *Research stimulates growth* by means of increased productivity, reduced production and input costs, development of new products and improvement on existing ones, contributing to policy processes and reducing risk.
- *Research promotes sustainability*. Increased production due to expansion or intensification of the area under cultivation.
- *Research helps to alleviate poverty*. Cost reduced technology is essential in lowering food prices, which directly effects the poor who spend most of their budget on food. However, improved technology can also lead to the displacement of labor for mechanization, which has an adverse affect on employment of farm workers.
- *Research contributes to financial stability* by broadening the tax base, lowering prices through expanded food supply, increased export opportunities and possibly raising incomes.

The demands placed on national and international research is intensifying (ISNAR, 1992). The role of R&D in providing the potential benefits listed above must be recognized and governments must be convinced of the contribution that research can make to national development (Baharsjah, 1992).

2.3.1 The contribution of research to South African agriculture

All indications are that agricultural R&D, as well as the technology systems in place, have contributed substantially towards the productive application and use of resources (SAAU, 1998). However, although this may be true for certain sections of the farming sector, the fact that R&D was misguided in the past, has resulted in high opportunity costs and a drop in social welfare (Donovan, 1995). This misguidance can be explained as follows.

By means of a profit function approach it has been estimated that the returns to public sector research in South Africa is approximately 44 percent (Khatri et al., 1996). This picture is, however, misleading. Market distorting macro policies³ have resulted in serious resource misallocation, in turn resulting in over-capitalization (Khatri et al., 1996). This over-capitalization has been socially costly if one looks at the unemployment and poverty levels in the rural sector that were of direct consequence, as well as the agricultural sector using scarce resources wastefully (Khatri et al., 1996). This raises an interesting question regarding the social returns to R&D. Furthermore, the lag time between research and resulting productivity is often long.

While the returns to public expenditure seem high, the issue now is to whom do those high returns accrue (Khatri et al., 1996). Commercial farmers make up five percent of all farmers in South Africa and have in the past received 50 percent of state expenditure, while the remaining 95 percent received only 30 percent of government's R&D budget, spent mostly on extension work (Donovan, 1995). It has already been mentioned that market distortions led to

³ Policy distortions in this case refers to excessive subsidization, use of tariffs, price fixing, single channel marketing and other forms of government intervention.

over-capitalization, and it is this over-mechanization that led to high costs for farmers and decreased profits. This indicates inefficient use of the 50 percent of state funds that were made available for commercial farmers.

Furthermore, one of the more important objectives of agricultural research should be an increase in consumer welfare through a decrease in commodity prices (Schuh, 1986). In South Africa, however, the controlled marketing system led to higher domestic prices especially in years of surplus (Khatri et al., 1996). Added to this is the fact that R&D expenditure has contributed to the substitution of labor for capital and thus to rural poverty and unemployment. The minority has thus benefited from R&D and the returns to R&D grossly overestimated.

If R&D is to play a part in the future development of South African agriculture, it must be redirected to provide technology for the non-commercial sector, as well as technology that will serve the commercial sector positively in response to market forces free from distorted government intervention (SAAU, 1998). In order to do this successfully, the structure of the R&D system in South Africa needs to be analyzed and altered wherever necessary.

2.4 Structure of agricultural research systems

Differences in agricultural growth patterns are in large attributed to the varying policies adopted towards agriculture and, more specifically, agricultural research (ISNAR, 1992). Public agricultural research systems, also known as national agricultural research systems (NARS), vary in terms of who funds, manages and performs the research (Alston et al., 1998). A NARS is an institution that supplies a core economic development support service through the generation of suitable agricultural technology (Tabor, 1995). Without such innovations, the agricultural sectors of many developing countries would be sentenced to low productivity and ever-increasing pressure on fragile natural resources (Tabor, 1995). If agricultural research systems do not perform effectively, farmers will lack the technologies they need to respond positively to changing macroeconomic policies, public investment, and price regimes (ISNAR, 1995).

In most countries the structure of NARS has evolved through *ad-hoc* growth as a government department within a ministry of agriculture (Donovan, 1995). An inefficient agricultural R&D institutional structure is the result of a lack of effective planning, and inter-departmental power politics, institutional prestige considerations and personality problems have had a greater hand in shaping the organizational structure than planning according to the specific needs of a country (Arnon, 1968). An additional reason for the presence of unsuitable institutional R&D structures is that their activities are supply-led, having been enforced by an administrative bureaucracy instead of being demand-led by being determined from the stakeholders up (Donovan, 1995).

Many, if not most, of the problems of state managed agricultural R&D are intrinsic to an organization structured as a government department, which by definition are public institutions and therefore political (Donovan, 1995). Because their goals will be politically determined and decisions politically motivated, they will be predisposed to financial and economic losses. Furthermore, all of their operations will ultimately be judged and determined by politicians and not market forces (Knudsen and Nash, 1990). The end result is an ineffective research system due to ineffective interactions between stakeholders (Donovan, 1995).

As a result, public agricultural R&D systems have experienced various degrees of structural adjustment in recent years (Alston et al., 1998). Growing recognition of the importance of a policy environment conducive to economic growth and development, has also contributed to increasing international support for policy reforms (Tabor, 1995).

2.4.1 Recent international structural changes to agricultural research systems

Uncertainty and adverse publicity surround the notion of structural adjustment of agricultural research, leading to a poor understanding of the causes and consequences of policy reform, which in turn induces confusion and uncertainty (Tabor, 1995). This is particularly relevant in Africa where NARS' have a greater responsibility to supply the rural population with new applicable technologies,

enabling the rural population to respond efficiently to changes in the economic environment (Tabor, 1995).

During the past three decades, African NARS', including South Africa, have grown substantially in size, particularly the number of mid-sized systems, i.e. those employing between 100 and 400 researchers (Pardey et al., 1997). Public sector agricultural research is carried out mainly by government agencies, while universities and semi-public agencies play only a minor role (Pardey et al., 1997). Currently, government, semi-public agencies and universities account for roughly 86.5, 3.5 and 10 percent of public research respectively. University personnel in Africa allocate less than 15 percent of their time to research (Pardey et al., 1997). The challenge ahead is to usefully mobilize and manage the available potential without undermining their important role in training future generations of African researchers (Pardey et al., 1997).

In developed countries the motivation behind structural changes reflect more the need to adapt to the changing environment than the need to overcome inefficiencies. The changes currently taking place in the national research structures of developed countries reflect six major trends (Alston et al., 1998), namely:

- Trends towards using public funds to support more basic rather than applied or 'near market' research
- Trends towards the joint funding of near-market research through the development of industry levies and other such mechanisms
- Revamped oversight and accountability mechanisms and other changes in management of research resources
- Measures for encouraging competition among researchers to increase research productivity and as a means of allocating research resources
- Measures to privatize, directly or indirectly, public agricultural research facilities
- Trends towards the rationalization of public agricultural research institutions.

In the United States, there are two closely linked, but separate, research systems. The United States Department of Agriculture (USDA) primarily has one large national research agenda for all of its research agencies, while receiving almost all of its funds

from the federal government (Huffmann and Just, 1994). In contrast the state agricultural experiment stations (SAES) system has more than fifty separate agricultural experiment stations with fifty different research plans for individual States (Huffmann and Just, 1994).

The success of the SAES's has been widely acknowledged by Ruttan (1989) and Huffman and Just (1994). The primary reason for the success of the SAES system is its decentralized nature, which provides sufficient flexibility and incentive to adapt to local or state needs (Huffmann and Just, 1994). Furthermore, the importance of vertical integration, so that the needs of stakeholders and producers are aligned with the intentions of the funding body and the researchers, is heavily emphasized (Huffmann and Just, 1994).

As with most countries economic hard times have forced land grant administrators in the United States to look for new sources of funding, prioritize research, initiate cutbacks and generally enforce tighter control over research projects (Alston et al., 1998). As a result, land grant universities and SAES's in some States have undergone structural changes. Administration of extension has moved to a university official above the dean of agriculture (Huffmann and Just, 1994). Similar changes in administration have occurred in experiment stations. As a result, simple traditional administrative lines have been modified in a way that most likely lowers incentives for co-operation amongst research institutions because of increased competition (Huffmann and Just, 1994). Separating research and extension activities into different institutions is a recipe for inefficiency (Anderson and Hardaker., 1992). Yet policy and environmental changes may leave the research system in question with little choice.

This situation has some political and economic consequences (Huffmann and Just., 1994). Although the changes have little effect on the productivity of universities, the change in administrative structure within SAES's reduces productivity of research expenditure by shifting the focus away from innovations that improve local productivity. Research will then be conducted according to the demands of those who fund the research, resulting in sub-optimum application of resources.

Other rich countries have also undergone structural changes in recent years. While public research in the United Kingdom, New Zealand and the Netherlands is dominantly administered by the national government, Australia has a similar set-up to

the United States with a mix of state and nationally administered institutions (Alston et al., 1998). Public research agencies in the United Kingdom, New Zealand and the Netherlands have been consolidated and commercialized in many instances. In New Zealand, new Crown Research Institutes were established in an effort to create a market for R&D services where a distinction is clearly made between buyers and sellers of such services (Alston et al., 1998).

Closer analysis of the trends listed above will provide a clearer picture of the motivation behind these structural changes:

- ***Basic and applied research***

In the United States, the Netherlands, and the United Kingdom research funds derived from general tax revenues have been redirected towards basic research and away from applied research (Alston et al., 1998). This change in policy is in accord with the notion that public funds should be used to provide public goods (Pardey et al., 1997). In all three countries, the R&D funds allocated to universities (that typically conduct basic research) has increased substantially (Alston et al., 1998)

- ***Managed competition***

The introduction of managed forms of competition for the allocation of public funds has been a feature in most OECD countries since the mid-1980's (Alston et al. 1998). The result is increased competition between researchers for these funds. For example, in the United Kingdom Universities are assessed once every five years with respect to their research output. They are then given a ranking of one to five, five being excellent, and research resources are allocated according to these results (Alston et al., 1998). Similarly, universities in the Netherlands are allocated funds according to four-year research plans submitted once every two years (Alston et al., 1998).

- ***Privatizing previously public roles***

One of the more striking examples of this trend is found in Australia where R&D corporations were established to manage research funds generated by industry levies with dollar-for-dollar matching funds to be provided by the government up to a limit

of 0.5 percent of the gross value of industry production (Alston et al., 1998). The Netherlands has also adopted a similar joint funding principle for experiment stations and other research programs (Smith et al., 1997, as quoted by Alston et al., 1998). In New Zealand, the Crown Research Institutes were established, while in the United States, private sector involvement occurred incrementally rather than due to major legislative changes (Alston et al., 1998). Changes such as these make a great deal more funds available for public use, while revitalizing agricultural research (Donovan, 1995).

- ***Rationalizing government agricultural research***

In the Netherlands and United Kingdom, the perceived costs of inefficiencies in public research systems grew (Alston et al., 1998). As a result agricultural research in the Netherlands is constantly being reorganized and rationalized and oversight made more streamlined, while in the United Kingdom the number of publicly funded research institutes has been more than halved. Public expenditure has similarly been rationalized in most rich countries (Alston et al., 1998). Public sector management policy reforms are undertaken in an attempt to refocus and enhance the effectiveness and efficiency of public sector activities (Tabor, 1995).

Changes in the scientific, economic and political factors relating to agricultural science have created serious concerns for managers of national research organizations in that restructuring is a task with little certainty (Alston et al., 1998). Consequently, countries adopt their own unique structural changes in an attempt to adapt to the changing environment. Another reason why structural changes are taking place is that research administrators may simply be incompetent or are experimenting with different structures in order to obtain the one most suited to their situation (Huffmann and Just, 1994). In general, however, most R&D structural developments are an attempt to adapt to the changing market and economic environments where fiscal constraints have become a dominant factor (van der Merwe and Otto, 1997).

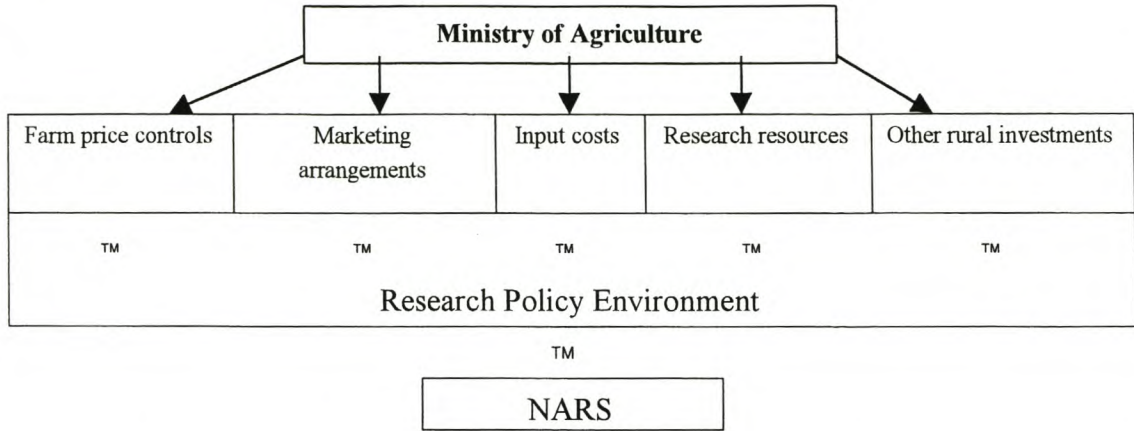
2.4.1.1 Research system responses to structural adjustments

Agricultural research systems are affected by changing economic policies in two ways (Tabor, 1995). Firstly, the demand for new technologies, and the capacity to adopt them, change as policies change. Secondly, policy reforms directly affect the operating environment for research systems (Tabor, 1995). The degree of adjustment carried out by agricultural research institutions in response to changing economic policies, will depend on the balance between forces leading to inertia, such as long-standing bureaucratic routine and forces motivating institutional innovation, such as political lobbying by technology users (Tabor, 1995).

In a regulated economy, the agricultural ministry would determine the structure of the agricultural research policy environment (Donovan, 1995) (Refer to Figure 2.4.1.1.1). A small number of officials would determine agricultural input and output prices, organize marketing and determine the levels of investment into the sector (Tabor, 1995). This situation means that NARS leaders would identify the Ministry of Agriculture as the architect of research policy and consequently turn to them for policy guidance or to influence the policy process (Tabor, 1995).

In a liberalized, adjusted economy (refer to Figure 2.4.1.1.2) the research policy environment becomes more reflective of the economic environment. The agricultural research system is affected by, and must respond to, policies emanating from many different ministries and many of these policies are set for the economy as a whole, rather than for the specific interests of agriculture (Tabor, 1995). Furthermore, many of the key factors influencing agriculture, such as global and local market forces, are left free from government intervention. Leaders of research are faced with the challenge of having to learn to operate effectively in a more institutionally diverse and market-responsive research policy environment (Tabor, 1995).

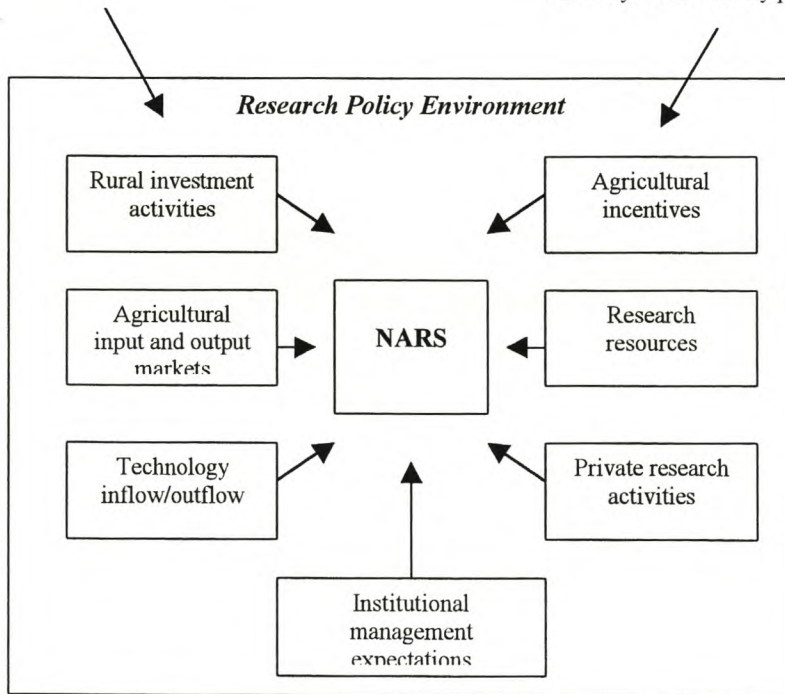
Figure 2.4.1.1.1: Pre-adjustment controlled-economy case



Source: ISNAR, Proceedings of the Roundtable on Research Policy and Financing in an Era of Adjustment, Pretoria, Republic of South Africa, 1995.

Figure 2.4.1.1.2: Post-adjustment liberalized-economy case

- Ministry of Planning/Donor activity
- Trade/Industry Ministry Investment Policy
- Development Bank Lending Policy
- Global markets
- Central Bank Exchange Rate Policy
- Finance ministry and Trade policy
- Ministry and Monetary policy



Source: ISNAR, Proceedings of the Roundtable on Research Policy and Financing in an Era of Adjustment, Pretoria, Republic of South Africa, 1995.

One of the more important responses emanating from research systems after policy changes is that the content and focus of agricultural research changes (Tabor, 1995). Policy change will alter both the relative profitability of agriculture as a whole and that of various agricultural activities, which in turn will affect the expected profitability of different agricultural innovations, as well as the capacity of the farm community to adopt new technologies (Tabor, 1995). For example, if agricultural input subsidies were to be reduced, agricultural producers are likely to demand new technologies with lower cash requirements. If output prices increase after trade liberalization, and other steps are taken to enhance competitiveness, producers may have a greater incentive to adopt more productive technology and to diversify into new products for emerging markets (Tabor, 1995). Should export incentives improve, farmers may have more of an incentive to produce for global rather than local markets (Tabor, 1995).

Such changes in the agricultural incentive environment will affect the demand for research services, which may be latent in the sense that the implicit willingness to innovate, has been altered (Tabor, 1995). For the research service itself, a major challenge will be to anticipate and respond to the changes in agricultural incentives by establishing an appropriate research agenda.

2.4.1.1.1 International examples

The structural changes that have taken place in the United States with regard to increased competition have resulted in a misalignment between producer demands and the actual research provided (Huffman and Just, 1994). State experiment stations have shown a new tendency to conduct research according to those who fund it and not according to local conditions, as was the case when competition was not an issue. The separation of extension duties from research institutes, as is the case in the United States, will quickly lead to inefficiencies (Anderson et al., 1992).

Evidence of research system responses in Australia and New Zealand is unclear and any conclusions are based on speculation and suspicion (Jacobson et al., 1997, as quoted by Huffman and Just, 1994). Private sector involvement, however, has without doubt made more funds available for public sector research while giving the agricultural sector in general a much needed boost (Alston et al., 1998). This is a

phenomenon experienced also by the United Kingdom, Australia, the Netherlands and many of the remaining developed countries (Alston et al., 1998).

A broader picture with regard to research system response to structural changes can be derived from a study carried out by ISNAR in which six countries, namely Indonesia, Sri Lanka, Burkina Faso, Ghana, Chile and Mexico, were investigated. These countries represent those with important agricultural sectors and with a relatively well developed agricultural research capacity, a definition that would include South Africa. A summary of the various aspects of the response is listed below (ISNAR, 1995).

- ***Adjustment and the research policy environment***

Not all the economies that experienced positive adjustment were able to stimulate higher rates of agricultural growth. Chile, Ghana, Burkina Faso, and Indonesia recorded moderate to high agricultural growth during the main period of structural adjustment, mainly due to increased yields associated with the adoption of new technologies. Agriculture has stagnated in the case of Mexico and Sri Lanka. Diversification into new export-orientated, high value agricultural commodities was especially important for the growth experienced in Chile and Indonesia. In Ghana and Burkina Faso, expansion in traditional export crops was the main source of agricultural growth. In contrast Mexico and Sri Lanka recorded no growth in major commodities or diversification.

Agricultural production incentives were more favorable in Chile, Ghana, Burkina Faso, and Indonesia, which influenced the demand for new technology while increasing the ability of the farm communities to afford these new technologies. In Chile and Indonesia, improvement in the agricultural investment environment (accomplished mainly through property rights reform, investment and trade liberalization) made agriculture more attractive to outside investors. This resulted in booms in some of their major agricultural commodity industries. In Burkina Faso, public sector support for rural development led to small scale farmers expanding cotton production fivefold through financial and technological support. In Ghana, the abolition of punitive taxes on cocoa exports, together with donor support, led to the recovery of that traditional export crop.

In both Mexico and Sri Lanka, structural reforms in trade, marketing and rural property rights have not dramatically changed the agricultural investment environment due to terms of trade shifting away from agriculture. In both countries agricultural programs continue to be dominated by subsidy and market stabilization schemes which have been notably ineffective in stimulating agricultural growth.

- ***Research financing linkages***

Cutbacks in public investment were a feature of all of these economies. In the successfully adjusting economies, the financing position of agricultural research has been superior to that of other public investment-oriented activities. During the main adjustment period, total agricultural research spending increased fourfold in Chile, doubled in Burkina Faso and Ghana, and remained relatively flat in Sri Lanka and Indonesia. Only in Mexico did total research spending fall sharply, a decline of over 50 percent. In several countries funding was volatile during the adjustment years, but in all countries, with the exception of Mexico, agricultural research spending accounted for a higher share of public investment and public expenditure after adjustment than before.

- ***Staff development***

During structural adjustment periods, growth in the size of the public service was held in check or reduced in all six countries. The numbers employed by agricultural research institutions, by comparison, continued to grow substantially during this time. The number of trained scientists at work tripled in Sri Lanka, doubled in Indonesia and Chile, and increased by 40 to 50 percent in Burkina Faso and Ghana. Despite the plummeting budget it rose by 10 percent in Mexico.

- ***Research agenda***

All the countries surveyed assessed their research priorities during the adjustment periods. In all cases it was easier to document gaps, inefficiencies, and sub-optimal use of resources than to change the focus of the research, due to strong conservative forces. In Ghana, for example, the export crop research program remained dominated by cocoa, despite well-articulated demands for alternative agroexports as cocoa markets weakened. In Mexico, research remained concentrated on the irrigated

northern lands, despite the shift in policy priority toward the smaller farmers in the rainfed south.

Changes in research priorities did however occur when agriculture expanded into new areas. In Ghana, food crop research priorities shifted towards maize in response to a major commodity development program and donor support. In Chile, the national research service was assigned responsibility for agricultural extension and outreach. Burkina Faso developed new research capacity in an attempt to redress colonial biases toward export crops and to provide more direct services to small growers. Again special research funding was provided to identify agricultural technologies that would be viable after the withdrawal of certain subsidies. In Indonesia, new research centers were established that diversified the research effort away from the dominant focus on rice. In Chile, strong growth in the export of perishable goods, as well as the resurgence of wine exports, aided in shifting research towards horticulture and postproduction processing.

- ***Reforms in public sector management***

Despite the prominent feature of privatization in the adjustment programs of Chile, Ghana, Sri Lanka and Mexico, none of these countries privatized a major agricultural research organization. In all cases, publicly sponsored agricultural research organizations, often in collaboration with international agricultural research centers, have remained the mainstay of the agricultural research system. Several countries attempted to induce publicly financed research institutions to manage operations in a more business-like, “private sector” manner. This led to the creation of co-ordination and planning units, and the reshuffling of different parts of the research system into various administrative structures. With few readily monitored indicators, the degree to which these changes actually helped improve research service management is difficult to assess.

It can be concluded that there are many different ways in which research systems respond to adjustment programs brought about by policy changes. The affects on agriculture have been generally mixed although certain policies, such as the move away from overvalued exchange rates, have unambiguously assisted agriculture. Other

policies, such as the phasing out of input subsidies, have raised costs and reduced short-term incentives to innovate.

Neither donor intervention nor the efforts of policy makers were able to fully fix the imbalances in research funding, offset the erosion of scientists' salaries, reorienting research priorities, or rationalizing research system operations (Tabor, 1995). However, those research systems in which private-public co-operation increased the most, namely Chile and Indonesia, were also the systems showing the closest links between diffusion of technology and success in agricultural diversification and growth (Tabor 1995).

The case studies indicate numerous reasons for the incomplete nature of research system reform during adjustment, namely: policy neglect, high transaction costs of making institutional changes, inertial forces within research management, donors' excessive support for research bodies and the limited ability of research leaders to participate in the adjustment dialogue (Tabor, 1995). All are possible reasons for the varying reactions of research systems to such programs (Tabor, 1995).

2.4.2 Present structure of the South African research system

The South African Agricultural Union believes that an effective research system has always been in place in South Africa, which has undoubtedly contributed significantly to agriculture, not only in South Africa, but also in the rest of Africa (SAAU, 1998). Although the South African commercial sector has benefited enormously in the past, this statement is not as accurate as it is made out to be as has been discussed earlier with reference to Khatri et al., (1996). Furthermore, research in South Africa has always been supply driven as determined by past and present bureaucracies (Donovan, 1995).

Considering the limited resources in South Africa, population growth and increased international competition, it is imperative that an effective agricultural research system is put in place to ensure sustained economic growth and increased welfare (SAAU, 1998). SAAU (1998), wishes to see the present structure altered to ensure that it functions as well as it has done in the past. Others such as Khatri et al. (1996) and

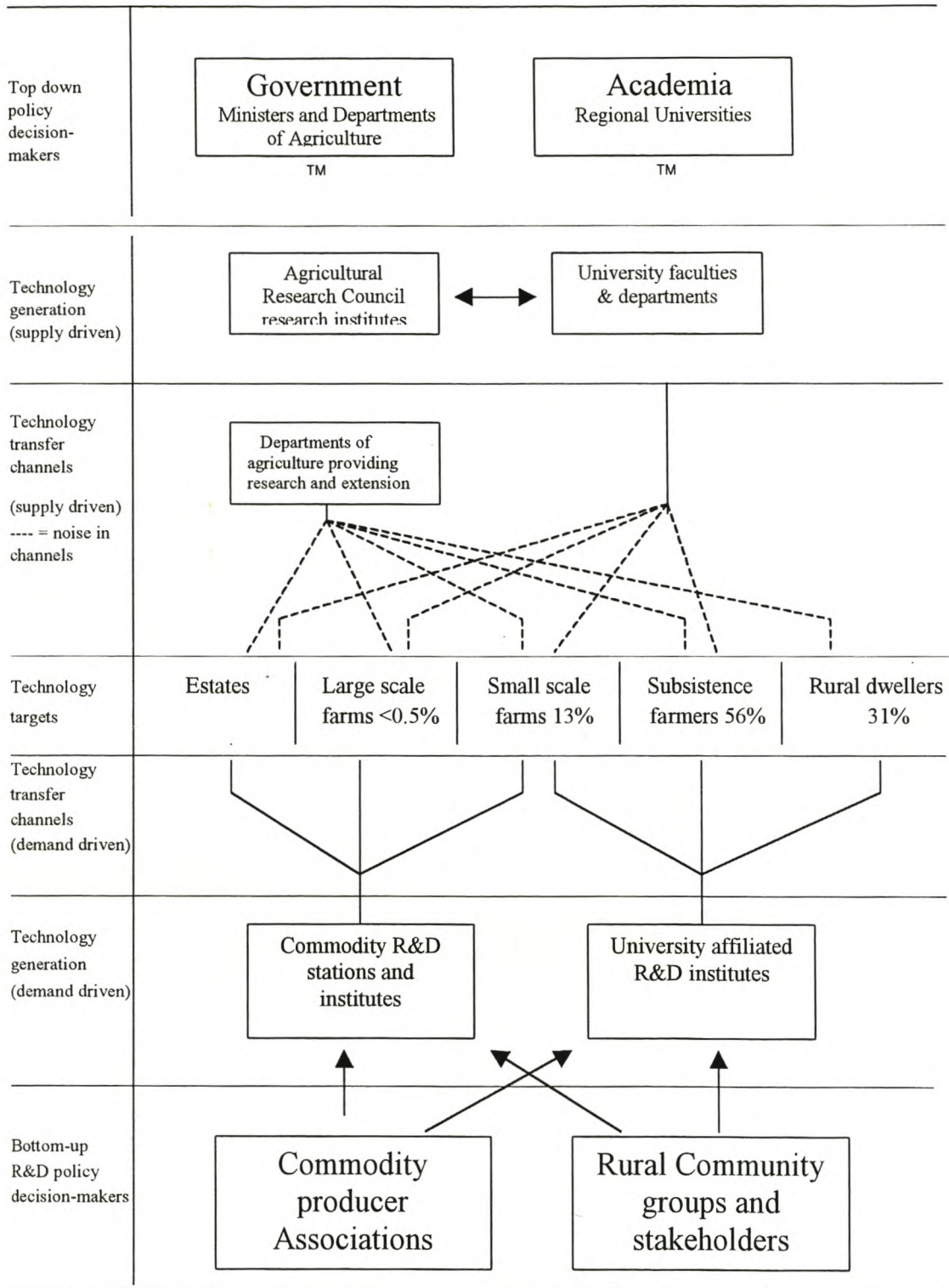
Donovan (1995), wish to see a full restructuring of the research system so that the irregularities of the past are eliminated.

The ARC is the principal agricultural research entity in the country (Roseboom et al., 1995). In the past, ARC institutes focused exclusively on white commercial farmers. Its present mandate, however, is to serve the entire population, including black subsistence farmers in the former homelands, and emerging farmers (Roseboom et al., 1995). At the time, the ARC institutes had little autonomy and decisions concerning research priorities were taken at Council level (Roseboom et al., 1995). The fact that research decisions were made in this way lead to inefficiencies within the structure (Donovan, 1995). Currently, operational decisions are made at institute level while the council ensures that guidelines regarding strategic programs are sufficiently adhered to.

Figure 2.4.2.1 is a simplified version of the present structure of agricultural R&D in South Africa. As can be seen from this depiction, government departments and ministers, as well as university faculties and departments, are making top-down decisions on agricultural R&D policy for commercial and non-commercial agriculture. In universities, however, the situation is changing due to the need to widen the source of funding. Policies are thus determined by the stakeholders, i.e. bottom-up decision making, meaning that research projects are becoming increasingly demand-driven (Donovan, 1995). Co-operation between the ARC and universities regarding research projects is also increasing.

The functions of technology generation are presently still the responsibility of the parastatal ARC, leading to supply driven decision making. Universities have traditionally researched the more basic problems of commercial agriculture for academic purposes and few new technologies have been generated (Donovan, 1995). University Institutes such as the Agricultural & Rural Development Institute at Fort Hare University, the Institute of Natural Resources and the School of Rural Community Development of the University of Natal and the Land Development Institute of the University of the Western Cape, were generally established to serve the technological needs of the resource poor agricultural sector (Donovan, 1995). Several producer associations, such as the South African Sugar Association, fund and control their own R&D institutes by means of levies from their member mills (Charlton, 1999) they are, therefore, commodity specific and demand driven (SASA, 1998).

Figure 2.4.2.1: Present R&D organizational structure in South Africa



Source: Donovan (1995)

The transfer of technology generated by the ARC and Universities is done by staff of separate organizations, there is, therefore, inevitably 'noise'⁴ in the transfer channels (Donovan, 1995). Because of economic reasons, government extension deteriorated in commercial farming to a passive advisory service with nevertheless well-qualified staff (Donovan, 1995). In rural non-commercial areas, however, extension staff are poorly qualified, supported with inadequate facilities, and there are still too few of them. Some commodity R&D stations and Institutes provide their stakeholder growers with specialized extension services. The South African Sugar Experiment Station has a fully integrated extension service for growers (SASA, 1998), while some mills even have their own extension officers meeting local demands (Charlton, 1999).

In accordance with these views the SAAU (1998), has identified areas of concern that have prompted it to support the need for a change in the research system. Firstly, the decrease in funds allocated to the ARC by parliament is raising concerns. Furthermore, the cancelling of research programs, the loss of skilled and experienced personell and the haste with which government has restructured and transformed the ARC, indicate the need for action (SAAU, 1998).

Added to this situation, future trends that are seemingly unavoidable and that need to be supported by the new research system have been identified (SAAU, 1998). These trends include:

- Technological development will not only be focused on the primary production level, considering that value added processing and increased competition will become increasingly important throughout the supply chain
- The commercial farmer will have to make a greater contribution towards the funding of R&D
- A partnership between the state, agribusiness and producers in the field of technology development and extension seems imminent and urgent

⁴ The term 'noise' refers to interference within the communication process. The result is that the optimum and complete transfer of knowledge does not take place.

- The increasing ineffectiveness of the present research structure.
- The shift in focus of government away from commercial farmers towards upcoming and subsistence farmers
- The exaggerated emphasis on accelerated economic and institutional transformation and
- The employment of a full and experienced research team is becoming increasingly difficult.

In order for agriculture to reach its goals of food security, improved international competitiveness and optimal use of natural resources, it requires constant access to new technology (SAAU, 1998). The performance of the agricultural sector in the future is thus largely dependent on the service of an effective technology development and extension system (SAAU, 1998). More attention will have to be given to the emerging and developing agricultural sectors especially in terms of extension work (Donovan, 1995). Furthermore, the issue of financing R&D and how this will fit into the research system, will have to be clarified (SAAU, 1998).

2.5 Investment trends in agricultural research

Since the beginning of the 1990's, many countries the world over have entered a phase of economic restraint, mostly in Africa (Pardey et al., 1997). This has had significant effects on the financing of R&D in rich and poor countries alike, especially in the public sector while in some cases, America and the EU, the drop in agricultural spending may be attributed to political agendas. In less developed countries, the rapid expansion of agricultural research capacity experienced in the 1960's and 1970's slowed dramatically in the 1980's (ISNAR, 1992). Particularly in Sub-Saharan Africa, Latin America and the Caribbean, investments in agricultural R&D stagnated or even declined (ISNAR, 1992). This situation led to a tightening of resources available for research and as a result clearer justification for R&D funds and greater accountability, are now required (Alston et al., 1998).

The drop in funds available for agricultural research has been associated with a general tightening of government budgets for all purposes and for all sciences in

particular. Added to this is the problem that agriculture, especially in the more developed countries, has a shrinking constituency and diminishing influence on policy (Alston et al., 1997). Donors and other interested observers have questioned the commitment of developing countries to agricultural research because their rate of growth in expenditure on agricultural research has been consistently lower than the increase in numbers of scientists over the last two decades (ISNAR, 1995). Hence donor fatigue is apparent, resulting in reduced humanitarian resolve to alleviate the plight of the poorer countries (Alston et al., 1998). Furthermore, a notion exists amongst donors worldwide that helping Third World agriculture through R&D is against the commercial and economic interests of First World farmers (Alston et al., 1998).

A closer look at current R&D investment trends will further illustrate this issue. The number of research personnel employed and the total expenditure on research are two of the more important indicators defining the breadth and depth of the research activities of a country, while being a major determinant of the rate of technology development (Umali, 1992). These, as well as other ratios, prove useful when investigating the dynamics of the research policy of a country.

2.5.1 International expenditure on research

National governments across the globe almost doubled their real investment in agricultural research over the past two decades, as can be seen in Table 2.5.1.1 (Alston et al., 1998). Total expenditure on agricultural research was roughly \$7.3 billion (in 1985 dollars) in 1971, and increased to nearly \$15 billion by 1991. For developed countries, public investment in agricultural research grew by 2.3 percent per annum from 1971 to 1991. For developing countries this rate was 5.1 percent per annum from 1971 to 1991 (Alston et al., 1998). However, it is noticeable that real R&D spending grew at a much slower rate the world over in the 1980's than in the 1970's, a trend which has continued up and till the early 90's (Alston et al., 1998).

Table 2.5.1.1: Public agricultural research expenditures in developed and developing countries (1971-91)^a

	1971	1981	1991
	(millions of 1985 international dollars) ^b		
<i>Expenditures</i>			
Developing countries (131) ^c	2 984	5 503	8 009
Sub-Saharan Africa (44)	699	927	968
China	457	939	1 494
Asia and Pacific, excl. China (28)	861	1 922	3 502
Latin America and Caribbean (38)	507	981	944
West Africa and North Africa (20)	459	733	1 100
Developed countries (22)	4 298	5 713	6 941
Global total (153)	7 282	11 217	14 951
	1971 – 81	1981 – 91	1991 –
		(percentage)	
<i>Average annual growth rates</i>			
Developing countries	6.4	3.9	5.1
Sub-Saharan Africa	2.5	0.8	1.6
China	7.7	4.7	6.3
Asia and Pacific (excl. China)	8.7	6.2	7.3
Latin America and Caribbean	7.0	-0.5	2.7
West Africa and North Africa	4.3	4.1	4.8
Developed countries	2.7	1.7	2.3
Global total	4.3	2.9	3.6

Source: Pardey et al.(1997), cited by Alston et al.(1998). *World Development*, Vol.26, No.6, p.1063.

^aThe 153 countries included in these totals correspond to the coverage reported in the appendix tables in Pardey et al. (1991). Countries from the former Soviet Union and Eastern Europe are excluded, but South Africa is included.

^bResearch expenditures denominated in current local currency units are first deflated to 1985 prices using local implicit GDP deflators taken from the World Bank (1985) and then converted to international dollars (where one international dollar is equal to one US dollar) using the purchasing power parities taken from Heston et al. (1995).

^cFigures in brackets indicate the number of countries in the respective totals.

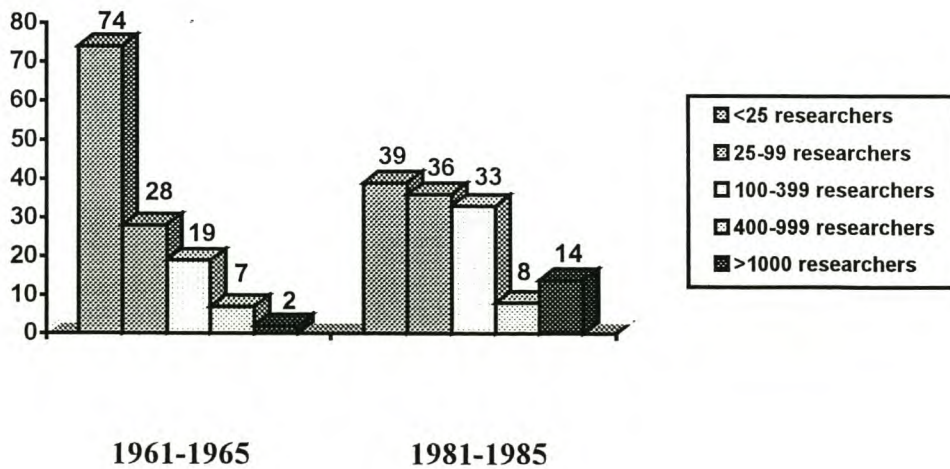
Developed countries accounted for 59 percent of global R&D spending in 1971, in 1991, however, the situation had changed dramatically with developed countries only accounting for 46 percent of public sector R&D spending world-wide (Alston et al., 1998). The same trend occurred in developing countries, with Asian countries accounting for 62 percent of the developing world's publicly performed agricultural

research expenditures (Alston et al., 1998), while Latin America and the Caribbean, as well as sub-Saharan African countries, accounted for only 12 percent to 14 percent each. It is interesting to note that developed countries lowered their R&D spending at a greater rate than the developing countries (ISNAR, 1992). Other than the fact that developing countries have historically had a higher growth rate in research spending, this trend is possibly due to greater international funding of R&D in these countries, due to the greater need for food security and sustained supply (Alston et al., 1998).

2.5.2 International expenditure per researcher

In less-developed countries the average size of the NARS increased from 150 to 600 full-time researchers between 1971 and 1991 (ISNAR, 1992). Nevertheless, 95 of the 130 NARS's in less-developed countries still employ fewer than 200 researchers, while 39 still employ fewer than 25 researchers, as can be seen from Figure 2.5.2.1.

Figure 2.5.2.1: Distribution of less-developed country NARS's by size



Source: ISNAR, 1992, Summary of Agricultural Research Policy: International perspectives, The Hague, International Service for National Agricultural Research, p. 9.

These figures do not tell the whole story, and one needs to look at the broader picture, in terms of the expenditure per researcher, in order to fully grasp the state of national research systems amongst developed and developing countries.

Table 2.5.2.1: Expenditure per researcher in developing countries

	Annual average agricultural research expenditure			Annual average number of researchers ¹			Annual average research expenditure/researcher		
	1971-75	1976-80	1981-85	1971-75	1976-80	1981-85	1971-75	1976-80	1981-85
	(1980 PPP mil. dollars per year)			(full-time equivalent)					
West Africa	134.3	201.4	204.6	1 015	1 928	2 640	13 232	10 446	7 750
Central Africa	16.6	16.1	17.9	169	177	255	9 822	9 096	7 020
Southern Africa	53.2	58.1	64.8	478	518	732	11 130	11 216	8 852
Eastern Africa	72.9	83.5	84.9	755	906	1 316	9 656	9 216	6 451
Sub-Saharan Africa	276.9	359.1	372.3	2 416	3 526	4 941	11 461	10 184	7 535
North Africa	81.3	93.5	126.0	2 514	3 364	5 016	3 234	2 779	2 512
Asia and Pacific	1 788.4	2 546	3 252.8	36 443	57 169	77 378	4 907	4 453	4 204
South America	401.6	542.3	519.9	4 713	5 314	6 774	8 521	10 205	7 675
Central America	56.2	106.2	159.0	763	1 262	1 723	7 366	8 415	9 228

Source: Umali, 1992

Table 2.5.2.2: Expenditure per researcher in developed countries

	Annual average agricultural research expenditure			Annual average number of researchers ¹			Annual average research expenditure/researcher		
	1971-75	1976-80	1981-85	1971-75	1976-80	1981-85	1971-75	1976-80	1981-85
	(1980 PPP mil. dollars per year)			(full-time equivalent)					
Japan	780.6	891.2	1021.6	13 798	13 747	14 779	5 657	6 483	6 913
Australia	229.4	189.9	236.1	3519	4254	4579	6 519	4 462	5 156
New Zealand	60.6	68.8	76.6	776	1138	1324	7 809	6 046	5 785
Northern Europe	134.8	155.8	181.7	1 996	2 317	2 711	6 754	6 724	6 702
Western Europe	979.8	1 058.9	1 134.8	9 887	10 384	11 396	9 910	10 917	9 958
Southern Europe	141.9	190.0	316.8	2 584	3 542	4 485	5 491	5 364	7 064
United States	1 140.8	1 301.0	1 423.9	13 313	13 903	14 366	8 569	9 358	9 912
Canada	258.3	315.9	421.4	2 252	2 317	2 737	11 470	13 634	15 396

Source: Umali, 1992

Agricultural research expenditure and personnel figures generally apply to public-sector research systems due to the fact that the private sector has largely been ignored (Umali, 1992). When it is the explicit goal of public R&D funding to alter the structure and function of the research system as an institution, then the trends in public funding will partly illustrate the process as it unfolds, as has been the case in the majority of countries in recent years (Alston et al., 1998). The expenditure per researcher figure gives a good indication of the status of the agricultural research sector (Umali, 1992). As can be seen from Tables 2.5.2.1 and 2.5.2.2, the average number of researchers showed significant growth in most countries between 1971-75 and 1981-85. However, the rate of growth of public research personnel outpaced the rate of growth of real public research expenditure in most cases, resulting in the average annual expenditure per researcher generally declining during the same period (Umali, 1992). Only 24 percent of the countries investigated exhibited growth in the research expenditure per researcher (Umali, 1992).

This decline in expenditure per researcher was partly due to government policies that entailed absorbing the majority of university graduates into the civil service, particularly in Africa (Eicher, 1990). Furthermore, there was a widespread movement to replace relatively expensive expatriate scientists with less costly national researchers. This resulted in additional training and salaries, which increased costs substantially. Added to this, the problem of overstaffing has negatively effected the expenditure per researcher ratio (Pardey et al., 1997).

2.5.3 International research intensity ratios

An alternative view on international agricultural R&D spending can be obtained from single ratios such as the classic agricultural research intensity ratio (Cremers et al., 1997, as quoted by Alston et al. 1998). The agricultural research intensity (ARI) ratio of different countries (see Table 2.5.3.1), expresses agricultural research expenditure as a percentage of agricultural GDP. This approach is criticized because it focuses on primary agricultural production and ignores private agricultural R&D taking place in the agricultural input and processing industries, thus not encompassing the whole agricultural production column (Roseboom, 1998). Nevertheless, most people accept it as an informative indicator of agricultural research intensity (Roseboom, 1998).

In the 1960's, the figure for industrialized countries was just under one percent, while for developing countries it was only 0.18 percent (ISNAR, 1990). By 1980-1985, the figure for industrialized countries had risen to 2.01 percent and 0.42 in developing countries (ISNAR, 1990). Two percent, roughly the figure being achieved by richer countries, has become the accepted target (ISNAR, 1990). As can be seen from Table 2.5.3.1, developed countries spent \$1.38 on public agricultural R&D for every \$100 of agricultural GDP in 1971-1975. This figure jumped to \$2.39 per \$100 of output in 1991. In contrast to the rate of investment growth seen in Table 2.5.3.1, developing countries in general have much lower ARI ratios than the developed countries. Over a twenty-year period the average ARI for developing countries increased only 12 cents from 38 cents per \$100 of output in 1971, to 50 cents in 1991 (Pardey et al., 1997).

Table 2.5.3.1: Agricultural research intensity ratios (%)^a

	1971-75	1976-80	1981-85	1986-90	1991
<i>Developing countries</i>	0.38	0.47	0.50	0.49	0.50
Sub-Saharan Africa	0.78	0.84	0.86	0.74	0.70
China	0.40	0.48	0.41	0.38	0.36
Asia and Pacific	0.26	0.36	0.44	0.50	0.55
Latin America	0.43	0.51	0.57	0.49	0.54
West Asia and North Africa	0.50	0.49	0.52	0.52 ^b	0.52 ^b
<i>Developed countries</i>	1.38	1.60	1.98	2.18	2.39
<i>Global total</i>	0.67	0.76	0.81	0.79	0.81

Source: Pardey et al. (1997), cited by Alston et al. (1998), *World Development*, Vol.26, No.6, p.1064

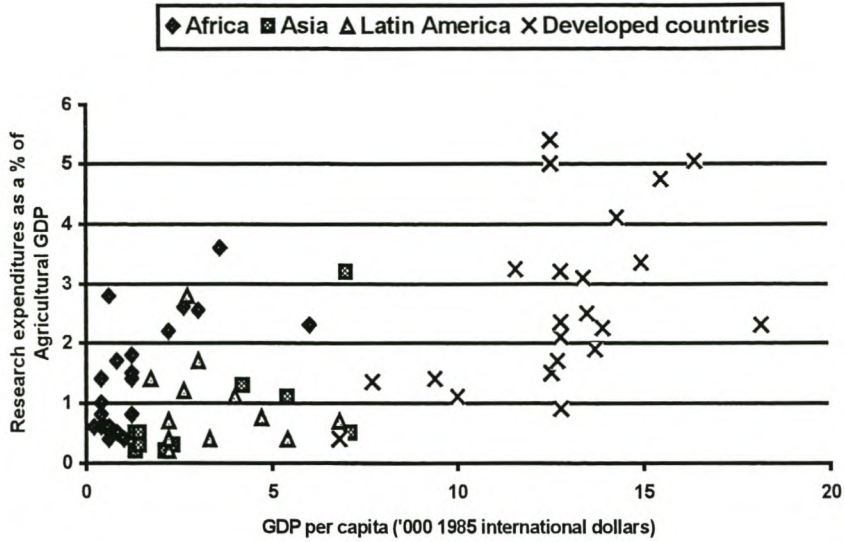
^a Agricultural research intensity measures agricultural research spending relative to agricultural GDP.

^b Extrapolated data.

Developed countries invest more intensively in agricultural R&D than developing countries. There is a positive relationship between public agricultural research intensity and per capita income (Alston et al., 1998). These sentiments are supported by Figure 2.5.3.1. However, it is further evident that some countries with low per capita income still invest relatively intensively in agricultural R&D. Figure 2.5.3.2 provides a partial explanation for this phenomenon. It indicates a negative relationship between a measure of the importance of agriculture in the domestic economy (indicated by the agricultural GDP as a share of GDP) and agricultural research. So sometimes countries

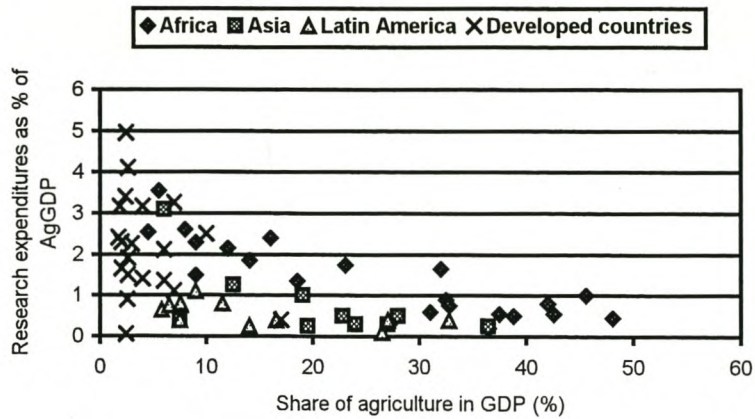
with low incomes and small agricultural sectors still invested relatively intensively in agricultural R&D, e.g. Botswana, Lesotho, and South Africa (Alston et al., 1998). International donor preferences and national policy stances amongst other factors also contribute to this discrepancy (Alston et al., 1998).

Figure 2.5.3.1: Agricultural research intensities and per capita income



Source: Alston et al.,(1998)

Figure 2.5.3.2: Agricultural research intensities and the share of agriculture in GDP



Source: Alston et al., (1998)

Two more expenditure ratios are useful when it comes to analyzing investment trends. These are the research spending per economically active agricultural population and research spending per capita (refer to Table 2.5.3.2.).

Agricultural R&D spending is measured relative to the size of the economically active agricultural population for the first ratio, and relative to the total population for the second (Alston et al., 1998). In 1991, developed countries spent \$354 (1985 international dollars) per agricultural worker while developing countries spent only \$7 per agricultural worker in the same period. This difference is not as surprising as it may seem, given the substantially higher proportion of developing country workers employed in agriculture, and the more rapid contraction in the agricultural labor force in the developed countries over the past several decades. Research spending per capita has risen an average 40 percent from \$6.30 in 1971, to \$8.84 in 1991 in developed countries, and an average of 79 percent in developing countries from \$1.10 per capita in 1971, to \$1.97 in 1991 (Alston et al., 1998).

Table 2.5.3.2: Agricultural research spending ratios

	1971-75	1976-80	1981-85	1986-90	1991
	(1985 international dollars per year)				
<i>Research spending per economically active agricultural population</i>					
Developing countries	3.81	4.83	5.75	6.45	6.99
Sub-Saharan Africa	8.67	9.20	8.76	7.98	7.60
China	1.62	2.14	2.71	3.07	2.98
Asia and Pacific	3.05	4.36	5.58	7.21	8.55
Latin America	13.04	17.81	20.13	19.36	21.80
West Africa and North Africa	13.08	15.46	20.43	24.22	27.05
Developed countries	144.00	190.64	250.03	304.10	354.25
Global total	9.29	10.69	11.92	12.65	13.44
<i>Research spending per capita</i>					
Developing countries	1.18	1.46	1.69	1.85	1.97
Sub-Saharan Africa	2.66	2.66	2.39	2.07	1.19
China	0.65	0.87	1.12	1.30	1.28
Asia and Pacific	0.91	1.24	1.53	1.88	2.17
Latin America	1.85	2.28	2.35	2.02	2.11
West Africa and North Africa	2.62	2.73	3.23	3.38	3.53
Developed countries	6.60	7.26	7.95	8.35	8.84
Global total	2.36	2.65	2.90	3.03	3.18

Source: Alston et al., 1998 as reported by Pardey et al., 1997

2.5.4 Implications of international investment trends

Decreasing public agricultural research expenditure per researcher in many countries has resulted in the deterioration of the quality of public research programs (Umali, 1992). Many countries, in Africa in particular, expanded their public research programs to such an extent that they could not sustain them with the national budget (Eicher, 1990). This expansion frequently outstripped the capacity of local research administrators to restrict the number of research problems addressed, manage the national research enterprise, pay staff time, plan experiments on schedule, and mobilize political and bureaucratic support from the Ministry of Finance to finance and sustain the system after foreign aid is phased out (Eicher, 1990). For example, Nigeria's petroleum boom financed the expansion of its NARS from nearly 100 scientists in 1960 to 900 by the mid 1970's (Umali, 1992). Since the economic slump in the 1970's and 1980's, the research system has been struggling to obtain funds (Umali, 1992).

Many researchers have had to be retrenched in order to cut costs (Pardey et al., 1997). The effects lend themselves to decreased productivity and technology generation (Pardey et al., 1997). Furthermore, considerable resources are devoted to simply maintaining current productivity levels, which constrains the ability of the public agricultural research system to respond to a broadening set of social demands concerning agriculture and food technology (Fuglie et al., 1996).

Due to the fact that funds for agricultural research are not freely available, and because natural resource management has become of utmost importance world-wide (Baharsjah, 1992), accountability for the application of funds has increased dramatically (Alston et al., 1998). Added to this is the fact that justification for the awarding of funds has become crucial, and thereby competition has become much more intense, not only for international funds, but between state departments as well (Alston et al., 1998).

One of the more significant implications that the trends investigated in this section have, is the increased emphasis, as well as the need for, increased private sector participation in financing R&D, particularly in the industry and commodity groups

(Alston et al., 1998). The need for more effective research systems is reflected by trends in research investment, and privatization is the tool seen by many as a solution to the problem (Alston et al., 1998). As it is, state institutions are relying more heavily on the private sector for new sources of funding (Fuglie et al., 1996). While the role of the private sector in agricultural research is acknowledged to be large in developed countries, it is still struggling to get recognition in developing countries (Echeveria, 1988). This situation is likely to change in the future with substantial increases in private-sector research in developing countries giving rise to fundamental changes in agricultural research in the public sector. An understanding of both public and private agricultural research roles is a prerequisite for informed public policy choice (Falconi and Elliot, 1994).

2.5.5 Trends in public agricultural research investments in South Africa

At present, agriculture accounts for some 33 percent (on average) of Africa's Gross Domestic Product (GDP), 66 percent of its labor force and 40 percent of its exports (Chause, 1995). In spite of these contributions, agriculture's share of national budgets has been declining over the last few years (Donovan, 1995). South African agriculture contributes 4 percent to the national GDP, while it receives only 2.9 percent of the national budget, keeping in mind that this share of the national budget has continued to decline in recent years (Donovan, 1995). In fact, of all the Southern African countries, South Africa has the lowest research expenditure as a percentage of GDP (0.12 percent) (Elliot, 1995). This subservience of agriculture in South Africa's fiscal policies has resulted in decreases in R&D in the agricultural sector. South Africa experienced a 46 percent decline in government expenditure on agricultural R&D between 1983 and 1989 (in real terms) which is in direct conflict with what was required in order to promote growth in this sector (Donovan, 1995).

The reasons for agriculture's inferior status in South Africa are the same as for most developing countries: government intervention in the form of price controls and subsidies, parastatal enterprises and trade, and foreign exchange quotas which are applied for political purposes (Knudsen and Nash, 1990). Although these are not in place any more, their effects have led to the current situation. South African agriculture can be regarded as a highly sophisticated and successful sector, but its development path was abnormal (World Bank, 1994). The development pattern of agriculture and its

present low share of the GDP, are regarded as direct consequences of widespread policy distortions introduced by decades of government intervention guided in part by the political and economic philosophy of white domination (World Bank, 1994).

The result is serious adverse effects on publicly funded R&D because at present, with the new government, it invariably has a lower political priority than most of the other demands on the national budget (Donovan, 1995). Subsidies which mainly benefit consumers will get preference because they constitute the most influential political lobby (Donovan, 1995).

Over the past thirty years, the South African NARS has grown at a moderate rate of more or less 2 percent per annum in terms of a full time equivalent (FTE) research staff, as well as research expenditures (Table 2.5.5.1) (Roseboom et al., 1995).

Table 2.5.5.1: NARS researcher and expenditure series (1961 – 1992)

	'61-65	'66-70	'71-75	'76-80	'81-85	'86.90	1991	1992	growth rate ^a
Researchers (FTE)	768	879	953	1013	1206	1281	1339	1373	2.0
Expenditures (million 1985 Rands per year)	79.7	105.7	114.7	109.0	129.5	142.0	148.3	169.8	2.0
Expenditures (million 1985 PPP dollars per year) ^b	88.1	116.9	126.8	120.5	143.2	157.0	163.9	187.7	2.0
Expenditures per FTE researcher (thousands 1985 PPP dollars per year)	114	113	113	119	119	123	122	137	0.0
Number of economically active agricultural population (millions)	2.1	2.6	2.5	1.9	1.7	1.8	1.8	1.8	-1.1
Researchers per million economically active agricultural population	371	339	378	529	714	696	732	746	3.2
AgGDP (million 1985 PPP dollars) ^c	4350	5080	5727	6517	6633	8256	8689	6499	2.2
Expenditure as a % of AgGDP	1.39	1.62	1.54	1.61	2.00	2.07	2.55	3.68	2.0

Source: Roseboom et al., (1995)

^a Least squares growth rate for the period 1961 – 1992.

^b Figures deflated with a local GDP deflator to base year 1985 and then converted to a common currency (US\$) using the 1985 purchasing power parity (PPP) over GDP.

^c Deflated with the AgGDP deflator

During the past three decades, agricultural research has primarily been executed by the Department of Agriculture (Table 2.5.5.2). Its share of total expenditures has, however, dropped from 80 percent in the early 1960's, to about 70 percent in recent years (Roseboom et al., 1995). At the same time forestry, sea fisheries and sugarcane research, as well as research carried out by universities, gained somewhat in relative importance.

Table 2.5.5.2: Agricultural research expenditures by institutional category

Institutional category	1961-65	1966-70	1971-75	1976-80	1981-85	1986-90	1991	1992
	percentages							
Government	87.3	87.4	87.4	85.1	85.7	84.7	84.3	84.8
DOA ¹	80.3	79.1	76.1	71.8	69.2	69.7	70.8	71.7
Other government ²	7.0	8.3	11.3	13.3	16.5	15.0	13.5	13.0
Semi public	5.0	4.1	4.5	6.5	5.7	6.0	6.6	5.9
Universities	7.7	8.5	8.1	8.4	8.6	9.3	9.1	9.3
Total	100	100	100	100	100	100	100	100

Source: Roseboom et al. 1995

¹ Includes ARC

² Includes Department of Sea Fisheries, Department of Forestry and CSIR, and National Botanical Institute. Although the National Botanical Institute was attached to the DOA until 1988, it is listed here under "other government" for the whole period.

In the early 1960's , 52 percent of DOA expenditure was spent by it's institutes, 43 percent by the ADI's and five percent by the Directorates of Agricultural Production Economics, Marketing, Engineering, and Biometric and Datametric services (Table 2.5.5.3) (Roseboom et al., 1995). Over time, however, the DOA institutes increased their expenditure share to reach roughly 75 percent in recent years, while the ADI's share dropped to about 20 percent. These figures do, however, exclude overheads and salaries at Universities rendering them not quite accurate. It is nevertheless a clear indication of how bottom up decision making was replaced by top down decision making resulting in a move away from market driven locally determined research.

Table 2.5.5.3: Agricultural research expenditure by the Department of Agriculture

Institutional category	1961-65	1966-70	1971-75	1976-80	1981-85	1986-90	1991	1992
	percentages							
DOA institutes	51.7	51.3	52.8	59.9	70.9	75.7	75.9	75.5
ADI's	43.3	41.7	36.0	34.2	23.0	18.6	18.8	20.7
Directorates	5.0	7.0	11.3	5.9	6.0	5.6	5.3	3.8
Total	100	100	100	100	100	100	100	100

Source: Roseboom et al., 1995.

Note: With the establishment of the Grain Crops Institute (GCI) in 1981, a substantial number of researchers at the regional offices of DOA were transferred to GCI.

South Africa's research intensities have been – and continue to be – relatively high, especially when compared to the rest of Africa (Roseboom et al., 1995). At present there are 746 researchers per million economically active agricultural population in South Africa compared to an average of little more than 60 for the rest of sub-Saharan Africa. This reflects the relatively small proportion of South Africa's population that is employed in agriculture, meaning that the figures are not as impressive as they look (Roseboom et al., 1995).

2.6 The role of the private sector in agricultural research

As far back as 1981, it was argued that the role of the private sector in agricultural research should receive special attention due to the contributions that it can make to agriculture (Evenson et al., 1981). Despite the fact that much of the output generated by research has the characteristics of a public good, private research is growing in a number of countries especially the more developed ones (Pray et al., 1991). In 1992, in Britain and the US, for example, privately sponsored and executed research accounted for nearly 60 percent of total agricultural research expenditures (ISNAR, 1992). Privately conducted R&D will continue to play a vital role in the future and institutional changes should allow for the full benefits of private sector involvement to be realized (Umali, 1992).

Table 2.6.1: Privately performed agricultural R&D in OECD countries

	(millions of 1985 international dollars)				Annual growth (%)
	1981	1986	1991	1993	1981-93
<i>Privately performed agricultural R&D</i>					
Australia	25.2	68.3	112.5	137.5 ^b	15.1
New Zealand	9.9	12.2 ^a	26.7	39.5	13.7
Netherlands	185.2	210.7	241.2	297.9	3.8
United Kingdom	404.2	473.6	593.5	614.3	5.0
United States	1 416.6	1 963.7	2 256.0	2 381.1 ^b	4.3
Other OECD countries (17) ^f	1 953.5	2 691.9	3 419.5	3 560.3	5.5
Total (22)^f	3 994.7	5 420.3	6 649.4	7 030.5	5.1
<i>Privately performed agricultural R&D as a percentage of total agricultural R&D (percentages)</i>					
Australia	8.2 ^c	17.9	26.8 ^d	30.3 ^b	
New Zealand	6.9	9.1	19.5	26.9	
Netherlands	47.8	51.8	52.7	56.8 ^e	
United Kingdom	52.1	55.8	62.0	62.4	
United States	46.6	52.1	52.7	53.7 ^e	
Other OECD countries (17) ^f	38.6	43.5	46.6	46.8	
Total (22)^f	41.1	46.2	48.9	49.6	

Source: Pardey et al., 1997

Italicized, country specific data are interpolated.

^a 1987 figure.

^b 1992 figure.

^c 1973 figure.

^d 1990 figure.

^e 1994 figure.

^f Figures in parentheses indicate the number of countries included in the respective totals.

A common misconception is that agricultural research is primarily the domain of the public sector, while the private sector serves the research needs of other sectors (Alston et al., 1998). A look at Table 2.6.1, however, reveals a different scenario, where privately performed R&D is a prominent, and occasionally dominant, feature of contemporary agricultural research in rich countries. Among the OECD countries nearly half of agricultural research is carried out by the private sector, and totaled \$7 billion in 1993, compared with \$4 billion dollars in 1981 (Pardey et al., 1997). These figure reflect a growth rate of 5.1 percent, compared with 1.8 percent for publicly

performed agricultural R&D, and 4.3 percent in all sectors (agriculture and non-agriculture) of the OECD (Pardey et al., 1997).

Roughly 12 percent of private research focuses on farm-level technology, whereas over 80 percent of public research has that orientation (Alston et al., 1998). Food processing and other post harvest research accounts for between 30 percent and 90 percent of private agricultural R&D (Pardey et al., 1997). Chemical research accounts for over 40 percent of private research in the United Kingdom and the United States, and nearly three-quarters of private agricultural research in Germany (Alston et al., 1998).

2.6.1 The benefits of private sector agricultural research

Private, profit orientated research should not be seen as something intrinsically detrimental to the public good (ISNAR, 1992). Private sector agricultural research has a part to play in achieving optimum social welfare by providing technologies that would otherwise have been out of reach of the public sector (ISNAR, 1992). Public policy makers will have to become increasingly aware of changing technological and institutional environments in order to take advantage of the opportunities that exist in mobilizing private research resources (ISNAR, 1992).

Research conducted by private firms is a growing source of agricultural technology, especially in developing countries (Pray et al., 1997). The creation of new technology supplements public sector research by concentrating on applied research in the input sector for seed, machinery, chemical and fertilizer (Echeverria, 1988). The private sector's greatest contribution comes from its focus on food-processing and post harvest research (Alston et al., 1998). The fact that private research is profit orientated means that the research will be carried out to provide optimum productivity, maximum input and output quality, lower production costs and improved production processes (Pray et al., 1997).

The privatization of publicly owned enterprises and agricultural research facilities, together with private firm involvement, frees up government resources and management to be applied elsewhere in the research field (Alston et al., 1998). These

freed resources should then be used to benefit subsistence farmers and small growers who would normally not have access to new technology (Donovan, 1995).

According to neoclassical economic theory, private firms will operate so long as there are opportunities to generate profits. The agricultural sector is no exception, and profitability is simply a necessary component for private sector participation (Umali, 1992). This profit-orientated approach ensures that the private sector generates income and capital growth, which will boost the economic vitality of the agricultural sector (Pray et al., 1997).

2.6.2 Incentives for private sector involvement

As mentioned, profitability is the main determinant of private-sector participation in agricultural research (Umali, 1992). This objective can be translated into three main determinants of private investment in R&D: Market factors, a firm's ability to appropriate economic gains from R&D, and the technological opportunities for innovation (Pray, 1997).

The key market factors are expected demand and input prices (Pray et al., 1997). Food and agricultural processing industries will not conduct research unless they expect a demand level for processed food that will generate sufficient profit (Pray et al., 1997). Derived demand for modern agricultural inputs and factor prices facing producers and agribusiness, also influence the nature and level of private agricultural R&D investment (ISNAR, 1992). This is further acknowledged by Prey et al. (1997), who emphasize the importance of relative input prices in determining the direction of research and thus of technical change.

Appropriability is one of the more important determinants of private-sector investment because it functions as a restraint on the potential returns of research investments (Umali, 1992). The public good nature of research output discourages private firms from participating in its production, unless mechanisms exist that will enable private firms to capture exclusively the returns to their research (Umali, 1992). The firm's ability to appropriate the gains from innovation depends on the structure of the industry, the nature of the technology, lead time, and the existence and enforcement of

patent legislation (Pray et al., 1997). Intellectual property rights are the frequently recommended solution for overcoming the appropriability problem (Umali, 1992). However, she further argues that intellectual property rights can lead to socially sub-optimal levels of research because there is no incentive for private firms to disclose the results of research that do not generate patentable innovation, resulting in inefficient use of research resources.

The last major determinant of private sector investment is the existence of technological opportunities for producing profitable products (ISNAR, 1992). The relevant dimension of this potential from the perspective of the private firm is the cost of producing an innovation relative to expected profits (Pray et al., 1997). Examples of technological opportunities include research conducted by other firms made available through patents and the hiring of another firm's scientists, local adaptation of foreign innovations and adaptation of public-sector agricultural research (Pray et al., 1997).

2.6.3 The justification for continued public sector research funding

A large portion of the knowledge generated by research has the nonrivalness⁵ and nonexcludability⁶ characteristics of a public good (Pray et al., 1997). Private firms do not usually produce goods that are nonrival or nonexcludable because they would be unable to fully capture the benefits to cover the costs resulting from their research (Pray et al., 1997). No individual farmer has the incentive to carry out R&D because he will only enjoy part of the resulting benefit from innovation because such research will serve society as a whole due to a lack of intellectual property rights (Nieuwoudt, 1984). A socially optimum level of public goods will thus not be supplied if production is left to the private sector (Pray et al., 1997). Because information is not perfectly appropriable, the extent to which the social value of new knowledge is greater than the private value leads to underinvestment in inventive activity (Pray et al., 1997).

⁵Nonrivalness means that the research output is available to everyone at zero marginal cost. The use of this knowledge by any agent has no effect on the amount available for use by others.

⁶Nonexcludability implies the high cost of denying use to those who do not pay for it so that the 'free rider' problem is present

Public institutions, universities, and non-profit organizations will not have the above mentioned incentive problem, because these institutions are not concerned with appropriating the gains from the research activity (Umali, 1992). In this context of multiple entities performing basic and managerial research and assuming that the socially optimum level of research can be established, government research will have the responsibility of filling the gap between the research output of universities, non-profit organizations and private firms and what is socially optimal (Umali, 1992).

Several more arguments can be put forward in support of public R&D funding:

- Equity concerns have for a long time lent strong support to public funding of research (Jansen, 1998). Poor farmers have greater difficulty in mobilizing resources than large farmers and private sector driven research, responding to demands by stakeholders, will pay no heed to these farmers (Jansen, 1998). This is particularly relevant in South Africa where the non-commercial farming sector makes up close to 95 percent of all farmers, meaning only 5 percent of farmers would benefit from private sector research activities (Donovan, 1995). By privatizing commodity R&D, government's resources available for non-commercial agriculture could be substantially increased (Donovan, 1995).
- A further trend strengthening the cause of publicly funded research is the inclusion of natural resource management issues in the agricultural research agenda of most countries (Tabor et al., 1998). The Netherlands provides a good example where the cost to society of groundwater pollution, due to excessive fertilizer use by farmers, is many times higher than the cost to the farmers (Tabor et al., 1998). If primary clients - farmers - dictate agricultural research, as would be the case in privately funded research, many important research issues will be ignored and demand orientated funding will bias any research carried out (Tabor et al., 1998).
- It takes on higher-risk and long term projects such as research on global environmental changes
- It addresses national and regional research problems that have little private investment incentive but potentially high social payoffs, such as food safety and health issues

- It maintains infrastructure and laboratory capacity that may be too expensive for private firms
- It supports the research needs of regulatory and research agencies
- It facilitates collaboration in multinational agricultural research partnerships within the above mentioned scopes.

The demand for public funding is well substantiated. Although private funding will have a major role to play in the future, it will be more because of fiscal constraints in general at Government levels than the unsuitability of public funding.

2.6.4 Moving from public to private sector funding in South Africa

Historically, agricultural research was a task performed predominantly by the public sector (Umali, 1992). During this time the issues that received most attention on public research agendas were the levels of intensity of research and the amount of human and capital resources necessary to achieve research targets (Roseboom, 1998). While these issues are still important today, the sustainability of public research systems has become another issue of major concern (Umali, 1992). Trade liberalization has become a dominant trend in the 1990's, resulting in a given country's domestic prices being shaped more by world market trends than by domestic conditions, the country becoming more of a price taker (Tabor et al., 1998). This has become a particularly relevant issue in South Africa, with Government committing itself to moving away from a fully regulated market environment, towards an open market system (van der Merwe and Otto, 1997). Improved agricultural technology will thus have less impact on consumer prices than it would have in a more controlled environment and more impact on producer incomes. What this means is that the benefits of national research will accrue more to the producer, with the rest of society experiencing the effects to a far lesser degree (Tabor et al., 1998). As a result agricultural research will continually be seen as less of a public responsibility (Tabor et al., 1998).

For these reasons the role of the private sector in South African agriculture has become more relevant in recent years. Not only because the focus of responsibility has shifted towards the private sector, but the advantages alone of private sector research (refer to Section 2.6.1) should be enough to encourage greater participation and involvement. During this time of adjustment, the advantages of more new technologies, especially applied technology in the processing sector and the likelihood of capital growth and generation of income, will assist in creating a more competitive and economically stable agricultural sector.

It is important to remember, however, that in many instances public research cannot simply be replaced by private sector involvement. The argument presented above presumes that public and private research are substitutes for one another. In many cases, however, they in fact complement each other (Pardey et al., 1997). Basic public research provides opportunities for firms to profit from R&D and to accelerate the spread of publicly produced technology by adapting it to the needs of farmers (Pardey et al., 1997). Although much more attention is being given to private funding opportunities now than ten years ago, it does not imply that support for public funding is declining.

2.7 Conclusion

The need to adapt existing research systems due to the changing political, economic and technological environments has been identified by the international community. This chapter has highlighted the resulting trends that are taking place globally in terms of recognizing the importance of agricultural research and its contribution to the development of agriculture in a national context. More specifically, it has illustrated what structural modifications are taking place, the changing investment trends in agricultural research and the new role of the private sector in agricultural research, as well as what effect these changes have had so far. It is evident that in order to successfully survive the present agricultural operating environment, certain steps need to be taken regarding the direction and approach towards agricultural research. The cases presented in this chapter illustrate the more important steps taken internationally to achieve this objective of adopting a new culture that endorses a commitment to R&D, as well as the resulting successes and failures. These examples can be used as a

guideline for studying the extent to which these developments have, and are, taking place in South Africa.

In order to satisfy the objective of this study, the issues of structural adjustments, research investments and private sector participation were investigated with regard to the two provinces of KwaZulu Natal and the Western Cape. Although the agricultural sectors of different countries are unique, the same basic economic principles apply, making it possible to critically analyze the agricultural research systems of the above mentioned provinces in terms of the progress they have made towards satisfying the demands placed on them by the respective agricultural sectors.

Chapter Three

METHODOLOGY GOVERNING THE FIELD STUDY INTO THE STATUS OF THE AGRICULTURAL RESEARCH SYSTEMS OF KWAZULU NATAL AND THE WESTERN CAPE

3.1 Introduction

In the previous chapter the new trends and generally accepted norms regarding agricultural research within global agriculture were illustrated. They serve to highlight the new orientation being adopted towards agricultural research, as well as what is being done in an effort to create stronger agricultural sectors. The pertinent issue now is how these trends are evolving in South Africa and whether or not agricultural research is receiving as much positive attention domestically as it is internationally.

This study aimed to develop an understanding for, and critical analysis of, the present status and dynamics of agricultural research and development carried out in the agricultural sectors of KwaZulu Natal and the Western Cape at producer, agribusiness and research institution levels. The analysis highlighted efficiencies and inefficiencies alike while serving to pinpoint areas where possible changes could increase the overall effectiveness of the research systems by providing a competitive advantage. As discussed in Section 2.3, the role and contribution of research and development to agriculture justifies the need for a transparent, well organized and suitable research system. Whether or not this is the case in KwaZulu Natal and the Western Cape was deduced from this investigation.

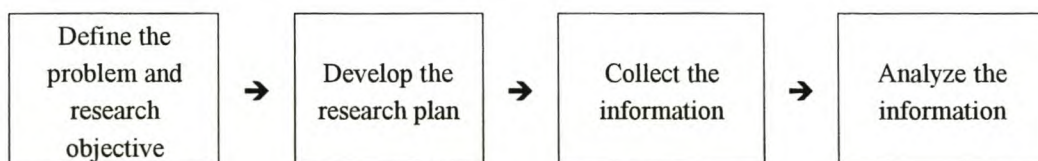
In line with the three main areas of study, three supporting hypotheses are presented here which will provide answers with regard to the main objective, which was to analyze the suitability of the respective provincial agricultural research systems for providing optimum growth, while maximizing global competitiveness. This study illustrated the characteristics of the structural interactions between research institutes, the agricultural private sector, co-operatives and farmers. More specifically, it highlighted the effectiveness of these relationships in terms of productivity. Research investment trends were scrutinized and judged according to international benchmarks.

Furthermore, whether or not the various institutions adequately take market factors into account in their research investment decision making with regard to technology development and production, are also made known. Finally, this investigation showed the degree to which the private sector has become involved in agricultural research and development and to what extent this role has been recognized, promoted and supported by the various stakeholders.

Following a short description of the methodology involved in this investigation, the rest of the report is conducted as described above. Based on the findings, the implications for the two provincial agricultural sectors are then discussed using deductive analogy, as well as international case examples. A recommended course of action for implementing possible changes completes the study.

A basic four-step research process, as presented by Kotler (1997), was chosen as the fundamental guideline for this part of the research. Its simplicity and thoroughness make it ideal for the task at hand, as well as the time frame allowed. A diagrammatic format of the research process reads as follows:

Figure 3.1.1



3.2 The problem and research objectives

According to Kotler (1997), “a problem well defined is half solved”. In order to effectively tackle the problem of this study, it was analyzed from three angles with each angle addressing a fundamental aspect of the overall problem. The three supporting hypotheses are listed below.

Supporting hypothesis A

The structural interactions between research institutions, agribusiness organisations and agricultural producers in South Africa, aimed at supplying the necessary technologies and research management needed to promote sustainable growth and improve global competitiveness for the agricultural sectors concerned, are inefficient.

Supporting hypothesis B

Market factors are not adequately taken into account by the respective provincial agricultural research administrators during decision making regarding technology development and production.

Supporting hypothesis C

The increasingly important role of the private sector, with regard to research and development contributions in the agricultural sectors of KwaZulu Natal and the Western Cape, has not been sufficiently recognised, promoted or supported by the various stakeholders within the sector.

3.3 Developing the research plan

This stage of the research process called for the development of the most efficient plan for collecting the needed information. The design of the research plan required decision making on a variety of areas, namely data sources, research approaches, research instruments, sampling plan and contact methods (Kotler, 1997).

- ***Data sources***

The collection of primary data was central to solving the problem. Information was needed from a variety of sources and was not adequately available, prior to this investigation, from any other secondary source. The data sources required for this investigation are listed here:

- *Farm level producers*: These were crucial for providing information on what is going on at ground level.
- *Agribusiness organizations*: These include co-operatives, and private sector companies.
- *Research institutions*: These include government funded research institutes as well as private research companies.

These three groups represent the main stakeholders within the provincial research systems.

- ***Research approach***

Being descriptive in nature, the necessary data was collected by means of the survey research method. This method allowed for the unhindered investigation of the respondent's beliefs, knowledge, attitudes, satisfaction, needs, etc., and the measurement of these parameters within the general surveyed population. The survey research method permits a number of alternative research instruments that could be used for the collection of the data.

- ***Research instruments***

The planning of the formal research project involved making use of some of the most common and reliable methods of collecting primary data, namely: questionnaires and interviews (McCarthy and Perreault, 1993). The interviews were reserved for the agribusiness organizations and research institutes. They allowed for stimulated responses, as well as immediate reactions without giving the respondent any guidelines about what to say. The interview was thus in-depth, while initiating higher quality responses.

Three different questionnaires were distributed amongst the research institutes, agribusiness, and producers. The questionnaires were designed so as to extract information that would satisfy the objectives of the three main goals stated in Section 3.1.1. Care was taken to keep the questionnaires as simple and short as possible in an attempt to prevent the respondents from being anything but thorough

in their response. The questions were kept unbiased, while maintaining a logical order.

- ***Sampling plan***

A sampling plan was drawn up that would determine who would be surveyed, how the respondents should be chosen, and how many people/organizations/institutes would be surveyed.

In order to analyze the interactions between agribusiness organizations and research institutes, it was ensured that they were linked to each other so that they would have a reliable and relevant opinion of one another. The farmer would thus be linked to a cooperative through membership, while both the farmer and the cooperative would in turn be linked to a research institute operating within the industry. Different such 'sets' were then selected.

The selection criterion for producers was simply membership of the selected cooperative. Private sector agribusiness organizations were approached if they supplied or distributed their goods or services throughout the greater part of the relevant agricultural industries in a specific region to ensure a link exists between these organizations and the farmers within the industry. Large organizations, which have the greatest influence within the provinces' agricultural industries, were selected. Research institutes were not subject to any selection criteria, provided they were linked to the respective agricultural industries, as described earlier.

- ***Contact method***

In order to distribute as many questionnaires and conduct as many interviews in the shortest time possible, several contact methods were used. The majority of the producers were contacted by means of an affiliated producer association, i.e. their co-operative. These organizations then distributed the questionnaires. In remote areas the questionnaires were distributed by mail. Agribusiness organizations were contacted by telephone and interviews were arranged whenever possible. In those cases where a personal interview was not possible a telephonic interview was held, and if that was not possible either, a questionnaire was sent by mail. With regard to

the research institutes, personal interviews were arranged where possible and questionnaires were sent to all.

3.4 Collecting the information

The collection of questionnaires was a relatively simple procedure. Most questionnaires were returned via the producer associations who had collected them; others were returned via the mail in pre-paid envelopes, while several were received by facsimile. The number of respondents included 265 producers, 15 major agribusiness organizations, and 5 agricultural research institutes.

3.5 Analyzing the information

In order to address each of the three main goals of this survey in a logical manner, the relevant results of the individual objectives for each goal were tabulated in order to isolate the necessary information pertaining to those objectives. Each objective was then discussed, followed by a discussion and conclusion for the main goal under analysis.

3.6 Conclusion

The research process in this study followed a simple four-step procedure whereby the problem and research objectives were defined, a research plan developed, the information collected and the data analyzed. This process broke the overall problem into its basic elements, thereby providing a clearer and more detailed picture of the various issues involved. In order to satisfy the objective of this study three main fields of study were identified pertaining to structural characteristics, research investment trends and the role of the private sector in agricultural research in KwaZulu Natal and the Western Cape. These three issues are dealt with in the chapters that follow.

Chapter Four

ANALYSIS OF THE STRUCTURAL INTERACTIONS BETWEEN THE RESEARCH SYSTEM STAKEHOLDERS OF KWAZULU NATAL AND THE WESTERN CAPE

4.1 Introduction

The first issue that was investigated as an element of the overall functioning of the provincial agricultural research systems, is that of structural interactions between the various stakeholders. The relationships between and among stakeholders form a dynamic and complex process that evolves over time and with reference to specific issues and problems (Fahey and Randell, 1994). The effectiveness of these relationships is crucial in determining the overall productivity of the system and is largely dependent on the structure of the research system, and as such the structural interactions of the research systems of the two provinces in question were analysed. In order to be in a position to judge whether or not the KwaZulu Natal and the Western Cape agricultural research systems can boast effective structural interactions, a few specific aspects were analyzed in this regard.

This part of the study focused on the nature of the inter-system relationships, specifically their contribution, or lack thereof, to the overall effectiveness of the research system. The structural interactions include those discussed earlier with regard to international structural trends. More specifically, these relationships include methods of establishing research agendas, competition amongst researchers, the separation of research and extension activities and vertical integration. Vertical integration is one of the more important aspects of structural interactions due to its concern with molding the various stakeholders into a unified system. The quality of most interactions is dependent on how well the research system stakeholders are integrated with each other in terms of expectations between stakeholder groups, cooperation and communication between stakeholders and the amount of faith one group has in the others.

Ultimately, each aspect of the interactions between the research institutions, agribusiness organizations and producers will have either a positive or a destructive

influence on productivity, and it is the sum of these that will go a long way in determining the success of the system.

4.2 Establishing research agendas

With the limited resources available throughout the world, it becomes crucial that efficient planning determines the direction of research activities (Donovan, 1995). It was established in Section 2.4 that in the past South African agricultural research was supply led as determined by a government bureaucracy. South African producers were therefore in no way prepared for the globalization of markets and had no option but to implement technologies aimed at supporting and creating market distortions. The advent of demand-led research has focused resources on what is needed at ground level by the stakeholders involved. Research thus becomes market driven which in turn leads to more productive results in the context of globalization.

Historically, producers have had little say in what should be researched. Public research by definition is there to assist the producer in achieving optimum production and marketing levels for his benefit and that of the agricultural sector as a whole. Involving the producer maximally in the research process to identify his/her needs, is the logical thing to do. Some may argue the point that those who finance the research should by rights determine what is to be researched. This argument may hold water for private sector research but public sector research should have the best interests of the producer in mind. Research conducted according to the demands of those who finance it will result in sub-optimum application of resources (Huffmann et al., 1994). It is thus important that the needs of stakeholders, specifically producers, are aligned with those who conduct research, as well as those who fund it.

According to the co-operatives, research institutes, and private sector organizations investigated in KwaZulu Natal and the Western Cape, producer involvement is a priority, with the exception of two co-operatives namely CFB and SSK, as can be seen from Tables 4.2.2, 4.2.3 and 4.2.4. (Note that the full names represented by the acronyms appearing in these Tables, and all relevant Tables hereafter, appear on page xv) The research institutes especially have a high producer involvement when it comes to establishing research agendas. Keeping in mind the benefits of producer

involvement, these results bode well for the future. Making these figures even more encouraging is the fact that the producers need not contribute anything to the funding of the research for them to contribute towards determining the application of the resources used for research.

In order to give these results some validity they need to be concurred with the opinions of the farmers themselves. It is interesting to note that in some instances the results differ from the claims of the agribusiness organizations, as can be seen from Table 4.2.1. Although no real benchmark exists for this type of data, it can be expected that the majority of producers should have a positive response in order to classify that group as having been sufficiently pulled into the decision making process when establishing research agendas. Judging from the response, the sugar, timber and grape industries argue that producers are clearly satisfied with their involvement in the decision making process. The livestock industry in both provinces suffers from significant producer dissatisfaction while the grain industry producers show a mixed response.

The livestock industry does not sufficiently involve producers in establishing research directives, or if they do, they are ineffective. The advantages of producer involvement are not being realized, to the detriment of the industry. Although in a slightly better situation than the livestock industry, the wheat industry also shows a need for improvement and could benefit if the organizations involved review their policies or improve their implementation thereof. The fact that so many producers in WPK are dissatisfied with the opportunities given to them to affect the research agendas of their company and other research institutes, who claim significant producer involvement, is an indication that the process of producer involvement has encountered stumbling blocks or that the application thereof is ineffective. CFB and SSK are likely to benefit if they were to implement bottom up decision making, thereby improving member satisfaction levels. The quest for a market driven orientation is again the primary issue here and the importance thereof towards achieving success must be emphasized.

Overall the research systems seem to have recognized the importance of producer involvement when it comes to committing resources to research. This is a positive result, indicating that supply-driven research is becoming dominant and that past mistakes are not being repeated in the present structure. If properly implemented, this

form of co-operation will ensure that producer demands, according to local conditions, are aligned with competent research.

Table 4.2.1: Producers' satisfaction regarding the establishment of research objectives in KwaZulu Natal and the Western Cape

KwaZulu Natal										
Description			Co-operatives							
			UCL		SOC		CFB		CTC	
			D¹	ND²	D¹	ND²	D¹	ND²	D¹	ND²
Satisfaction of producers regarding input in the determination of research objectives	Sugar industry	Satisfied %	65	63	72	86	81	75	80	66
		Unsatisfied %	35	37	28	14	19	15	20	34
	Livestock industry	Satisfied %	24	20	59	67	27	15	28	10
		Unsatisfied %	76	80	41	33	73	85	72	90
	Timber industry	Satisfied %	56	56	53	60	61	70	63	70
		Unsatisfied %	43	43	47	40	39	30	37	30
Western Cape										
Description			Co-operatives							
			BNK		SSK		CRK		WPK³	
			D¹	ND²	D¹	ND²	D¹	ND²	D¹	ND²
Satisfaction of producers regarding input in the determination of research objectives	Grain industry	Satisfied %	64	0	75	22	22	47	41	16
		Unsatisfied %	36	100	25	78	78	53	59	84
	Livestock industry	Satisfied %	40	0	70	35	38	32	35	29
		Unsatisfied %	60	100	30	65	62	68	65	71
	Grape industry	Satisfied %	-	-	-	-	-	-	80	40
		Unsatisfied %	-	-	-	-	-	-	20	50

¹ Donors who contribute to financing research

² Non-donors who do not contribute in financing research

³ WPK has changed to a company but is included for simplicity

Table 4.2.2: The role of the co-operatives in financing research, conducting extension activities and identifying research topics in KwaZulu Natal and the Western Cape

KwaZulu Natal					
Description		Co-operatives			
		UCL	SOC	CFB	CTC
Average R&D budget over last five years		R0	R800 000	R0	R200 000
Projected growth of R&D expenditure over next five years		Low	Nil to low	Nil	20%
Personnel exclusively assigned to R&D duties		0	3	Nil	1
Average extension budget over last five years		R300 000	R600 000	R5 000	R0
Personnel exclusively assigned to extension duties		3	3	Nil	7
Stakeholder involvement in identification of research topics ¹	Producers	Significant	Total	Nil	Significant
	Government	Nil	Nil	Nil	Nil
	Own administration	Significant	Slight	Nil	Significant
Western Cape					
Description		Co-operatives			
		BNK	SSK	CRK	WPK²
Average R&D budget over last five year		R20 000	R0	R300 000	R4 000
Projected growth of R&D expenditure over next five years		30%	Nil	15%	According to inflation
Personnel exclusively assigned to R&D duties		0	0	1	0
Average extension budget over last five years		R900 000	R534 000	R0	R190 000
Personnel exclusively assigned to extension duties		0	2	Nil	4
Stakeholder involvement in identification of research topics ¹	Producers	20%	Nil	Significant	Significant
	Government	70%	Nil	Nil	Nil
	Own administration	10%	100%	Significant	Significant

¹ The extent to which the stakeholder concerned influences or determines the research objectives² WPK has changed to a company but is included for simplicity

Table 4.2.3: The role of research institutes in financing research, conducting extension activities and identifying research topics in KwaZulu Natal and the Western Cape

KwaZulu Natal				
Description		Research institutes		
		Cedara	PANNAR	SASEX
Average R&D budget over last five years		R30 mil	- ²	- ²
Projected growth of R&D expenditure over next five years		15%	Low	10-15%
Personnel exclusively assigned to R&D duties		870	- ²	- ²
Average extension budget over last five years		R121 mil	- ²	- ²
Stakeholder involvement in identification of research topics ¹	Producers	75%	70%	90%
	Government	25%	5%	0%
	Own administration	25%	25%	10%
Western Cape				
Description		Research institutes		
		ARC1	ARC2	
Average R&D budget over last five years		- ²	- ²	
Personnel exclusively assigned to R&D duties		- ²	- ²	
Projected growth of R&D expenditure over next five years		Low	- ²	
Average extension budget over last five years		- ²	- ²	
Stakeholder involvement in identification of research topics ¹	Producers	60%	70%	
	Government	0%	30%	
	Own administration	40%	30%	

¹The extent to which the stakeholder concerned influences or determines the research objectives

²These figures were not released by the respondents concerned

Table 4.2.4: The role of private sector companies in financing research, conducting extension activities and identifying research topics in KwaZulu Natal and the Western Cape

KwaZulu Natal						
Description		Private sector organization ¹				
		A	B	C	D	E
Average R&D budget over last five years		R18 000	R0	R200 000	R100 000	R10 000
Projected growth of R&D expenditure over next five years		0	0	Low	0	0
Personnel exclusively assigned to R&D duties		0	0	0	2	0
Average extension budget over last five years		0	R0	R1 mil	R30 000	R200 000
Personnel exclusively assigned to extension duties		0	0	20	2	2
Stakeholder involvement in identification of research topics ²	Producers	100%	- ³	50%	80%	Significant
	Government	0%	- ³	0%	0%	Nil
	Own administration	0%	- ³	50%	20%	Slight
Western Cape						
Description		A		B		
Average R&D budget over last five years		R200 000		R0		
Projected growth of R&D expenditure over next five years		Low		0		
Personnel assigned to R&D duties		0		0		
Average extension budget over last five years		R1 mil		R50 000		
Personnel exclusively assigned to extension duties		20		1		
Stakeholder involvement in identification of research topics ²	Producers	50%		- ³		
	Government	0%		- ³		
	Own administration	50%		- ³		

¹These organizations wished their identity to remain confidential

²The extent to which the stakeholder concerned influences or determines the research objectives

³ These figures were not released by the respondents concerned

4.3 Competition amongst researchers

In many of the developed countries managed competition for public funds was introduced as an incentive for improved quality in research results. The basic idea is for universities, government research institutes and any other government subsidized organization to be awarded funds based on the quality of their previous work (Alston et al., 1998). Managed competition can be very effective in improving the productivity of the research system within the agricultural sector concerned (Alston et al., 1998). However, if not managed correctly competition amongst researchers can have a negative effect in that producer demands and research provided will differ due to research being conducted according to those who fund it, as was the case in the United States (Huffman et al., 1994). Furthermore, the necessary structural changes caused by managed competition tend to lead to the separation of research and extension services through the need to specialize, which causes inefficiencies (Alston et al., 1998). As a result co-operation between researchers tends to suffer. The potential benefits of managed competition, however, outweigh the possible pitfalls, as is evident from the successes enjoyed by many of the OECD countries such as the United Kingdom and the Netherlands (Alston et al., 1998).

As is evident in Table 4.3.2, most research institutes in KwaZulu Natal are unconcerned with competing organizations, both domestically and internationally. State researchers seem unconcerned with the need to compete for government funds. In the Western Cape evidence of competitor awareness can be found in ARC2. This data by no means indicates bad quality research within the public research structure. However, it does mean that both research systems are missing out on the potential benefits of managed competition, those being improved quality of research and increased productivity. If the reason for the lack of competition is the fear of administrators that producer needs and research supplied can become misaligned or that extension and research activities will become separated (as will be discussed in the next section), they could consider developing an effective management plan with policies that would serve to protect the interests of the stakeholders and maintain demand driven decision making. As things are, competitor awareness amongst government funded research institutes is low or non-existent and the advantages thereof lost.

Amongst the private sector organizations in KwaZulu Natal the fear of better research emanating from competitors is only slight, while in the Western Cape WPK, SSK, and BNK show signs of awareness of competing researchers. Furthermore, only one co-operative, namely SSK, and two of the private sector companies in KwaZulu Natal show any major concern that the information generated through research may not be safe enough from being used by other parties. The fact that there is little concern over intellectual property rights is a further indication that there is little or no fear of competition regarding research activities. These results indicate a possible lack of experience/exposure to competition, which may lead to difficulties when researchers start operating at a certain level and increase their investments in R&D in order to generate worthwhile results that other groups are interested in.

The incentive for improved research amongst public researchers is increased government funding, while private sector organizations strive for greater market share, more competitive products and ultimately greater profitability. In both cases competition seems to have a positive influence on quality of research. However, as mentioned earlier, this form of competition can easily lead to a lack of co-operation amongst researchers (Huffmann and Just, 1994). Currently, co-operation amongst researchers may be more important than internal competition, as local researchers are still coming to terms with the effects of globalization, and the accompanying increase in international competition and reduced government funding, provided the research conducted is of a high quality. Although this argument for co-operation seems relative in a local context, it should not prevent researchers from being competitive with international researchers. Failure to do so could lead to a waste of resources and loss of markets if producers adopt technologies generated outside their own agricultural sectors. It thus seems careless to ignore international competitors. It is an issue all research stakeholders should be aware of in order to successfully develop the research systems in KwaZulu Natal and the Western Cape.

Table 4.3.1: Co-operatives' approach towards competition in KwaZulu Natal and the Western Cape

KwaZulu Natal				
Description	Co-operatives			
	UCL	SOC	CFB	CTC
Concern that other organizations will develop better technologies and dominate the market	Unconcerned	Unconcerned	Unconcerned	Unconcerned
Concern over own organization's future competitiveness	Unconcerned	Unconcerned	Concerned	Unconcerned
The need for better appropriability legislation to protect research results from other organizations	Unnecessary	Unnecessary	Unnecessary	Unnecessary
Western Cape				
Description	Co-operatives			
	BNK	SSK	CRK	WPK¹
Concern that other organizations will develop better technologies and dominate the market	Concerned	Concerned	Unconcerned	Concerned
Concern over own organization's future competitiveness	Concerned	Concerned	Unconcerned	Unconcerned
The need for better appropriability legislation to protect research results from other organizations	Unconcerned	Necessary	Unnecessary	Necessary

¹ WPK has changed to a company but is included for simplicity

Table 4.3.2: Research institutes' approach towards competition in KwaZulu Natal and the Western Cape

KwaZulu Natal			
Description	Research institutes		
	Cedara	Pannar	SASEX
Concern that other organizations will develop better technologies and dominate the market	Unconcerned	Unconcerned	Unconcerned
Concern over own organization's future competitiveness	Unconcerned	Unconcerned	Unconcerned
The need for better appropriability legislation to protect research results from other organizations	Unnecessary	Unnecessary	Unnecessary
Western Cape			
Description	Research institutes		
	ARC1	ARC2	
Concern that other organizations will develop better technologies and dominate the market	Unconcerned	Concerned	
Concern over own organization's future competitiveness	Unconcerned	Concerned	
The need for better appropriability legislation to protect research results from other organizations	Unnecessary	Unnecessary	

Table 4.3.3: Private sector companies' approach towards competition in KwaZulu Natal and the Western Cape

KwaZulu Natal					
Description	Private sector companies				
	A	B	C	D	E
Concern that other organizations will develop better technologies and dominate the market	Concerned	Unconcerned	Concerned	Unconcerned	Unconcerned
Concern over own organization's future competitiveness	Unconcerned	Unconcerned	Concerned	Unconcerned	Unconcerned
The need for better appropriability legislation to protect research results from other organizations	Unnecessary	Necessary	Unnecessary	Unnecessary	Necessary
Western Cape					
Description	Private sector companies				
	A	B			
Concern that other organizations will develop better technologies and dominate the market	Unconcerned	Unconcerned			
Concern over own organization's future competitiveness	Unconcerned	Unconcerned			
The need for better appropriability legislation to protect research results from other organizations	Unnecessary	Unnecessary			

4.4 Separation of Research and Extension activities

The need for tighter control and the prioritization of research has resulted in structural adjustments where the administration of research and extension services became separated (Huffmann and Just, 1994). The aim was to improve the productivity of the various research and extension teams through specialization, thereby improving their competitiveness. As established in Section 4.3, competition is often a desirable state of affairs due to its effect on productivity and quality of research. However, the dangers of this approach could have serious implications for the research system as a whole (Alston et al., 1998). In the United States, for example, the separation of research and extension activities within the SAES' and Universities led directly to inefficiencies in production and administration (Alston et al., 1998). This, together with the fact that this form of structural adjustment lowers the incentive for co-operation amongst research institutions for fear of competition, highlights the dangers of this form of structural change (Huffmann and Just, 1994).

Judging from these examples, the agricultural research systems in KwaZulu Natal and the Western Cape find themselves in a unique situation. As has already been established, the researchers in the respective provincial research systems show very little or no concern for other competing researchers. In fact, research results are openly shared amongst the various research institutes, co-operatives and some private sector organizations. In other words they do not seek to improve the quality and productivity of their work out of fear for competition. Yet, as can be seen from Tables 4.2.1 and 4.2.3, three of the four co-operatives in KwaZulu Natal, two of the four co-operatives in the Western Cape, two of the five private sector companies in KwaZulu Natal and one of the two private sector companies in the Western Cape that were investigated, all have separated their research and extension activities, which is usually done for the sake of improved competitiveness. The research institutes in both provinces have kept all their activities under one administration.

Keeping in mind the arguments put forward by Alston et al. (1998), it seems that those organizations that have separated their research and extension activities are running the unnecessary risk of inefficiencies creeping into production and administration without the usual associated benefits of managed competition. In fact not only are different administrators in charge of the research and extension functions, but in all but one case a different organization is charged with carrying out the one or the other function. Seeing that those efficiency failures in the United States occurred between separate departments in a single organization, the danger of them occurring between different organizations must be greater still.

Although this inconsistency can be justified if the organization can produce higher quality results, the practical implications of such actions are not to be taken lightly (Alston et al., 1998). An organization will have to carefully weigh its options in terms of potential benefits and the potential negative effects before making such a decision. As it is, a large number of the organizations under review have already made that decision and have separated their research and extension activities. Although the issue of increased competition, and lack of co-operation as a result of this structural characteristic, seems to have been avoided, judging from the availability of research

results amongst the stakeholders, the dangers of quality, productivity and planning inefficiencies are still very much relevant and must be heeded.

4.5 Vertical integration

From the proceedings of the Roundtable on Research Policy and Financing held in Pretoria (1995), the advantages of a liberalized, adjusted economy become evident. Whereas previously in South Africa, agricultural ministry officials would determine research policies and set levels of investment, while influencing agricultural prices and marketing, presently market forces are left to run their course free from government intervention (Tabor, 1995). This is the first step towards achieving vertical integration (Huffmann and Just, 1994). Perhaps the most important issue of structural interaction, vertical integration implies that, free from the shackles of government intervention producers, researchers and those who fund research are left to align needs with that which is being researched in an effort to promote a demand driven research program. Vertical integration becomes the foundation for creating a research system that is institutionally diverse and that is as flexible as it is market responsive (Tabor, 1995).

Alignment of needs and research, which has already been discussed in Section 4.2, is, however, only one aspect of vertical integration and demand driven research. Expectations, co-operation, communication and a faith in the abilities of the other stakeholders in the research system are important elements when striving for an ideal vertically integrated research system. Another important aspect of vertical integration that has already been discussed is that of effectively coordinating research and extension. The dangers of separating the two have been established and it is in the above mentioned elements of vertical integration that the inefficiencies resulting from the separation of research and extension often manifest themselves (Alston et al., 1998). Ultimately, these elements serve to illustrate how well the system has become integrated and will consequently be investigated and analyzed in this section.

4.5.1 Expectations amongst stakeholders in the vertical chain

Stakeholder expectations contribute significantly towards determining the levels of conflict within the system. In order to establish productive vertical relationships, conflicting interests should be kept to a minimum and all stakeholders within the research system should acknowledge each other's needs and limitations while working together to overcome any potential stumbling blocks. For this reason, responsibilities, opinions and demands should be carefully administered to ensure that expectations remain reasonable and justified and that the various institutions can coordinate their efforts efficiently.

The more important expectations are naturally concerned with the more important issues of agricultural research. As such, the expectations to be investigated were identified as those regarding the financing of research, development and extension and the quality of the research. Furthermore, in order to determine these expectations across the board, each stakeholder group was investigated with regard to its expectations of every other stakeholder group.

Tables 4.5.1.1 to 4.5.1.6 illustrate the state of the expectations regarding the aforementioned issues. The fact that these expectations differ widely between the various stakeholders is quite evident. Fifty percent or more of the producers investigated of all four co-operatives in KwaZulu Natal expect the government to finance R&D and extension, with the majority of the remaining producers believing government should be between forty and sixty percent responsible. Compared to this, only CFB agrees with its members that the government should fund R&D and extension. In the Western Cape, on the other hand, the majority of producers of all the co-operatives believe that the private sector should assume responsibility for funding R&D and extension while SSK, WPK and BNK want the government to pay. When KwaZulu Natal producers were asked more specifically whether their co-operative should be responsible for funding R&D, their response was similar to that of the producers, namely that co-operatives should have as little as possible to do with the funding of research. However, the majority were adamant that the co-operative should be responsible for conducting extension, citing reasons of familiarity, having the best interests of the members at heart and ability, provided the state supplies the necessary

funds. The Western Cape producers remained adamant that their co-operative should contribute financially to R&D and extension while also conducting extension duties.

The research institutes and private sector organizations interviewed differed further in their response. In four cases out of five, the research institutes believed the responsibility of funding R&D and extension should be divided equally between government and the private sector, while four of the seven private sector organizations shared the same view.

Regarding the response over the quality of research in Tables 4.5.1.1, 4.5.1.2, and 4.5.1.7 to 4.5.1.9, producers in KwaZulu Natal are overwhelmingly in favor of the private sector with very little faith in the abilities of the state. The Western Cape producers, however, feel that both the state and the private sector deliver good quality research. All of the co-operatives in both provinces show little faith in the state's abilities, save SOC, which finds the quality of state research acceptable. All the co-operatives, except for SSK, are satisfied with the abilities of the private sector. With the exception of SASEX, which feels the government has done little in terms of contributing through research to their industry, all research institutes are satisfied with both the state's and the private sector's level of research quality. All but two of the private sector organizations had the same response as the majority of producers and co-operatives, in that the state delivers poor quality research, while only one organization was dissatisfied with the quality brought forth by the private sector.

Several disconcerting conclusions can be extracted from these results. Firstly, the fact that such a large number of producers in KwaZulu Natal feel that it is the duty of the state to fund R&D and extension while their co-operatives feel it should be the private sector who should accept responsibility, could have serious implications for the future. Earlier it was established that the SAAU has recognized the need to convince producers to increase their contribution to the funding of research. This will prove very difficult if producers feel it is not their responsibility and are at loggerheads with their co-operatives and the research institutes about the issue. Similarly, while Western Cape producers seem in favor of private sector involvement when it comes to financing research, their co-operatives are against it. Thus the money that could potentially be available from producers will not be channeled into research. A vertically integrated system will be a tough proposition if the stakeholders disagree on this issue.

Secondly, and paradoxically, the KwaZulu Natal producers and some of the Western Cape co-operatives want the state to be responsible for R&D and yet have no faith in their ability to deliver quality research. State funding of research conducted by the private sector, which should be the case according to producers, is not a viable option. Furthermore, it is unlikely that the state will increase its research funding in the near future. Producers should instead be provided with adequate incentive to increase their own research funding. It is likely to prove more beneficial if all stakeholders concerned recognize a personal responsibility to contribute to financing agricultural research.

Table 4.5.1.1: Producers’ expectations regarding financing, quality and relevance of research in KwaZulu Natal

KwaZulu Natal						
Description			Co-operatives ¹			
			UCL	SO	CFB	CTC
Expectations regarding the responsibility of financing R&D and extension	Government should be responsible	0-20%	43	21	49	25
		20-40%	13	35	12	25
		40-60%	32	33	31	55
		60-80%	12	9	8	0
		80-100%	0	2	0	0
	Private sector should be responsible	0-20%	0	2	0	0
		20-40%	12	9	8	0
		40-60%	32	33	31	55
		60-80%	13	35	12	25
		80-100%	43	21	49	25
Expectations regarding the difference in quality of research (5 – highest quality)	Government	5	0	3	4	11
		4	11	11	4	20
		3	24	28	38	17
		2	26	17	27	22
		1	39	41	23	30
	Private sector	5	46	22	53	37
		4	30	39	19	26
		3	15	30	12	28
		2	7	9	16	7
		1	2	0	0	2

¹The figures in these columns represent the percentage of producers surveyed who fall into the respective categories described

Table 4.5.1.2: Producers’ expectations regarding financing, quality and relevance of research in the Western Cape

Western Cape						
Description			Co-operatives ¹			
			BNK	SSK	CRK	WPK ²
Expectations regarding the responsibility of financing R&D and extension	Government should be responsible	0-20%	12	26	25	11
		20-40%	24	9	6	11
		40-60%	28	48	9	55
		60-80%	16	17	47	19
		80-100%	20	0	13	5
	Private sector should be responsible	0-20%	20	0	13	5
		20-40%	16	17	47	19
		40-60%	28	48	9	55
		60-80%	24	9	6	11
		80-100%	12	26	25	11
Expectations regarding the difference in quality of research (5 – highest quality)	Government	5	24	19	22	8
		4	20	37	19	8
		3	44	11	41	32
		2	12	31	5	34
		1	0	11	13	18
	Private sector	5	60	23	22	26
		4	28	66	22	29
		3	12	11	59	34
		2	0	0	6	11
		1	0	0	0	0

¹ The figures in these columns represent the percentage of producers surveyed who fall into the respective categories described

³ WPK has changed to a company but is included for simplicity

Table 4.5.1.3: Producers' expectations regarding the role of the co-operative in financing research and conducting extension in KwaZulu Natal and the Western Cape

KwaZulu Natal					
Description		Co-operatives¹			
		UCL	SOC	CFB	CTC
How much responsibility should the co-operative have regarding the financing of research?	Nil	17	13	27	4
	Minimum	78	74	31	80
	Significant	5	13	23	12
	Maximum	0	0	5	4
How much responsibility should the co-operative have regarding the distribution and introduction of research results?	Nil	2	0	7	0
	Minimum	20	9	27	11
	Significant	48	44	31	39
	Maximum	30	47	35	50
Western Cape					
Description		Co-operatives¹			
		BNK	SSK	CRK	WPK²
How much responsibility should the co-operative have regarding the financing of research?	Nil	44	9	19	21
	Minimum	32	43	15	37
	Significant	12	37	44	34
	Maximum	12	11	22	8
How much responsibility should the co-operative have regarding the distribution and introduction of research results?	Nil	8	0	0	0
	Minimum	0	0	0	13
	Significant	36	46	63	55
	Maximum	56	54	47	32

¹The figures in these columns represent the percentage of producers surveyed who fall into the respective categories described

² WPK has changed to a company but is included for simplicity

Table 4.5.1.4: Co-operatives' expectations regarding financing of research, development and extension in KwaZulu Natal and the Western Cape

KwaZulu Natal				
Description	Co-operatives			
	UCL	SOC	CFB	CTC
Distribution of responsibility for financing R&D and extension between government and the private sector	Central private organizations	Private sector	Government	Both, mostly private sector
Western Cape				
Description	Co-operatives			
	BNK	SSK	CRK	WPK¹
Distribution of responsibility for financing R&D and extension between government and the private sector	Government	Government	Private sector	Government

¹ WPK has changed to a company but is included for simplicity

Table 4.5.1.5: Research institutes' expectations regarding the financing of research, development and extension in KwaZulu Natal and the Western Cape

KwaZulu Natal				
Description		Research institutes		
		Cedara	Pannar	SASEX
Distribution of responsibility for financing R&D and extension between government and the private sector (%)	Government	50	50	40
	Private sector	50	50	60
Western Cape				
Description		Research institutes		
		ARC1	ARC2	
Distribution of responsibility for financing R&D and extension between government and the private sector (%)	Government	50	50	
	Private sector	50	50	

Table 4.5.1.6: Private sector companies' expectations regarding the financing of research, development and extension in KwaZulu Natal and the Western Cape

KwaZulu Natal						
Description		Private sector organization¹				
		A	B	C	D	E
Distribution of responsibility for financing R&D between government and the private sector (%)	Government	50	50	50	70	40
	Private sector	50	50	50	30	60
Western Cape						
Description		Organizations¹				
		A	B			
Distribution of responsibility for financing R&D between government and the private sector (%)	Government	100		50		
	Private sector	0		50		

¹These organizations wished their identity to remain confidential

Table 4.5.1.7: Co-operatives' opinions on quality of research in KwaZulu Natal and the Western Cape

KwaZulu Natal		
Co-operative	Co-operative opinion on quality of research	
	Government	Private sector
UCL	Unsatisfied	Very satisfied
SOC	Acceptable	Satisfied
CFB	Very unsatisfied	Satisfied
NCT	Very unsatisfied	Satisfied
Western Cape		
Co-operative	Co-operative opinion regarding quality of research	
	Government	Private sector
BNK		
SSK	Unsatisfied	Unsatisfied
CRK	Unsatisfied	Satisfied
WPK¹	Unsatisfied	Satisfied

¹ WPK has changed to a company but is included for simplicity

Table 4.5.1.8: Research institutes' opinions on quality of research in KwaZulu Natal and the Western Cape

KwaZulu Natal		
Research institute	Research institute opinion regarding quality of research	
	Government	Private sector
Cedara	Satisfactory	Satisfactory
Pannar	Satisfactory	Satisfactory
SASEX	Little if any contribution	Very satisfactory
Western Cape		
Research institute	Research institute opinion regarding quality of research	
	Government	Private sector
ARC1	Unsatisfactory	Unsatisfactory
ARC2	Very satisfactory	Satisfactory

Table 4.5.1.9: Private sector companies' opinions on quality of research in KwaZulu Natal and the Western Cape

KwaZulu Natal		
Organization¹	Organization's opinion regarding quality of research	
	Government	Private sector
A	Poor	Satisfactory
B	Reasonable	Satisfactory
C	Satisfactory	Satisfactory
D	Must improve	Must improve
E	Poor	Cautiously satisfactory
Western Cape		
Organization¹	Organization's opinion regarding quality of research	
	Government	Private sector
A	Poor	Satisfactory
B	Satisfactory	Satisfactory

¹These organizations wished their identity to remain confidential

Thirdly, it is of some concern that there are so many producers, co-operatives and private sector organizations who show a complete lack of trust in the state's ability to produce quality research. The state run research institutes of Cedara, Small Grain Institute and the Center for Fruit Vine and Wine claim their research is widely sought after and used, with excellent increases in productivity reported. Such misunderstandings can have grave consequences such as the possibility of a complete lack of support for state proposed projects and structural adjustments of the research systems, even if they are in the best interests of the agricultural sector and its stakeholders. The question must be asked how was this misconception allowed to happen. It is critical that government restores faith in its ability to produce quality and necessary technologies amongst all agribusiness organizations and especially the producers. Without such trust, it will be difficult to extract funding from producers, encourage co-operation or even effectively distribute the technology through the research systems in question.

The results show radically different expectations amongst the stakeholders making up the system. Although differing expectations are acceptable, these should be in the best interests of the research system as a whole and must be devoid of political and personal convictions that may cloud the issue. These problem areas will have to be resolved if the ultimate goal is a unified, flexible, fully integrated and market responsive agricultural research system.

4.5.2 Co-operation amongst stakeholders in the vertical chain

One of the most prominent characteristics of vertical integration in the research system is cooperation amongst the various stakeholder groups from ground level all the way to the top. Co-operation between producers, co-operatives, agribusiness and research institutes strengthens the ties within the research system, thereby bringing it closer to a fully integrated system capable of adjusting as one to any changes in the political or economic environment. In the sugar industry, for example, producers and some millers bring their problems and needs to their respective co-operatives who in turn present these to the South African Sugar Association (most millers go directly to SASA as they are private sector companies) who then charge SASEX with the responsibility of

finding solutions. In this way each stakeholder group is linked to the others throughout the research process. The primary concern is not so much with the lack of cooperation between parties of the same stakeholder group as it is with cooperation among the various groups in the vertical chain of the research system. For instance, between producers and research institutes, between private sector organizations and research institutes and between producers and their co-operatives.

Some forms of this type of research co-operation have already been dealt with, namely the establishment of research agendas and the sharing of the responsibility for financing research, development and extension, and many more could still be discussed. However, this section deals specifically with cooperation pertaining to the actual conducting of research and so three aspects of research co-operation between stakeholders have been identified.

It was established earlier that the policies currently in place tend to favor cooperation amongst the relevant parties while taking producer needs into account. Conversely, the same should be true for the farmer, whose needs, such as new innovative ideas and improved products capable of increasing his market competitiveness and productivity, should come from the researchers who had initially approached him. A second vital aspect of vertical co-operation in research is co-operation between the researchers themselves. The private sector usually conducts processing research while research institutes, co-operatives and sometimes producers conduct production research (Prey et al., 1997). Who researches what is not as important as co-operation between these groups, thereby ensuring efficient use of resources and interdependence between them. Finally, co-operation between producers and their co-operatives in conducting research is of crucial importance.

The easiest way to determine whether or not the cooperation between producers and researchers is satisfactory, is to determine the sources of the research results being implemented amongst producers in the form of new ideas and products, and improved existing products. According to the researchers in the respective provincial research systems, producers are given their say in determining research agendas according to their needs (Section 4.2) and so it must be expected that researchers then supply them

with the resulting technologies and innovations which coincide with these needs. The results of Table 4.5.2.1 indicate that this is not the case.

Although researchers cooperate by including producers in establishing their research agendas, few of them actually seem to deliver, and then only to a small degree. Twenty percent of the producers investigated from UCL were the only ones who reported receiving any form of innovation or new technology from a research institute. Only four to eight percent of producers from SOC, NCT, CRK and WPK report having benefited from innovations of some kind developed by their co-operatives. This may be explained by the long lag time often associated with agricultural research. By far the most production innovations being implemented by producers come from the agricultural media.

Considering that all the research institutes and half the co-operatives have not separated their research and extension activities and are thus directly involved with producers, it is unlikely that the researchers initially developed the innovations emanating from the agricultural media, after which they filtered down to the producers. The lack of innovations emanating from researchers is more likely explained by the fact that they simply have not come up with any innovations, which questions their productivity and the effectiveness of their extension work. Of those researchers who have separated their research and extension activities, it is likely that they have not been able to co-ordinate one or the other, or both activities, effectively.

Whatever the reason, the fact that so few producers are innovating and that of those who do innovate, few innovations actually come from who they are supposed to, is a sign of poor productivity on the part of the researchers. It is furthermore an indication that unless this problem is addressed the agricultural sectors concerned, fuelled by producers' inability to innovate, are likely to experience slow growth and struggling competitiveness. Many of the producers who innovate take it upon themselves to do so, while it is the function of the agricultural research system to either guide them through this process or assist them by providing these innovations, a task in which it is clearly struggling.

The issue of research cooperation between researchers is illustrated by the results in

Table 4.5.2.1: Sources of new technologies and innovations amongst producers in KwaZulu Natal and the Western Cape

KwaZulu Natal					
<i>Description</i>		Co-operatives			
		UCL	SOC	CFB	CTC
Percentage producers who have received new technologies and innovations from the sources listed	Research institutes	20	0	0	0
	Co-operative	0	4	0	4
	Agricultural media ¹	18	16	3	26
	Fellow farmers	6	4	10	9
	Other	2	0	3	0
Western Cape					
Description		Co-operatives			
		BNK	SSK	CRK	WPK²
Percentage producers who have received new technologies and innovations from the sources listed	Research institutes	0	0	0	0
	Co-operative	0	0	5	8
	Agricultural media ¹	20	11	5	18
	Fellow farmers	13	3	5	4
	Other	4	0	0	0

¹ Includes mediums such as journals, magazines, television etc.

² WPK has changed to a company but is included for simplicity

Tables 4.5.2.2, 4.5.2.3 and 4.5.2.4. It is quite apparent that a problem exists amongst the various agribusiness organizations and research institutes in terms of cooperation and although seemingly not too severe it is nonetheless significant. Only UCL stated that no problems concerning research co-operation exist whatsoever between itself, the private sector and research institutes, while all the others believed it to be a stumbling block to some or other degree.

The fact that so many organizations perceive this issue to be a problem is not to be taken lightly. Most organizations seem to have failed to recognize the benefits of a cooperation scenario, which can be blamed on management. This is somewhat of a paradox considering that most organizations freely share their research results with each other and competition is not an issue. Whatever the cause thereof, the situation could, and is likely to, result in opportunity costs as a result of failure to share

resources, which would promote more efficient consumption of resources, and duplication of research.

While a lack of cooperation between agribusiness organizations is not welcome, a lack of co-operation within an organization is of even greater concern. Unfortunately, this seems to be the case far too often, judging from the data in Tables 4.5.2.5 to 4.5.2.7. Once again UCL is the exception, being the only organization who has the full support of its members when it comes to R&D. Although UCL neither conducts the research itself, or even finances it, it has full support to act as a mediator with SASEX. Although roughly half the organizations studied saw this lack of cooperation from its members as only a slight problem, the rest thought it a significant to major obstacle in conducting research. If the organizations concerned cannot get their own operations in order, it can be expected that cooperating with the rest of the research system will be difficult. It is likely to benefit the stakeholders concerned if producers were made aware of the importance of agricultural research in terms of its contribution, and were then willing to contribute towards financing R&D, while allowing their co-operative to spend resources on research.

Judging from these three aspects of research system cooperation, it becomes clear that problems regarding cooperation amongst stakeholders do exist. The system is unlikely to become fully vertically integrated if the degree of cooperation cannot be increased. It should be determined why these problems exist and what can be done about it.

Table 4.5.2.2: Co-operatives' opinions on the lack of co-operation in terms of conducting research and development with other organizations in KwaZulu Natal and the Western Cape

KwaZulu Natal				
<i>Description</i>	UCL	SOC	CFB	CTC
Co-operative rating regarding their concern with the lack of co-operation in terms of conducting research and development with other organizations ¹	1	3	4	2
Western Cape				
<i>Description</i>	BNK	SSK	CRK	WPK²
Co-operative rating regarding their concern with the lack of co-operation in terms of conducting research and development with other organizations ¹	2	2	3	2

¹ 5 – severe problem, 1 – no problem

² WPK has changed to a company but is included for simplicity

Table 4.5.2.3: Research institutes' opinions on the lack of co-operation in terms of conducting research and development with other organizations in KwaZulu Natal and the Western Cape

KwaZulu Natal			
<i>Description</i>	Cedara	Pannar	SASEX
Research institutes' rating regarding their concern with the lack of co-operation in terms of conducting research and development with other organizations ¹	3	2	3
Western Cape			
<i>Description</i>	ARC1		ARC2
Research institutes' rating regarding their concern with the lack of co-operation in terms of conducting research and development with other organizations ¹	4		2

¹ 5 – severe problem, 1 – no problem

Table 4.5.2.4: Private sector companies' opinions on the lack of co-operation in terms of conducting research and development with other organizations in KwaZulu Natal and the Western Cape

KwaZulu Natal					
<i>Description</i>	A	B	C	D	E
Private sector organizations' concern with the lack of co-operation in terms of conducting research and development with other organizations ¹	2	3	2	3	4
Western Cape					
Description	A		B		
Private sector organizations' concern with the lack of co-operation in terms of conducting research and development with other organizations ¹	2		3		

¹ 5 – severe problem, 1 – no problem

Table 4.5.2.5: Co-operatives' opinions on the lack of member support for conducting and financing research and development in KwaZulu Natal and the Western Cape

KwaZulu Natal				
<i>Description</i>	UCL	SOC	CFB	CTC
Co-operatives' rating regarding their concern with the lack of member support when it comes to conducting and financing research ¹	1	3	4	2
Western Cape				
Description	BNK	SSK	CRK	WPK²
Co-operatives' rating regarding their concern with the lack of member support when it comes to conducting and financing research ¹	2	2	3	2

¹ 5 – severe problem, 1 – no problem

² WPK has changed to a company but is included for simplicity

Table 4.5.2.6: Research institutes’ opinions on the lack of member support for conducting and financing research and development in KwaZulu Natal and the Western Cape

KwaZulu Natal			
<i>Description</i>	Cedara	Pannar	SASEX
Research institutes’ rating regarding their concern with the lack of member support when it comes to conducting and financing research ¹	3	2	3
Western Cape			
Description	ARC1	ARC2	
Research institutes’ rating regarding their concern with the lack of member support when it comes to conducting and financing research ¹	4	2	

¹ 5 – severe problem, 1 – no problem

Table 4.5.2.7: Private sector companies’ opinions on the lack of member support for conducting and financing research and development in KwaZulu Natal and the Western Cape

KwaZulu Natal					
<i>Description</i>	A	B	C	D	E
Private sector organizations’ rating regarding their concern with the lack of member support when it comes to conducting and financing research ¹	2	3	2	3	4
Western Cape					
Description	A		B		
Private sector organizations’ rating regarding their concern with the lack of member support when it comes to conducting and financing research ¹	2		3		

¹ 5 – severe problem, 1 – no problem

4.5.3 Communication amongst stakeholders in the vertical chain

Effective communication within the vertical research system becomes important when it comes to transferring research results and innovations to those who will need to apply them at ground level. The term communication in this section thus refers to conducting extension. More specifically, the forms of extension, their shortcomings

and possible solutions to these shortcomings as experienced by producers will be analyzed.

Table 4.5.3.1 provides a description of producer satisfaction with regard to extension as conducted by government, the private sector and their own co-operatives as well as the various extension channels within those sectors. Once again producers proclaim dissatisfaction with government. Very few farmers are satisfied with the extension work of the Agricultural Research Council and both Provincial and National Departments of Agriculture, especially KwaZulu Natal producers. Again the concept of lag time may provide an explanation. In fact, of all the channels investigated magazines, the Internet and the respective co-operatives were the only ones who had more producers satisfied than unsatisfied with their performance. Furthermore, private sector agribusiness, from whom so much is expected nowadays, is also included in this group of under-performers.

The response from producers when asked more specifically which forms of extension they are exposed to most, what their shortcomings were and what could be done to improve extension, is listed in Tables 4.5.3.2 and 4.5.3.3. Farmer days are clearly very popular in both provinces. However, complaints were that farmer days are too infrequent and that too few organizations conduct this form of extension. Journals are another medium that seems to be very effective in communicating innovations and information to the producers considering also the few complaints made concerning this form of extension. Farm visits as an effective extension method has potential while pamphlets and the other forms of extension are seemingly ineffective.

What researchers can learn from this response is that effective forms of extension do exist and should be utilized if the producers concerned will respond. Those who do engage in this type of extension work should ensure that they use it often enough and do not fall into the trap of complacency. The statistics here confirm that extension activities from researchers are conducted poorly and inadequately. There is little sense in spending resources on research if the research results are never properly received by those for whom they are intended. The research system cannot operate effectively under these conditions. Ultimately, producers need to be informed and it should be the responsibility of the researchers to ensure that this takes place.

Table 4.5.3.1: Producers' satisfaction regarding extension activities in KwaZulu Natal and the Western Cape

KwaZulu Natal										
Description			Co-operatives							
			UCL		SOC		CFB		CTC	
			3 ¹	X ²	3 ¹	X ²	3 ¹	X ²	3 ¹	X ²
Producer satisfaction with extension activities of co-operative private sector, and government	Government	ARC	11	89	9	91	12	88	24	76
		NDA	7	93	9	91	4	96	13	87
		PDA	5	95	9	91	7	93	25	75
	Private sector	University	15	85	22	78	12	78	42	58
		Consultants	37	63	33	67	46	54	63	37
		Television	10	90	3	97	20	80	3	97
		Agribusiness	14	86	35	65	40	60	50	50
		Magazines	56	44	86	14	66	34	70	30
		Internet	70	30	70	30	61	39	78	22
		PSRI	28	72	28	72	21	79	56	44
Co-operative	63	37	59	41	12	78	70	30		
Western Cape										
Description			Co-operatives							
			BNK		SSK		CRK		WPK³	
			3 ¹	X ²	3 ¹	X ²	3 ¹	X ²	3 ¹	X ²
Producer satisfaction with extension activities of co-operative private sector, and government	Government	ARC	60	40	29	71	58	42	24	76
		NDA	32	68	14	86	13	87	8	92
		PDA	52	48	20	80	38	62	13	87
	Private sector	University	40	60	66	34	41	59	45	55
		Consultants	56	44	63	37	68	32	58	42
		Television	8	92	17	83	10	90	21	79
		Agribusiness	36	64	26	74	87	13	18	82
		Magazines	52	48	34	66	68	32	29	71
		Internet	79	21	83	17	80	20	74	26
		PSRI	40	60	37	63	65	35	11	89
Co-operative	56	44	59	41	68	32				

¹ Percentage producers that are satisfied

² Percentage producers that are unsatisfied

³ WPK has changed to a company but is included for simplicity

Table 4.5.3.2: Forms of communication used for extension services, their shortcomings and possible improvements as experienced by producers in KwaZulu Natal

KwaZulu Natal					
Description		Percentage producers			
		UCL	SOC	CFB	CTC
Most experienced forms of extension	Farm visits	48	32	42	23
	Farmer days	88	84	78	76
	Pamphlets	22	12	0	94
	Journals	76	68	46	85
	Other	-	-	Conference	marketers
Shortcomings of extension forms	Farm visits	-	Not often enough	More variety	-
	Farmer days	Not often enough, too long	-	More variety	Not often enough, more variety
	Pamphlets	Not enough information	Not enough information	Not enough information	-
	Journals	-	-	-	-
	Other	-	-	-	Too far away
Possible improvements	Farm visits	-	More often	More organizations should conduct farm visits	-
	Farmer days	Increase occurrence	-	More organizations should have them	More organizations should have them more often
	Pamphlets	More information required	More information required	More information required	-
	Journals	-	-	-	-
	Other	-	-	-	More regionalized

Table 4.5.3.3: Forms of communication used for extension services, their shortcomings and possible improvements as experienced by producers in the Western Cape

KwaZulu Natal					
Description		Percentage producers			
		BNK	SSK	CRK	WPK¹
Most experienced forms of extension	Farm visits	25	34	16	76
	Farmer days	38	57	66	64
	Pamphlets	34	12	22	27
	Journals	68	75	57	81
	Other	Internet, seminar	-	-	Meetings
Shortcomings of extension forms	Farm visits	Not often enough	Not often enough, more variety	Not often enough, more variety	-
	Farmer days	Not often enough, more variety	Not often enough	Not often enough, more variety	-
	Pamphlets	Useless information	Not enough information	Not enough information	Not enough information
	Journals	-	-	More information	-
	Other	-	-	-	-
Possible improvements	Farm visits	Increased occurrence	Increased occurrence, more organizations should visit	Increased occurrence, more organizations should visit	-
	Farmer days	Increase occurrence, more organizations should have them	Increase occurrence	Increase occurrence, more organizations should have them	-
	Pamphlets	-	More information required	More information required	More information required
	Journals	-	-	More variety in farming subjects	-
	Other	-	-	-	-

¹ WPK has changed to a company but is included for simplicity

4.5.4: Faith of stakeholders in the abilities of other stakeholders in the vertical chain

The final aspect of vertical integration that needs to be addressed is the amount of faith that stakeholder groups have in each other. Even more so than the issues already discussed, levels of faith will provide a clear-cut image of how well the stakeholders have integrated to form a solid research system. This is one of the core issues and will describe how much faith the stakeholder groups have in the technology generating capabilities of the other researchers in the system. This may shed some light on the seemingly lack of cooperation that exists between producers, co-operatives, private sector companies and research institutes with regard to conducting research and will provide a good indication of where relations will need to be improved.

From Tables 4.5.4.1 and 4.5.4.2, one can deduce that in KwaZulu Natal, the producers put all their faith in the private sector while being heavily critical of the ability of government institutes to supply them with new technologies. Concerning producer faith in their co-operatives, CFB and BNK are struggling in terms of getting their producers to show confidence in their abilities, while producers in KwaZulu Natal show far more faith in their co-operatives than is the case in the Western Cape. The opinions displayed by the Western Cape producers are not necessarily based on a lack of ability on the part of their co-operatives, but are likely to be due to the lack of action demonstrated by many of the co-operatives regarding the financing and conducting of research. For more details on producer faith within the separate industries see Appendix 1.

Table 4.5.4.1: Producers' faith in the new technology creating abilities of their co-operatives, the private sector and the government in KwaZulu Natal

Description		Rating ¹	Co-operatives			
			UCL	SOC	CFB	CTC
Producer satisfaction with the new technology creating ability of co-operatives, government and private sector	Co-operative	1	0	0	49	0
		2	7	6	41	4
		3	4	34	10	26
		4	15	22	0	30
		5	75	38	0	40
	Government	1	82	47	90	91
		2	11	25	5	9
		3	7	22	5	0
		4	0	6	0	0
		5	0	0	0	0
	Private sector	1	0	0	0	0
		2	0	0	0	0
		3	0	3	4	5
		4	22	13	16	7
		5	78	84	80	88

¹A rating of 5 indicates a very satisfied producer, a rating of 1 means a very unsatisfied producer.

Table 4.5.4.2: Producers' faith in the new technology creating abilities of their co-operatives, the private sector and the government in the Western Cape

Description		Rating ¹	Co-operatives			
			BNK	SSK	CRK	WPK ²
Producer satisfaction with the new technology creating ability of co-operatives, government and private sector	Co-operative	1	20	0	9	5
		2	52	6	19	30
		3	24	34	34	33
		4	4	22	25	22
		5	0	38	13	10
	Government	1	56	47	25	70
		2	24	25	38	26
		3	20	22	25	4
		4	0	6	5	0
		5	0	0	5	0
	Private sector	1	0	0	5	0
		2	0	0	0	8
		3	0	3	34	29
		4	22	13	20	30
		5	78	84	41	33

¹ A rating of 5 indicates a very satisfied producer, a rating of 1 means a very unsatisfied producer.

² WPK has changed to a company but is included for simplicity

Table 4.5.4.3: Co-operatives' faith in the new technology creating abilities of the private sector and government in KwaZulu Natal and the Western Cape

KwaZulu Natal					
Description		Co-operatives			
		UCL	CFB	SOC	CTC
Faith of co-operative in own new technology creating abilities and that of government and the private sector	Own organization	Satisfied	Unsatisfied, but have no resources	Satisfied, but could be more	Satisfied
	Government	Unsatisfied	Unsatisfied	Unsatisfied	Unsatisfied
	Private sector	Satisfied	Unsatisfied	Satisfied	Satisfied
Western Cape					
Description		Co-operatives			
		BNK	SSK	CRK	WPK¹
Faith of co-operative in own new technology creating abilities and that of government and the private sector	Own organization	Unsatisfied	Unsatisfied	Satisfied	Satisfied
	Government	Unsatisfied	Unsatisfied	Unsatisfied	Unsatisfied
	Private sector	Unsatisfied	Unsatisfied	Satisfied	Satisfied

¹ WPK has changed to a company but is included for simplicity

Table 4.5.4.4: Research institutes' faith in the new technology creating ability of the private sector and government in KwaZulu Natal and the Western Cape

KwaZulu Natal				
Description		Research institutes		
		Cedara	PANNAR	SASEX
Faith of research institutes in the new technology creating ability of government and the private sector	Government	Satisfied	Unsatisfied	Unsatisfied
	Private sector	Satisfied	Satisfied	Satisfied
Western Cape				
Description		Research institutes		
		ARC1	ARC2	
Faith of research institutes in the new technology creating ability of government and the private sector	Government	Unsatisfied	Satisfied	
	Private sector	Unsatisfied	Satisfied	

Table 4.5.4.5: Private sector companies' faith in the new technology creating ability of the private sector and government in KwaZulu Natal and the Western Cape

KwaZulu Natal						
Description		Private sector organization¹				
		A	B	C	D	E
Faith of private sector organizations in the new technology creating ability of government and the private sector	Government	Unsatisfied	Unsatisfied	Unsatisfied	Unsatisfied	Satisfied
	Private sector	Satisfied	Unsatisfied	Satisfied	Satisfied	Satisfied
Western Cape						
Description		Private sector organization¹				
		A	B			
Faith of private sector organizations in the new technology creating ability of government and the private sector	Government	Unsatisfied	Unsatisfied			
	Private sector	Satisfied	Unsatisfied			

¹These organizations wished their information to remain confidential

From Table 4.5.4.3 a similar trend is found amongst the co-operatives. CFB, BNK, and SSK are critical of their own abilities, which justifies the beliefs of their producers. These same three co-operatives are also not happy with the ability of the private sector to supply adequate technology while no co-operative shows any faith in government researchers. Similarly, from Table 4.5.4.4, ARC1 is the only research institute which is critical of the private sector while, as can be expected, considering that both are government institutes, Cedara and ARC2 both believe government has the ability to succeed in the task of generating new technology for the agricultural sectors concerned. Amongst the private sector companies in Table 4.5.4.5, only

company E is satisfied with the abilities of the state while company A in KwaZulu Natal and company B in the Western Cape are critical of the private sector.

These results come as no surprise considering the evidence from Section 4.5.1, where the expectations regarding the quality of research were investigated. The most striking issue again is the alarming lack of faith in government administered institutes. The only organizations that have any faith in government's ability are the government organizations themselves, and even of these, one is not satisfied with its own abilities. It is unlikely that these institutes do not have the ability to generate new technologies that are in demand at ground level. A major contributing factor to this lack of faith is likely to be the ineffectiveness of the extension services of the research institutes concerned (see Sections 4.4 and 4.5.3). A further explanation comes from the fact that a general mistrust exists amongst producers towards government actions (see Section 4.5.1) that is not necessarily reflective of the abilities of government institutions. If cooperation amongst producers, co-operatives and private sector companies is to be achieved, faith in government, more specifically government research institutes, must be restored.

The fact that at least some of the co-operatives and private sector companies are critical of themselves is a positive sign. It shows that they recognize the fact that there is room for improvement and that new technology generation is an important issue to them and must ultimately be realized. The faith that producers have put in the private sector is reflective of their belief that the private sector can deliver quality results. It is a good indication that producers are likely to invest in private sector research, provided profit incentives exist. It is up to private sector organizations to live up to these expectations and ensure that they generate quality and profitable innovations.

Although there is no lack of faith between producers and the private sector, and within the private sector itself, regarding the ability to generate new technologies, the fact that there is little to no faith in government institutes means that vertical integration is incomplete.

4.6 Conclusion

Most of the aspects of structural relationships investigated here seem to induce concern regarding the various elements of interaction between the stakeholder groups. The issue of increased producer involvement in determining research agendas is a significant step in the right direction. However, most of the remaining issues that were studied revealed too many problem areas especially when illustrating the likely consequences of these actions as experienced internationally. The separation of research and extension activities is likely to result in inefficiencies with regard to coordinating related research activities while encouraging undesirable levels of competition and lack of cooperation. There are differing expectations between stakeholders regarding the funding and conducting of research, preventing the research system from extracting maximum funds for research, while hindering teamwork. There is furthermore a lack of cooperation and communication amongst stakeholders, as well as a lack of faith shown by producers and private sector organizations in the abilities of the state.

The relevant parties will need to determine ways of overcoming the dangers illustrated by these findings. Instead of contributing to the effectiveness of the agricultural research systems concerned, these results are presently undermining the objectives of system which is to supply effective research management and technology.

Chapter Five

ANALYSIS OF RESEARCH INVESTMENT TRENDS IN THE AGRICULTURAL RESEARCH SYSTEMS OF KWAZULU NATAL AND THE WESTERN CAPE

1. Introduction

Together with structural interactions, the role of research investment trends form part of the new orientation towards agricultural research. Agricultural research systems throughout the world have been experiencing financing pressure since the early 90's (Tabor et al. 1998). Over the last two decades in the developing world, growth in agricultural research staff has far exceeded the supply of funds. Added to this, political neglect, over-reliance on donors, and pressure on resources are compounding the developing world's crisis. Developed nations are experiencing similar difficulties due to reductions in government spending and corporate R&D being concentrated amongst a few leading institutes (Tabor et al. 1998). Similarly, in the case of the South African agricultural sector, a shift in focus away from commercial farming towards developing farmers is taking place (Donovan, 1995).

The dilemma originates in the increasingly competitive agricultural market, where South African producers are evermore reliant on new technologies to stay ahead of their competitors. A reduction in research investments is thus likely to delay the growth and development of commercial agriculture.

This section serves to illustrate various aspects of research investment in the agricultural sectors of KwaZulu Natal and the Western Cape that provide a view of the present situation, its shortcomings and strengths. Various investment indicators were investigated including total research expenditure, research growth rates and expenditure per researcher. Once the overall picture was ascertained a more detailed study into one of the more relevant and urgent aspects of research investment was highlighted, that of market related research investments.

5.2 General agricultural research expenditure in KwaZulu Natal and the Western Cape

The decline in funding for research is somewhat paradoxical given the documented high returns to investment in agricultural research reported in Section 2.3. The reasons for the decline in financing of research vary. Budget cuts, lack of understanding of the role of research, research system inefficiencies, irrelevant research outputs and a decline in agricultural commodity prices have all been suggested as reasons for the decline (Tabor et al., 1998). Further study into this issue is necessary to determine its exact causes. In order to obtain a more detailed picture of the current situation regarding agricultural research expenditure in the two provinces under review, several indicators were investigated including total research expenditure as a percentage of turnover, research expenditure growth rates and expenditure per researcher. As can be expected, several organizations were not eager to reveal all of their financial results and for this reason some empty cells occur in Tables 5.2.1 to 5.2.6.

Based on a study into successful agricultural firms, it was suggested that five percent of an organization's turnover should be re-invested into the firm in the form of research and development in order to achieve maximum success (ISNAR, 1992). The five percent figure applies to private sector organizations. It can be expected that research institutes will invest more of their turnover into research because research is their primary function. Of all the private sector organizations investigated and willing to reveal their figures, not one recorded an R&D expenditure figure as a percentage of turnover higher than five percent. Amongst these, CRK recorded a figure of 0.5 percent while the remainder showed figures of less than 0.09 percent. These figures are so low in many cases that it is difficult to imagine what impact those R&D investments can have towards future benefit. Furthermore, several of the organizations who were willing to reveal these figures not only had low investment levels, but have over the last five years experienced a declining R&D expenditure figure as a percentage of turnover, indicating further deterioration of their investment in agricultural research. In such cases researchers are forced to make due with what little resources they have. Most of the research institutes were not willing to reveal their figures concerning re-investment of turnover into research. Cedara recorded a figure of 11.8 percent, considerably higher than any other organization investigated, as was expected. In general these figures are likely to result in poor research productivity and

technology generation (Alston et al., 1998), as well as a possible loss of experienced research personnel (Pardey et al., 1997).

Added to this situation, four of the twenty organizations included in the survey had zero R&D expenditure, further illustrating the lack of commitment, adaptation and understanding of the role of agricultural research even though globalization is a reality and the dangers of a lack of competitiveness quite evident. Furthermore, of the remaining sixteen organizations eight were not willing to reveal their figures concerning either their turnover or investments in R&D. How many of these also have poor R&D figures is thus unclear.

Table 5.2.1: Total research expenditure as percentage of turnover in KwaZulu Natal

Organization	Average total R&D expenditure over the last five years as a percentage of turnover
<i>Co-operatives</i>	
UCL	Not available
SOC	Not available
CFB	0%
CTC	+/- 0.05% decreasing
<i>Research institutes</i>	
Cedara	+/- 11.8 % decreasing
PANNAR	Not available
SASEX	Not available
<i>Private sector organizations</i>	
A	+/- 0.01% increasing
B	0%
C	+/- 0.083% decreasing
D	+/- 0.2% increasing
E	Not available

Table 5.2.2: Total research expenditure as a percentage of turnover in the Western Cape

Organization	Average total R&D expenditure over the last five years as a percentage of turnover
<i>Co-operatives</i>	
BNK	+/- 0.02% increasing
SSK	0%
CRK	+/- 0.5% increasing
WPK¹	Not available
<i>Research institutes</i>	
ARC1	Not available
ARC2	Not available
<i>Private sector organizations</i>	
A	+/- 0.083% decreasing
B	0%

¹ WPK has changed to a company but is included for simplicity

Table 5.2.3: Research expenditure growth rates in KwaZulu Natal

Organization	Average annual growth rate (1994 – 1998)	Predicted future growth rate
<i>Co-operatives</i>		
UCL	Nil	Nil
SOC	+/- 14.46 % decreasing	Nil to low
CFB	0	Nil
CTC	+/- 8.7 % decreasing	20 %
<i>Research institutes</i>		
Cedara	+/- 17.5% increasing	15 %
PANNAR	Not available	10 %
SASEX	Not available	10-15 %
<i>Private sector organizations</i>		
A	+/- 22.5 stable	0
B	0	0
C	0	Low
D	+/- 5.68 % increasing	0
E	+/- 5.1 % decreasing	0

Table 5.2.4: Research expenditure growth rates in the Western Cape

Organization	Average growth rate (1994 – 1998)	Predicted future growth rate
<i>Co-operatives</i>		
BNK	Not available	30 %
SSK	0	Nil
CRK	+/- 27 % increasing	15 %
WPK¹	+/- 9.55 % decreasing	According to inflation
<i>Research institutes</i>		
ARC1	Not available	low
ARC2	Not available	Not available
<i>Private sector organizations</i>		
A	0	low
B	0	10

¹ WPK has changed to a company but is included for simplicity

Table 5.2.5: Expenditure per researcher in KwaZulu Natal (Rand)

Organization	Expenditure per researcher (Rand)	
	Part time researchers	Full time equivalent
<i>Co-operatives</i>		
UCL	0	0
SOC	n.a.	266 666
CFB	0	0
CTC	24 375	195 000
<i>Research institutes</i>		
Cedara	31 325	38 000
PANNAR	Not available	Not available
SASEX	Not available	Not available
<i>Private sector organizations</i>		
A	10 000	n.a.
B	0	0
C	6 000	n.a.
D	25 000	50 000
E	10 000	n.a.

Table 5.2.6: Expenditure per researcher in the Western Cape (Rand)

Organization	Expenditure per researcher (Rand)	
	Part time researchers	Full time equivalent
<i>Co-operatives</i>		
BNK	10 000	n.a.
SSK	0	0
CRK	150 000	300 000
WPK¹	1 000	n.a.
<i>Research institutes</i>		
ARC1	Not available	Not available
ARC2	Not available	Not available
<i>Private sector organizations</i>		
A	6 000	n.a.
B	0	0

¹ WPK has changed to a company but is included for simplicity

Slightly more heartening than the current total investment levels is the rate at which research expenditure is growing (Tables 5.2.3 and 5.2.4). Of all the organizations which reported continuous research investments, only one (private sector company C in KwaZulu Natal), showed no growth rate in research expenditure. Of the rest the lowest was 5.1 percent while the highest was 27 percent. These results reflect favorably when one compares them to the research expenditure growth rates of developed countries. In all cases the growth rates were considerably higher than the averages of developed countries since 1971 (Section 2.5). However, this optimism must be stated cautiously, because, as stated earlier, the investment levels themselves are low and it could take several years yet for those organizations committed to these growth rates to achieve a margin close to five percent. Furthermore, many of the organizations boasting high growth rates are not committed to them. Of these organizations, four are experiencing a declining growth rate while three of these four, and an additional two, are predicting nil to lower growth rates in the future. Only five organizations predict a growth rate of between 10 and 30 percent for the future. This implies that the current situation seems unlikely to improve and research expenditure will be destined to remain inadequate.

Finally, the figures regarding expenditure per full time equivalent researcher show some cause for optimism when compared to the rest of the developed world (Section 2.5). However, before commenting on the statistics in Tables 5.2.5 and 5.2.6, it is somewhat disconcerting that in line with the findings regarding research expenditure and lack of commitment towards agricultural research, seven of the organizations who do invest in R&D do not have any full time researchers. Furthermore, of these only two have their research done by an outside organization who employ full time researchers, namely BNK and UCL. When the part time researchers are added to the equation the expenditure per researcher falls quite dramatically. SOC is the only organization that employs only full time researchers. Once again these figures must be viewed with caution considering that the total investment levels per organization are relatively low.

Potential profits and the need for increased competitiveness motivate private sector research. Presently, investments are low indicating a lack of incentive by those who recognize the need for research, and a lack of understanding by those who do not recognize the need for research. Urgent solutions are required for both situations.

5.3 Agricultural market driven research expenditure in KwaZulu Natal and the Western Cape

Earlier the argument against supply-led research systems was put forward because of its negative influences through bureaucratic causes, market distortions, and its inability to reflect and respond to market forces. The importance of a flexible, demand led research system capable of producing technologies that would provide a competitive advantage for local producers, was highlighted instead. Added to this was the argument that basic technology rather than applied technology should be the goal of public research due to it being market based (Alston et al., 1998). Broken down, these arguments imply that market influences should be central in any commitment of resources towards generating technologies through research. The notion that applied, science-driven research has an important role to play in the overall functioning of the research system goes without saying. However, the importance of market related research must be underlined. In a study conducted in France, Germany, the United Kingdom, the United States and Japan and involving over six hundred firms, market

driven organizations in all five countries were found to be far and away the most successful and competitive (Webster, 1999). The fact that market orientation is central towards achieving integration with local and global markets, is without doubt.

Thus the objective here is to determine whether agribusinesses within the agricultural research systems of KwaZulu Natal and the Western Cape have recognized the importance of market orientated research and have facilitated its presence. The presence of market innovations will also be scrutinized due to their importance in terms of survival in a hostile market environment as discussed in Section 2.2.1, as well as the levels of market analysis being done on both existing products and prior to the commencement of any particular research project. Finally, a look at potential barriers towards applying and implementing market orientated research will highlight potential means of increasing its occurrence.

5.3.1 Investments in agricultural market innovations

It is argued that not only does it pay to be market driven but the single strongest influence on a company's competitive success is innovativeness (Webster, 1999). Innovation means developing the product in tune with evolving consumer preferences, thereby achieving productivity and competitiveness and ultimately success. Innovativeness comes from being alert to the dynamics and changes occurring within markets and the most effective way to achieve this market sensitivity, is to become market driven. Market innovations are thus created through market driven research. Market driven research is exactly what it says, research based on perceived market demand. This type of research focuses on areas that are likely to improve the product concerned, or create a completely new product, in line with any one or more of the market factors investigated, resulting in market innovations that will go a long way towards improving competitiveness. Although significant literature exists on the issue of innovation in the normal business context, less exists on innovation in the agricultural sector. The same basic principles nevertheless apply, meaning that innovation is just as effective in improving competitiveness and capturing markets amongst producers and agribusiness.

The objective here was simple, and involved determining the number of innovative producers, co-operatives, research institutes and private sector organizations amongst those investigated in the agricultural research systems of KwaZulu Natal and Western Cape. Innovation is a good indication of how local agribusinesses and producers have evolved towards becoming market driven. Any research conducted will involve either the improvement of existing products, which in itself is an innovation, or creating a completely new product. For this reason, analyzing the innovativeness of products being researched will serve little purpose, instead, products under production will be studied to determine just how productive the research systems are in filtering innovations down to ground level. However, analyzing the ratio between new products under development and existing products being altered by research institutes, will prove informative.

The results of the study are illustrated in Tables 5.3.1.1 to 5.3.1.3. Before commenting on the response, it is important to remember that, as mentioned earlier, most of the private sector research is conducted in the post harvest stage of processing where most innovations will naturally occur. However, this by no means prevents agribusiness organizations from developing new base products such as improved hybrids or new non-traditional products. Judging from the results, it seems that many organizations are satisfied with the performance of their existing traditional products and feel there is no need for investing in innovation. In KwaZulu Natal, only UCL is producing innovative products while in the Western Cape, BNK and SSK are producing one innovative product each. The private sector organizations investigated in both provinces are split down the middle with some producing innovative products and the rest traditional products.

Considering the fact that the research organizations studied in this investigation are all involved in developing pre-harvest products, it seems as if the effectiveness and efficiency of these researchers is in question if only five innovative new products are being produced amongst eight co-operatives in two different provinces, of which two are the same product namely canola, one is aquaculture feed and one is a sugar product. This leaves one new innovative crop that being a new sugar cane hybrid, which together with canola means only two new innovative crops have been developed in the last five years and are being planted by producers, amongst all the co-

operatives investigated. The co-operatives that have failed to innovate are running the risk of stagnation and although they may still be doing fine by relying on traditional products they are losing out on the potential benefits of innovations and may encounter difficulties in the future. These co-operatives will struggle to achieve renewal and growth, both necessary components for succeeding in a globalized market (Hough, 1996).

Table 5.3.1.1 Innovations amongst co-operatives and private sector organizations in the agricultural research systems of KwaZulu Natal and the Western Cape

KwaZulu Natal						
Description	Product description¹					
	1	2	3	4	5	6
<i>Co-operatives</i>						
UCL	Traditional	Traditional	Traditional	Traditional	Innovative	Innovative
SOC	Traditional	-	-	-	-	-
CFB	Traditional	-	-	-	-	-
CTC	Traditional	-	-	-	-	-
<i>Private sector organizations</i>						
A	Traditional	Traditional	Traditional	Traditional	-	-
B	Traditional	Traditional	Traditional	-	-	-
C	Innovative	Innovative	Innovative	Traditional	-	-
D	Innovative	Traditional	Innovative	Traditional	-	-
E	Innovative	-	-	-	-	-
Western Cape						
Description	Products					
	1	2	3	4	5	6
<i>Co-operatives</i>						
BNK	Traditional	Traditional	Innovative	-	-	-
SSK	Traditional	Traditional	Innovative	-	-	-
CRK	Traditional	-	-	-	-	-
WPK²	Innovative	Traditional	Traditional	Traditional	Traditional	Traditional
<i>Private sector organizations</i>						
A	Innovative	Innovative	Innovative	Traditional	-	-
B	Traditional	Traditional	Traditional	-	-	-

¹ A product classified as innovative is a new product or altered existing product introduced in the last five years while a traditional product is one that has been around for more than five years

² WPK has changed to a company but is included for simplicity

Table 5.3.1.2 Types of research conducted by research institutes in KwaZulu Natal and the Western Cape

KwaZulu Natal			
Description	Cedara	PANNAR	SASEX
	Percentage of total research		
Research aimed at improving existing products and production techniques	80	0	50
Research aimed at developing new products	20	90	50
Western Cape			
Description	ARC1		ARC2
Research aimed at improving existing products and production techniques	80		70
Research aimed at developing new products	20		30

Table 5.3.1.3 Innovation amongst producers in KwaZulu Natal and the Western Cape

KwaZulu Natal				
Description	UCL	SOC	CFB	CTC
Percentage producers experimenting with traditional products	14	14	15	24
Percentage producers experimenting with innovative products	19	4	5	4
Western Cape				
Description	BNK	SSK	CRK	WPK¹
Percentage producers experimenting with traditional products	20	8	5	10
Percentage producers experimenting with innovative products	16	4	4	16

¹ WPK has changed to a company but is included for simplicity

A similar scenario is also reflected in the response from the producers, where only three co-operatives can boast having a percentage of their members willing to invest in new innovative products, of which the maximum is 19 percent (Table 5.3.1.3). Added to that, the percentage producers experimenting with existing products in an attempt to innovate for themselves is low, never more than twenty-four percent for any given co-operative.

Amongst the research institutes, PANNAR is the only one fully committed to developing completely new products while the rest, with the exception of SASEX which divides its resources equally, commit most of their resources to altering existing products and developing new production techniques (Table 5.3.1.2). The question must be asked why are there so few new innovative products being produced amongst producers. It is, however, not surprising considering the levels of commitment demonstrated by the research institutes towards developing new products. It is likely that research institutes do not conduct adequate extension work, as suggested by the results in Section 4.5.3, or they are inefficient in doing so. This poor show of productivity amongst research institutes is likely to result in slow growth in the context of globalization.

Together these figures indicate a slow recognition of the need to become predominantly market driven. As already mentioned, the parties involved may be happy with their returns as they are, but none will reach their full potential and maximum returns if they are unwilling to invest in the development of market innovations.

5.3.2 Market research amongst agribusiness organizations

An organization's willingness to invest in becoming market orientated can also be judged by determining whether or not it conducts actual market research. By conducting market research on existing products and by preceding any research activities with market analysis aimed at directing the research towards market demands, thereby improving its effectiveness and productivity, an organization can be classified as market driven.

Market research as conducted by the agribusiness organizations in KwaZulu Natal and Western Cape is illustrated in Tables 3.3.2.2.1 and 3.3.2.2.2. From these tables it can be seen that amongst the co-operatives, NCT, SOC and WPK conduct market research on all their existing products. UCL, SSK and CRK have their market research done by an outside organization, namely SASEX and Kaap Graan respectively. This leaves CFB and BNK as the only ones who do not carry out any market research on their

products. However, both co-operatives acknowledge that it is necessary to conduct market research in order to maximize returns but are not doing so, for reasons undisclosed. Amongst the research institutes, Cedara conducts market research on some of its existing products, while SASEX conducts market research on all but one of its products. PANNAR does not conduct any market research. Amongst the private sector organizations only two conduct market research on existing products in KwaZulu Natal and one in the Western Cape.

Reflective of the results regarding a lack of product innovations, BNK and WPK are the only co-operatives that conducted, or are conducting, research prior to developing a new product. SSK has a new product but did not conduct any market research prior to development although acknowledging that market research is now necessary. The rest have no new products under production, while UCL has its new products developed by SASEX. Cedara, SASEX and the Small Grain Institute conducted market research prior to conducting new product research on some of their products, although it is the minority in SASEX's case. PANNAR and the remaining ARC institute do not conduct initial market research. Only two private sector organizations are developing new products, both in KwaZulu Natal, while only one of them precedes research with market analysis.

As can be expected most of the organizations investigated conducted market research on their existing products or have an outside organization carrying out market research on their behalf. These results are positive in that it shows how agribusinesses have become independent since the demise of control boards when the need to conduct market research was minimal. Recognition of the need for marketing research on existing products is clearly not an issue anymore, which bodes well for future deregulation.

The fact that there are so few new products under development has already been discussed. However, the lack of market analysis prior to conducting research amongst the new products that are under development is a cause for concern. Those new products being developed without market research will have to rely on the marketing skills of the organization concerned once development is complete. The possibility of

markets rejecting these new products or that the life span will be unpredictably limited, exists. This in turn would have resulted in inefficient use of resources.

Table 5.3.2.1 Market analysis conducted by co-operatives, research institutes and private sector companies in KwaZulu Natal and Western Cape on existing products

KwaZulu Natal							
Description		Products					
		1	2	3	4	5	6
Co-operatives engaging in market research	UCL	No	No	No	No	Yes	Yes
	SOC	Yes	-	-	-	-	-
	CFB	No	-	-	-	-	-
	CTC	Yes	-	-	-	-	-
Research institutes engaging in market research	Cedara	No	No	Yes	No	No	Yes
	PANNAR	No	No	No	No	-	-
	SASEX	Yes	Yes	Yes	Yes	Yes	No
Private sector organizations engaging in market research	A	No	No	No	No	-	-
	B	No	No	No	-	-	-
	C	Yes	Yes	Yes	No	-	-
	D	Yes	No	Yes	No	-	-
	E	No	-	-	-	-	-
Western Cape							
Description		Products					
		1	2	3	4	5	6
Co-operatives engaging in market research	BNK	No	No	No	-	-	-
	SSK	No	No	No	-	-	-
	CRK	No	-	-	-	-	-
	WPK¹	Yes	Yes	Yes	Yes	Yes	Yes
Research institutes engaging in market research	ARC1	No	No	No	No	No	No
	ARC2	Yes	Yes	Yes	No	No	-
Private sector organizations engaging in market research	A	Yes	Yes	Yes	No	-	-
	B	No	No	No	-	-	-

¹ WPK has changed to a company but is included for simplicity

Table 5.3.2.2 Market analysis conducted by co-operatives, research institutes and private sector companies in KwaZulu Natal and Western Cape prior to conducting research

KwaZulu Natal							
Description		Products¹					
		1	2	3	4	5	6
Co-operatives engaging in market research prior to conducting research	UCL	-	-	-	-	-	-
	SOC	-	-	-	-	-	-
	CFB	-	-	-	-	-	-
	CTC	-	-	-	-	-	-
Research institutes engaging in market research prior to conducting research	Cedara	Yes	No	-	-	-	-
	PANNAR	No	-	-	-	-	-
	SASEX	Yes	No	No	No	-	-
Private sector organizations engaging in market research prior to conducting research	A	No	-	-	-	-	-
	B	-	-	-	-	-	-
	C	-	-	-	-	-	-
	D	-	-	-	-	-	-
	E	Yes	-	-	-	-	-
Western Cape							
Description		Products					
		1	2	3	4	5	6
Co-operatives engaging in market research prior to conducting research	BNK	Yes	-	-	-	-	-
	SSK	No	-	-	-	-	-
	CRK	-	-	-	-	-	-
	WPK²	Yes	-	-	-	-	-
Research institutes engaging in market research prior to conducting research	ARC1	-	-	-	-	-	-
	ARC2	Yes	-	-	-	-	-
Private sector organizations engaging in market research prior to conducting research	A	-	-	-	-	-	-
	B	-	-	-	-	-	-

¹ Products only analyzed if they are current new products under development² WPK has changed to a company but is included for simplicity

Only one private sector organization of all those investigated was involved in market analysis before committing resources to research. Considering that the private sector

will have to shoulder much of the research responsibilities left vacant by the government, a lack of investment in market orientated research amongst private sector organizations is likely to contribute towards slower development rates amongst the agricultural industries. An internationally competitive private sector is crucial in encouraging a fast growing agricultural sector, and as mentioned before, market flexibility and responsiveness are key factors in achieving this goal.

5.3.3 Barriers to investing in market driven research

Having analyzed the levels of investment in market innovations and market research, it suggests that much can still be done to encourage a more market orientated approach amongst the various stakeholders within the research system. To analyze the causes leading to the present situation regarding market innovations and pre-research market analysis, one merely has to investigate the barriers standing in the way of investing in market research.

The respondents' viewpoints on the matter are recorded in Tables 5.3.3.1, where they list the biggest stumbling blocks towards greater market research investments. The most prominent feature of these results is the lack of funds available for additional market research. Nearly all the organizations list a lack of funds as the biggest stumbling block towards establishing more market research agendas. This again raises some concern regarding the priority that certain areas of market research holds amongst the organizations investigated. For example, considering the cost of research, organizations will want to ensure that the research that is carried out is constructive, necessary and will ensure productive results without wasting resources. Conducting market research before committing resources is thus the logical step to take and yet this is often not the case. Funds that are available are allocated elsewhere and pre-research market studies are being shelved too often.

Table 5.3.3.1 Barriers to market research as viewed by the co-operatives of KwaZulu Natal and the Western Cape

KwaZulu Natal				
Barriers to market research	Co-operatives' rating (5 – large barrier, 1 – small barrier)			
	UCL¹	SOC	CFB	CTC
Producers do not want to finance research	-	4	5	4
Too little faith in satisfactory results	-	2	1	1
Lack of organizational funds	-	4	5	3
Returns too small	-	1	4	1
Returns too long term	-	1	3	1
Inadequate control over research results	-	3	3	2
Lack of member support even if funds are available	-	5	4	3
Lack of partners for joint ventures	-	4	5	3
Western Cape				
Barriers to market research	Co-operatives' rating (5 – large barrier, 1 – small barrier)			
	BNK	SSK	CRK	WPK¹
Producers do not want to finance research	2	4	3	-
Too little faith in satisfactory results	3	2	5	-
Lack of organizational funds	4	5	5	-
Returns too small	2	4	3	-
Returns too long term	2	3	1	-
Inadequate control over research results	2	4	1	-
Lack of member support even if funds are available	2	4	2	-
Lack of partners for joint ventures	4	5	2	-

¹ These organizations feel they need not invest more in market research. WPK has changed to a company but is included for simplicity

Table 5.3.3.2 Barriers to market research as viewed by the research institutes of KwaZulu Natal and Western Cape

KwaZulu Natal			
Barriers to market research	Research institutes' rating (5 – large barrier, 1 – small barrier)		
	Cedara	PANNAR	SASEX
Producers do not want to finance research	4	2	2
Too little faith in satisfactory results	2	1	1
Lack of organizational funds	4	2	1
Returns too small	5	2	1
Returns too long term	2	2	2
Inadequate control over research results	1	1	3
Lack of member support even if funds are available	1	2	2
Lack of partners for joint ventures	1	2	2
Western Cape			
Barriers to market research	Research institutes' rating (5 – large barrier, 1 – small barrier)		
	ARC1¹	ARC2	
Producers do not want to finance research	-	3	
Too little faith in satisfactory results	-	2	
Lack of organizational funds	-	3	
Returns too small	-	2	
Returns too long term	-	1	
Inadequate control over research results	-	1	
Lack of member support even if funds are available	-	2	
Lack of partners for joint ventures	-	3	

¹ These organizations feel they need not invest more in market research

The fact that producers are in many cases loath to contribute financially to market research or even condone market research if funds are available, especially in KwaZulu Natal, is indicative of a lack of understanding of the importance of market research amongst this stakeholder group. Creating awareness amongst producers regarding the contributions of research, should be high on the list of priorities for any agribusiness organization. If producers were to contribute more financially it could alleviate the problem of organizations not being able to conduct more market research, which they are likely to do if one looks back at how many involve themselves with market studies concerning their existing products.

Table 5.3.3.3 Barriers to market research as viewed by the private sector companies of KwaZulu Natal and Western Cape

KwaZulu Natal					
Barriers to market research	Private sector organizations' rating (5 – large barrier, 1 – small barrier)				
	A¹	B	C	D	E
Producers do not want to finance research	-	4	5	-	4
Too little faith in satisfactory results	-	2	3	3	1
Lack of organizational funds	-	4	5	3	5
Returns too small	-	1	2	2	3
Returns too long term	-	1	2	1	2
Inadequate control over research results	-	4	1	3	5
Lack of member support even if funds are available	-	1	3	1	2
Lack of partners for joint ventures	-	4	3	4	2
Western Cape					
Barriers to market research	Private sector organizations' rating¹ (5 – large barrier, 1 – small barrier)				
	A	B			
Producers do not want to finance research	5	5			
Too little faith in satisfactory results	3	2			
Lack of organizational funds	5	5			
Returns too small	2	3			
Returns too long term	2	3			
Inadequate control over research results	1	3			
Lack of member support even if funds are available	3	1			
Lack of partners for joint ventures	3	3			

¹ These organizations feel they need not invest more in market research

Another important issue is the lack of organizations willing to conduct joint ventures. The advantages of joint ventures include cost savings, pooling of human resources, etc. and for these reasons it is rather surprising that so many co-operatives and private sector organizations list a lack of partners as a major stumbling block in conducting such an important task such as market research. This is an issue of management and should be addressed.

The lack of faith in satisfactory results and good returns is also a significant concern amongst many organizations. If organizations doubt their own ability to conduct quality market research then additional investments will rarely take place. It is up to the organizations themselves to appoint capable staff and carry out thorough planning to ensure satisfactory results.

Finally, the issue of adequate intellectual property rights requires attention. In any developed economy, the function of legislation is to protect the investment of any researcher, excluding public research to which everyone has access. The free-rider problem is likely to prevent private sector organizations from investing in research, which poses the danger of slowing down their development and growth.

5.4 Conclusion

The indicators representing agricultural research investment trends investigated in this Chapter, illustrate the fact that research funding is too low. Although growth rates and expenditure per researcher reveal some positives, the low investment levels negate them. Increased private sector financing from both organizations and producers will assist in providing sufficient quality technologies throughout the respective agricultural sectors. This calls for the promotion of profit incentives in the trading and production environments. Current research spending is too low to accommodate an effective change in agricultural research productivity.

Furthermore, regarding investments in market research, it is crucial to recognizing the importance and priority of market research in all its forms as the first step towards achieving market orientation. This seems to be the case with regard to products presently under production, where nearly all the stakeholders recognize the contribution of this type of market research. However, market research prior to conducting research is currently not seen as necessary when assigning resources to research. The dangers are clear considering the value and limited amount of available resources and the indiscriminate and constantly changing agricultural market. Most of the barriers discussed are a reality, whether because of inadequate management techniques or something more inhibiting such as a lack of funds.

In recent times co-operation between researchers and private sector companies has become an important issue. Funds provided by the NRF, The Innovation Fund, Thrifts and several EU Funds have been made available to promote such collaboration. It is thus surprising that so many organizations see a lack of funds as one of the larger stumbling blocks. Either these funds are inadequate or not enough is being done to make known the existence of these opportunities.

By implementing the means for change through appropriate institutional changes, agribusiness can commit itself to not only research in general, but a market driven approach whereby market forces dictate the use of resources and ultimately competitiveness.

Chapter Six

THE ROLE OF THE PRIVATE SECTOR IN CONDUCTING RESEARCH IN THE AGRICULTURAL RESEARCH SYSTEMS OF KWAZULU NATAL AND THE WESTERN CAPE

6.1 Introduction

The final aspect of the provincial agricultural research systems that will be investigated with regard to the new approach towards agricultural research, is the role of the private sector in conducting research. In line with decreasing funds from the public sector for agricultural research, the role of the private sector in this regard seems more important than ever. The growing contribution of the private sector to agricultural research in developed countries has already been discussed in Section 2.6.1, while the resulting benefits have also been illustrated. The question is thus not whether or not private sector participation will be beneficial, but rather how private sector participation can be maximized.

In South Africa the notion of increased private sector participation in the agricultural sector is particularly relevant due to a change in state policies resulting in lower spending and the shifting of resources towards developing a new generation of small farmers. The private sector should be seen as an instrument used to fill the gap created by the reduction in government research funding and their change in focus away from commercial agriculture (Donovan, 1995). In order for this to occur, the private sector must identify sufficient profit incentive in order to willingly invest in R&D. Furthermore, private sector companies must first understand the potential benefits of R&D, before they are likely to commit resources. In the following sections it will be established whether or not the various stakeholder groups have recognized these potential benefits of R&D, and what exactly they expect their function to be, in terms of increased participation in agricultural research. This is a reflection of attitude and not of actions. If the levels of awareness regarding the need for R&D are high, it does not necessarily mean enough is being done about it. Consequently, the levels of awareness as well as what is actually being done about it were investigated.

6.2 The role of the private sector as viewed by the research system stakeholders

Ultimately, it is what the private sector will put into practice that will determine its contribution to agricultural research. If the stakeholders hold negative perceptions regarding private sector participation, it will be difficult to implement this participation. It is thus important to determine exactly what the various stakeholders believe to be the role of the private sector, as this is likely also to influence their course of action. If these views and expectations are contrary to accepted theory and require guidance and a change in direction, then it should be done before any attempt is made to alter the research system structure.

The issue of increased private sector participation in general was referred to the various stakeholders. The response was in favor of increased private sector participation with the exception of two private sector companies in KwaZulu Natal who feel government should shoulder all the responsibility. This bodes well for the future implementation of this concept. Increased private sector participation consists of both increased financing of agricultural research, including producers, as well as increased research and extension actually conducted by the private sector, in return for increased profits. These aspects were put to the various producers, co-operatives, research institutes and private sector organizations, more specifically to what extent they themselves would participate in conducting these activities. The responses are listed in Tables 6.2.1 to 6.2.3.

The results indicate a lack of commitment towards increased research funding amongst the private sector organizations investigated. Similar to the results referring to the distribution of responsibility between government and the private sector as a whole in Table 4.5.1, half of the co-operatives do not feel they need to increase either financing of research or the conducting of research and extension. Four of the private sector organizations feel the same way. All the research institutes feel the private sector should become more involved.

Table 6.2.1 Self-analysis of co-operatives, research institutes and private sector companies of KwaZulu Natal, in terms of increased private sector participation in agricultural research

Organization	Role of own organization in terms of increased private sector participation ¹	
	Increased financing of research	Increased conducting of research and extension
<i>Co-operatives</i>		
UCL	No increase	No increase
SOC	Must increase	Must increase
CFB	No increase	No increase
CTC	Must increase	Must increase
<i>Research institutes</i>		
Cedara	Must increase	Must increase
PANNAR	Must increase	Must increase
SASEX	Must increase	Must increase
<i>Private sector organizations</i>		
A	No increase	No increase
B	Must increase	Must increase
C	No increase	No increase
D	No increase	No increase
E	Must increase	Must increase

¹ The research institutes are public or semi-private and their opinions thus relate to the rest of the private sector not their own organization

Considering the successes achieved internationally by the private sector in generating profits through R&D, it is surprising that more than half of the private sector organizations interviewed in this study state that they do not feel they need to increase their contribution to agricultural research in their provinces. In fact, these same organizations are at present making little to no contribution at all (see Tables 4.2.2 and 4.2.4).

Table 6.2.2 Self-analysis of co-operatives, research institutes and private sector companies of the Western Cape, in terms of increased private sector participation

Organization	Role of own organization in terms of increased private sector participation ¹	
	Increased financing of research	Increased conducting of research and extension
<i>Co-operatives</i>		
BNK	Must increase	Must increase
SSK	No increase	No increase
CRK	Must increase	Must increase
WPK²	No increase	No increase
<i>Research institutes</i>		
ARC1	Must increase	Must increase
ARC2	Must increase	Must increase
<i>Private sector organizations</i>		
A	No increase	No increase
B	No increase	No increase

¹ The research institutes are public or semi-private and their opinions thus relate to the rest of the private sector not their own organization

² WPK has changed to a company but is included for simplicity

According to the respondents, the reasons for this are straightforward; they feel they are doing enough in terms of technology generation and do not fear that their future competitiveness is under threat. Interestingly enough, most producers of those same co-operatives feel the private sector should increase its contribution to agricultural research as a means of generating higher profits (Table 6.2.1). This once again highlights the differences in expectations amongst stakeholders.

It is important to remember that there may just not be enough incentive for many private sector organizations to increase their research activities, especially if they lack funds, input prices are too high and the perceived risk is too high. In some cases, especially among the smaller organizations, this is likely to be true. However, when looking at the present situation in South Africa where global competition is very relevant, the incentives discussed earlier such as potential economic gains, and market conditions are very much a reality.

Table 6.2.3: The importance of increased private sector participation in agricultural research as seen by producers of KwaZulu Natal and the Western Cape

KwaZulu Natal				
Description	Co-operatives			
	UCL	SOC	CFB	CTC
Percentage producers who call for increased private sector participation in terms of funding research	83	87	73	96
Percentage producers who call for increased private sector participation in terms of conducting research and extension	98	88	93	100
Percentage producers who call for increased private sector participation in terms of determining research agendas	96	100	100	100
Western Cape				
Description	Co-operatives			
	BNK	SSK	CRK	WPK¹
Percentage producers who call for increased private sector participation in terms of funding research	56	91	81	79
Percentage producers who call for increased private sector participation in terms of conducting research and extension	92	91	92	100
Percentage producers who call for increased private sector participation in terms of determining research agendas	80	100	100	84

¹ WPK has changed to a company but is included for simplicity

Competitiveness is becoming an increasingly important issue, whether from local or international suppliers, and unless the private sector identifies incentives that will induce technology generation capable of countering these trends, many South African agribusinesses are going to encounter difficulties. There are many opportunities internationally and incentives for exporting are high due to the exchange rate, yet only four of the private sector organizations, including the co-operatives, investigated the possibilities of exporting a product. This is where increased product research, and especially market research, are a necessity.

A research system, be it provincial or national, cannot obtain maximum growth without the benefit of private sector participation, and it is this notion that is not being recognized and implemented by nearly half the private sector organizations studied.

6.3 Present actions of private sector organizations regarding the role of the private sector according to their views

Having determined the attitudes of the private sector organizations in question regarding increased private sector participation, and having painted a gloomy picture, it is important to determine what those organizations that do support increased participation by the private sector are actually doing about it. In the past government either supplied the necessary technology or manipulated the market in order to protect the agricultural sectors. The impetus now is on the private sector to help itself through technology generation. Although some private sector organizations acknowledge the advantages of increased research and support the need for it, these organizations will have to apply their beliefs in practice. It seems as if many of these organizations are cautiously observing whether or not others are succeeding in their activities, specifically those regarding research, and not risking investments in this field without some guarantees.

It was established earlier in section 5.2, that levels of investment are too low amongst private sector organizations, including co-operatives. Even those committed to greater private sector involvement seem to fall short of the mark. In KwaZulu Natal SOC, NCT and private sector companies B and E, and in the Western Cape, BNK and CRK, stated that the private sector in general, and specifically their own organization, must do more in terms of research (Table 6.2.1). In spite of this general perception, most of the institutions have a declining research investment growth rate, except CRK. BNK did not make its figures available. SOC and private sector companies B and E predict their future growth rates to be zero or low (Table 5.2.3 and 5.2.4). This effectively means that CRK is the only private sector organization currently fully committed to increasing its contribution to research and development.

6.4 Conclusion

The benefits of greater private sector involvement in agricultural research are presently not adequately recognized by most of the organizations investigated. More than half of the private sector organizations interviewed predict no increases in their investments in agricultural research while the research institutes and the majority of producers oppose this view and are calling for greater private sector participation in the funding and conducting of research. Furthermore, of those organizations that feel it is necessary to invest more in research, most have not increased their research spending as yet and many predict a low growth rate in future research funding. These results indicate a poor understanding of the need for agricultural research and its benefits by certain organizations, as well as highlighting the need for proper incentives for those organizations that do recognise the need for R&D.

Chapter Seven

CONCLUSIONS AND SUMMARY

7.1 Conclusions

The evolution of global marketing together with technological advances and the accompanying trends, specifically the need for international competitiveness, has induced the need for a new orientation towards agricultural business management. Successful agribusinesses and individuals have to adapt their strategic position regarding agricultural operations, partially facilitated by a new commitment to, and understanding of, the role of research and development. Technological and market leadership through research has been identified as central in dealing with globalization and the resulting need for competitiveness and growth. Consequently, institutional structures have to be altered to accommodate and promote the generation of technological innovations and market awareness through higher investment levels and greater private sector participation. The objective of this study was to investigate the awareness of top and middle management of agribusiness institutions of the strategic importance of R&D and also their efforts to implement this awareness; and furthermore the degree to which the operating functions and structures of the agricultural research systems of KwaZulu Natal and the Western Cape have been altered to suit the new dispensation.

Most of the organizations and individuals investigated displayed varying degrees of indifference towards agricultural research in terms of higher investment levels and structural adaptation. Unsuitable practices such as the lack of sufficient vertical integration and cooperation amongst producers, agribusinesses and researchers, a lack of incentives and the lingering presence of top-down and supply driven decision making, are likely to prevent the research system from operating at its maximum potential. Important research benefits are thus lost to the agricultural sector, providing motivation to encourage and promote integration and co-operation. These issues are indicative of the fact that the majority of stakeholders have failed to recognize and implement institutional changes that will serve to streamline agricultural research services with what is being demanded to increase competitiveness. Furthermore, the

inefficient conduct of extension activities by researchers as experienced by producers, and the separation of research and extension activities by the various agribusinesses and research institutes, reflect poorly on the effective functioning of the system. Together, these facts indicate that the current institutional structure of the two provincial agricultural research systems and its inherent operating procedures are not suitable.

Research investment levels have shown few signs of increasing and remain low, between 0.01 percent and 0.083 percent, when compared to the internationally accepted standard of 5 percent. Research investment growth rates are relatively high. However, with the exception of CRK, all of the private sector organizations have a declining growth rate or predict a low to nil future growth rate. Only seven full time researchers are at present employed and funded by fifteen private sector organizations. This points towards failure amongst the parties involved to either identify the benefits resulting from agricultural research or that they simply have no incentive to risk an unprofitable investment. Investment in agricultural R&D is a strategic function that renders returns over the long term and requires management with strategic vision capable of understanding this necessity and motivating investment as a sacrifice now in order to reap the benefits later. This lack of strategic vision can be ascribed to a change in culture away from the era of greater government support of R&D and a less demanding business environment prior to deregulation, and failure by management to adapt accordingly by allocating resources for research.

Current market research investments are primarily concerned with products already developed and largely ignore proactive market research initiated prior to product development. Not only is research funding low, but also the manner in which these funds are applied does not represent suitable convictions as illustrated by the lack of proactive market research and specialized research personnel. Added to this notion is the fact that half of the private sector organizations do not view increased participation in research as a priority. Projected research growth rates are low in many cases, while those who do claim commitment to research have not implemented their beliefs, displaying instead a declining research expenditure growth rate, placing the burden on the shoulders of public research institutes in whom they show little faith.

Although these are issues creating cause for concern there are certain aspects of a positive nature revealed in this study. There is general consensus that there is a need for change in many areas of agricultural research. This is the first step towards encouraging the adoption of a more appropriate orientation towards research. A unified demand driven decision making process has been identified as the more suitable alternative, although not yet adequately implemented.

The facts revealed in this study indicate that the agricultural sectors of KwaZulu Natal and the Western Cape are presently not able to boast efficient and effective agricultural research systems in line with current international benchmarks. These systems are thus not succeeding in providing the agricultural industries concerned with the required technologies and research management necessary to maximize competitiveness. The legacy of bureaucratic involvement is by no means an issue of the past. Many organizations still cling to a view ignorant of global trends and developments. Failure to recognize and alter unsuitable institutional structures and practices, increase research spending and incorporate the private sector in the technology development process is likely to encourage complacency with regard to competitiveness.

Improved research output through higher efficiency levels and more effective operating functions is brought about by developing a suitable research system structure. Such a system evokes structural interactions and processes that extract maximum contributions from its stakeholders. The close relationship between high levels of R&D spending and successful agricultural sectors, provides motivation for increased R&D investment, while increasing contributions from the private sector have also resulted in landmark achievements in developing agricultural sectors. These philosophies together with the recognition of the contributions of research and a commitment towards adopting a demand driven approach underline the present international culture surrounding agricultural research. This culture has as yet not been fully understood and adopted by the producers, agribusiness and researchers of the two respective agricultural sectors investigated. Although certain areas of this culture have been recognized by several of the stakeholders, such as the need for change in terms of increased R&D spending, the implementation thereof has been poor and the new orientation thus ineffective. For these organizations and individuals it is a matter of developing the appropriate means in order to achieve the desired end. However, for

the majority of organizations and individuals, not only must the appropriate means be found, but also the correct orientation on which those means are based.

There is little doubt that the present research system structures of KwaZulu Natal and the Western Cape still require attention in order to adequately fulfill their responsibilities towards the agricultural sectors of the two provinces. Various aspects of structural interactions, research investments and increased private sector participation have been critically analyzed and found to wanting. It is important to create an understanding for the need for change amongst those stakeholders who have as yet failed to adopt a new orientation towards research, by illustrating the stumbling blocks of their current actions, as well as the inefficiencies of the present system and describing how a different approach will result in greater benefits. Once the new culture surrounding agricultural research has been recognized and understood throughout the system then administrators, producers, agribusinesses and researchers can work together to devise the means by which the new objectives can be obtained. This will not only equip the agricultural sector for the challenges of globalization, but also put it in a position where the stakeholders can effectively take advantage of the opportunities presented by it.

7.2 Summary

A summary describing the state of the two provincial agricultural research systems revealed in this study are summarized below.

In recent years South African agriculture has been subjected to changes in the global economic, political, social and technological environments. Internally, government intervention in agricultural marketing as well as government expenditure aimed at supporting commercial agriculture has been significantly lowered. Agricultural producers and agribusiness are now faced with the task of overcoming the challenges presented by these changes, specifically the need for increased competitiveness. Agricultural R&D has been identified as central to this process through its reflection of market trends and its ability to supply the necessary technologies and innovations. In order for R&D to have the desired affect, it must be facilitated by a suitable and

effective agricultural research system. Determining the degree to which this is the case in KwaZulu Natal and the Western Cape was the objective of this study.

It is imperative that all stakeholders within the local agricultural industries recognize and understand the changes that have taken place and more importantly adapt accordingly. This requires a new strategic orientation towards agricultural production and marketing. This market based orientation calls for increased competitiveness through renewal and growth by focusing on innovation and research. International trends representative of this approach are characterized by several institutional changes within the respective agricultural research systems of those countries. Structural changes aimed at improving the efficiency and effectiveness of researchers include the process whereby research agendas are established, inducing competition amongst researchers, separating research and extension activities and vertically integrating the system. Regarding research investments, fiscal constraints have forced a drop in public research expenditure across the globe. A large contributing factor to the success of agricultural sectors as experienced by other countries, is cooperation between public and private sector organizations. While public spending has decreased in many industrialized countries, private sector funding has increased significantly resulting in capital gains, sufficient new technologies and ultimately competitiveness and growth.

The institutional changes described above served as the foundation for this study. The research process selected to guide the investigation constituted a simple four-step procedure directed by the research objectives. The first step was to define the problem and the research objectives. Secondly, the research plan was formulated whereby the data sources, the research approach, the research instruments, the sampling plan and the contact method were established. The next step involved collecting the necessary data followed by the final task of analyzing the information.

When establishing research agendas, researchers have expressed the need to move away from the supply-driven, top-down decision making process that was employed during the era of government intervention. They have realized that the producer should become involved in the decision making process whereby market forces determine what is to be researched. However, many of these same researchers have failed to implement these ideals and have not yet established a fully demand driven decision

making process which involves the ground level stakeholders. Specifically, the livestock and grain industries in both provinces have failed in this regard and are currently evoking high levels of producer dissatisfaction.

The advantages of competition amongst public researchers, in terms of inducing higher quality research and higher productivity levels in order to obtain maximum funds, have not been implemented by the state researchers investigated. Although risks are involved, such as a resulting lack of co-operation, it is nevertheless a research system function that could prove useful in the future. This success enjoyed internationally in this regard, specifically in the OECD countries, in terms of improved quality of research and increased productivity, further emphasize the issue.

Nearly half of the organizations investigated have separated their research and extension activities. Usually a trend reserved for increasing competitiveness through the need to specialize, it holds many dangers in the form of inefficiencies and uncoordinated planning and actions.

Vertical integration is an aspect of the research systems that has been poorly approached and implemented. Expectations regarding the financing, development and extension of research, as well as the quality of research, differ widely between the various stakeholders concerned. Cooperation amongst agribusinesses and between organizations and their members regarding research in general has not been realized and seems a difficult proposition. Communication, in the form of extension, is poorly conducted by research institutes as the vast majority of producers show dissatisfaction. Many of the mediums used to conduct extension are also criticized, producers judging them too infrequent and lacking variety. Finally, there is an alarming lack of faith shown by the various stakeholders in the ability of the state to generate the necessary quality technology. Furthermore, agribusiness organizations are often critical of themselves and other private sector organization with regard to conducting R&D.

When compared to the suggested figure of five percent, the organizations investigated fell short in terms of re-investment into research as a percentage of turnover. Investment levels were found to be significantly lower than this norm and in several cases research investment was non-existent. Although research expenditure growth

rates and expenditure per full time researcher proved favorable by international standards, they were negated by the fact that many of these research expenditure growth rates were on the decline, while by far the most research departments did not employ full time researchers.

There is a distinct lack of market innovations being implemented by producers. This indicates poor productivity amongst the research organizations. Concerning the market orientation of the organizations investigated, it was determined that nearly all of them conducted market research on their existing product range. While this was a positive result, the same cannot be said about market research conducted prior to committing resources to research, which is practiced too infrequently.

Several barriers to increased market research were evident. Many of these had to do with the presiding perceptions of the relevant stakeholders towards investing in market research, such as allocating funds elsewhere, lack of member support and risk orientation. Some institutional barriers however also exist such as lack of partners and inadequate legislation governing intellectual property rights.

Although the need for private sector participation has generally been recognized in terms of financing, conducting and determining research agendas amongst producers and research institutes, the private sector itself shows significant opposition to this move. Over half of the organizations interviewed felt that they would not increase their R&D spending in the near future, while those who have recognized the need for more investment, lack incentive.

Little is being done in terms of increased financing of agricultural research, even by those organizations who do feel that the private sector should increase its contribution to research. Research expenditure remains low and future predicted expenditure growth rates are also low to nil.

7.3 Recommendations

Providing solutions to the problems encountered in this study is not a simple procedure, considering the number of stakeholders involved and the accompanying

different perceptions and expectation. An effective and fully functional agricultural research system is a necessity and it is up to producers, co-operatives, private sector companies, research institutes, government and anyone else who stakes a claim in the agricultural sectors of the country, to recognize and investigate problem areas and provide amicable solutions. This study has aimed to provide guidelines of where administrators can begin searching for the means to restructure the research system so as to make it better suited to the present global environment. Some recommendations can thus be made based on the findings of this investigation and their implications.

- Regarding structural interactions, stakeholders would do well to ensure that they promote effective cooperation and communication throughout the system to avoid contradicting notions with regard to the responsibility of planning and conducting research.
- Good planning and coordination of extension activities must be realized if researchers want to effectively distribute their technologies while creating awareness for the need to adopt new technologies amongst producers. In short, the researchers concerned must carry out extension effectively and often enough. The separation of research and extension duties holds too many dangers.
- Investigating the possibility of managed competition in an effort to promote higher quality research and increased productivity amongst government researchers, may prove successful.
- Competitive bidding opportunities to fund R&D amongst private sector organizations do exist (NRF, Innovation Fund, Thrips, EU funds etc.). Private sector organizations must be made aware of these in order to promote greater collaboration between them and the research institutes.
- The issue of varying expectations regarding the quality, financing and conducting of research must be addressed. Stakeholders must have a common understanding of what is to be expected from one another in order to further the gains for everyone. State researchers especially need to address the fact that there is so little expected from them in terms of quality of research and the ability to provide stakeholders

with the necessary technologies for increased competitiveness, as illustrated by the lack of faith demonstrated by producers and the private sector organizations investigated.

- Producers, and especially agribusiness, must not only become aware of the benefits of agricultural research but also be in a position where specific, worthwhile research opportunities can be identified. Research investment levels are too low, and by creating awareness for the need for agricultural research one is more likely to induce greater research spending. Research should become a priority and funds should be budgeted to ensure research departments do not suffer due to insufficient resources. Although many acknowledge the need for greater research, few are actually doing anything about it.
- Incentive for increased private sector research spending should be developed in order to maximize the contribution of this sector and encourage cooperation between public and private researchers. The responsibility of supplying new technologies cannot be left to public researchers alone. Incentives for greater research participation by producers and private sector organizations such as market factors, appropriability of research results and technological opportunities, which are all underlined by profitability, must be realized if the system as a whole is to become effective and efficient in terms of productivity.
- The whole research system must become more market-orientated and demand driven. Market-based research investments are inadequate, illustrated by the lack of innovations currently being implemented. Most developed countries have long since altered their research structures towards a market-orientated stance in line with global economic, political, social and technological changes where market forces dictate actions. The South African NARS must do the same if it is to enjoy the success experienced by those who have already accomplished this.
- It is crucial that strategic planning between co-operative members and co-operative management, to discuss the removal of discrepancies between the two parties with regard to the co-operation's R&D responsibilities, takes place.

Significant changes will have to take place in order to maximize the performance of the research systems of KwaZulu Natal and the Western Cape. Although the results of this study provide a starting point, it is merely an indication of the challenge that lies ahead and more detailed areas of study will still be required in order to fully understand exactly what institutional changes must take place. Some recommended areas of study for the near future are listed below.



How extension activities can be re-addressed in order to promote effective technology transfers, specifically what forms of extension to use.



Determining the reasons for the low agricultural research investment levels and what can be done to increase them, specifically the reasons for the lack of private sector investment in agricultural research and what can be done to develop incentives for increased participation.



How to develop an understanding amongst all stakeholders for a more market orientated approach towards agricultural research and agriculture in general.



How to encourage producers, agribusiness and researchers to adapt a new culture towards agricultural research based on high investment levels, flexible and integrated research systems, and greater private sector participation.

Appendix 1

Table 1: Producer satisfaction regarding the new technology creating abilities of their co-operatives, the private sector and the government within the sugar industry of KwaZulu Natal

Description		Rating ¹	Co-operatives			
			UCL ²	SOC ³	CFB ⁴	CTC ⁵
Producer satisfaction with new technology creating ability of co-operatives, government and private sector	Co-operative	1	0	0	0	0
		2	7	12	0	15
		3	4	36	22	15
		4	15	24	36	20
		5	75	38	42	50
	Government	1	82	47	100	91
		2	11	25	0	9
		3	7	22	0	0
		4	0	6	0	0
		5	0	0	0	0
	Private sector	1	0	0	0	0
		2	0	0	0	0
		3	0	3	4	0
		4	22	9	12	7
		5	78	88	84	93

¹A rating of 5 indicates a very satisfied producer, a rating of 1 means a very unsatisfied producer.

² Union Co-operative Limited

³ Stock Owners Co-operative

⁴ Co-operative Farmers' Butchery

⁵ Central Timber Co-operative

Table 2: Producer satisfaction regarding the new technology creating abilities of their co-operatives, the private sector and the government within the livestock industry of KwaZulu Natal

Description		Rating ¹	Co-operatives			
			UCL ³	SOC ⁴	CFB ⁵	CTC ^{2,6}
Producer satisfaction with new technology creating ability of co-operatives, government and private sector	Co-operative	1	11	0	31	-
		2	13	6	31	-
		3	30	34	39	-
		4	17	22	0	-
		5	30	38	0	-
	Government	1	52	44	61	63
		2	17	31	27	17
		3	28	9	12	17
		4	4	13	0	4
		5	0	3	0	0
	Private sector	1	4	0	4	2
		2	7	6	19	4
		3	28	25	27	37
		4	26	38	19	26
		5	35	31	31	30

¹A rating of 5 indicates a very satisfied producer, a rating of 1 means a very unsatisfied producer.

²The livestock industry is not significantly related to this particular co-operative

³ Union Co-operative Limited

⁴ Stock Owners Co-operative

⁵ Co-operative Farmers' Butchery

⁶ Central Timber Co-operative

Table 3: Producer satisfaction regarding the new technology creating abilities of their co-operatives, the private sector and the government within the timber industry of KwaZulu Natal

Description		Rating ¹	Co-operatives			
			UCL ³	SOC ^{2,4}	CFB ^{2,5}	CTC ⁶
Producer satisfaction with new technology creating ability of co-operatives, government and private sector	Co-operative	1	2	-	15	0
		2	9	-	20	4
		3	26	-	40	26
		4	33	-	15	3
		5	30	-	10	40
	Government	1	65	56	73	78
		2	24	34	17	20
		3	11	9	0	2
		4	0	0	0	0
		5	0	0	0	0
	Private sector	1	7	0	0	0
		2	0	3	4	4
		3	33	22	16	17
		4	22	38	23	41
		5	37	38	57	39

¹A rating of 5 indicates a very satisfied producer, a rating of 1 means a very unsatisfied producer.

²The timber industry is not significantly related to this particular co-operative

³Union Co-operative Limited

⁴Stock Owners Co-operative

⁵Co-operative Farmers' Butchery

⁶Central Timber Co-operative

Table 4: Producer satisfaction regarding the new technology creating abilities of their co-operatives, the private sector and the government within the grain industry of the Western Cape

Description		Rating ¹	Co-operatives			
			BNK ²	SSK ³	CRK ⁴	WPK ⁵
Producer satisfaction with new technology creating ability of co-operatives, government and private sector	Co-operative	1	20	11	9	5
		2	48	20	41	34
		3	24	31	19	29
		4	8	29	19	32
		5	0	9	13	0
	Government	1	56	54	22	74
		2	20	26	38	26
		3	24	14	28	0
		4	0	6	13	0
		5	0	0	0	0
	Private sector	1	8	11	0	5
		2	16	9	22	3
		3	28	11	22	29
		4	36	63	41	39
		5	12	6	16	24

¹A rating of 5 indicates a very satisfied producer, a rating of 1 means a very unsatisfied producer.

²Bredasdorp-Napiers Koöperasie

³Sentraal-Suid Koöperasie

⁴Caledon-Riversdal Koöperasie

⁵Westelike Provinsie Koöperasie. WPK has changed to a company but is included for simplicity

Table 5: Producer satisfaction regarding the new technology creating abilities of their co-operatives, the private sector and the government within the livestock industry of the Western Cape

Description		Rating ¹	Co-operatives			
			BNK ²	SSK ³	CRK ⁴	WPK ⁵
Producer satisfaction with new technology creating ability of co-operatives, government and private sector	Co-operative	1	16	32	21	12
		2	32	36	27	28
		3	36	12	33	32
		4	12	12	18	19
		5	4	8	0	8
	Government	1	60	71	62	61
		2	20	17	30	13
		3	16	3	8	18
		4	4	9	0	8
		5	0	0	0	0
	Private sector	1	4	29	0	0
		2	8	9	4	16
		3	40	26	68	27
		4	32	49	18	47
		5	16	6	10	11

¹A rating of 5 indicates a very satisfied producer, a rating of 1 means a very unsatisfied producer.

²Bredasdorp-Napiers Koöperasie

³Sentraal-Suid Koöperasie

⁴Caledon-Riversdal Koöperasie

⁵Westelike Provinsie Koöperasie. WPK has changed to a company but is included for simplicity

Table 6: Producer satisfaction regarding the new technology creating abilities of their co-operatives, the private sector and the government within the grape industry of the Western Cape

Description		Rating ¹	Co-operatives			
			BNK ^{2,6}	SSK ^{3,6}	CRK ^{4,6}	WPK ⁵
Producer satisfaction with new technology creating ability of co-operatives, government and private sector	Co-operative	1	-	-	-	3
		2	-	-	-	5
		3	-	-	-	29
		4	-	-	-	34
		5	-	-	-	29
	Government	1	-	-	-	64
		2	-	-	-	27
		3	-	-	-	5
		4	-	-	-	3
		5	-	-	-	0
	Private sector	1	-	-	-	5
		2	-	-	-	9
		3	-	-	-	24
		4	-	-	-	29
		5	-	-	-	32

¹A rating of 5 indicates a very satisfied producer, a rating of 1 means a very unsatisfied producer..

²Bredasdorp-Napiers Koöperasie

³Sentraal-Suid Koöperasie

⁴Caledon-Riversdal Koöperasie

⁵Westelike Provinsie Koöperasie. WPK has changed to a company but is included for simplicity

⁶The grape industry is unrelated to both the producers and the co-operatives concerned

References

- Alston, J.M., Pardey, P.G. & Roseboom, J. 1998. Financing agricultural research: International investment patterns and policy perspectives. *World Development*. 26 (6): 1057-1070.
- Alston, J.M., Pardey, P.G. & Smith, V.H. 1998. Financing agricultural R&D in rich countries: What's happening and why. *The Australian Journal of Agricultural and Resource Economics*. 42(1): 51-82.
- Alston, J.M., Pardey, P.G. & Smith, V.H. 1997. *Paying for agricultural productivity*. IFPRI. Washington, D.C.
- Anderson, J.E. 1997. The Uruguay Round and welfare in some distorted agricultural economies. Working Paper 5923. Cambridge: National Bureau of Economic Research.
- Anderson, J.R. 1997. Policy and management work within international agricultural research. *Australian Journal of Agricultural and Resource Economics*. 41 (4): 521-539.
- Anderson, J.R. & Hardaker, J.B. 1992. Efficacy and efficiency in agricultural research: A systems view. *Agricultural Systems*. 40: 105-123.
- Arnon, S. 1968. *Organization and administration of agricultural research*. Library of Congress. Yarmouth, England. Galliard Ltd..
- Baharsjah, S. 1992. The role of research facing the global agricultural challenge: The view from a national agricultural research system. Paper read at the policy dialogue entitled "Challenges and opportunities for the NARS in the year 2000". The Hague, Netherlands, International Service for National Agricultural Research.
- Baldwin, J.R. 1995. The development of sustainable farming systems on the semi-arid plains of New South Wales. Farm management unit report. University of Reading. 386-397

- Bonte-Friedheim, C.H. 1991. The benefits of agricultural research in European community and developing countries. Wise, T.E. 1991. Agricultural and Food Research: Who benefits? CAS Paper 23. Centre for Agricultural Strategy, Reading.
- Charlton, T. 1999. Chairman – Union Co-operative Limited, KwaZulu Natal. Interview conducted in April.
- Chause, J.P. 1995. The challenges facing agriculture in Southern Africa. Proceedings of the roundtable on research policy and financing in an era of adjustment. Proceedings of a roundtable held in the Republic of South Africa. Netherlands: International Service for National Agricultural Research.
- Dinar, A. 1996. Extension commercialisation. How much to change for extension services. *American Journal of Agricultural Economics*. 78 (1): 1-12
- Donovan, P. A. 1995. The management, funding and organizational structure of agricultural R&D in Zimbabwe, Malawi and South Africa: Part I – management and funding. *Agricultural Systems*. 47: 259-271.
- Echeveria, R.G. 1988. Public and private sector investments in agricultural research: The case of maize. A thesis submitted to the faculty of the Graduate School of the University of Minnesota. Minnesota, U.S.A.
- Echeveria, R.G. 1990. Impact of research and seed trade on maize production. *Agricultural Research Policy: International Quantitative Perspectives*, edited by Pardey, P.G., Roseboom, J and Anderson, J.R. Cambridge University Press.
- Eicher, C.K. 1990. Building African scientific capacity for agricultural development. *Agricultural Economics*. 4(2): 117-143.
- Elbasha, E.H. 1997. The calculation of research benefits with linear and non-linear specifications of demand and supply: Comment. *American Journal of Agricultural Economics*. 79 (Nov): 1363-1367.
- Elliot, H. 1995. The financial dilemma for African agricultural research systems: New evidence and policy challenges. Proceedings of the roundtable on research policy and financing in an era of adjustment. Proceedings of a roundtable held in the Republic of South Africa. Netherlands: International Service for National Agricultural Research.

- Evenson, E.E. & Evenson, R.E. 1981. Private sector in agricultural research. paper read at seminar entitled "Technological Progress in Latin American Agriculture", San Jose, Costa Rica.
- Fahey, L. & Randall, R.M. 1994. *The Portable MBA in Strategy*. Canada, John Wiley & Sons Inc.
- Falconi, C.A., and Elliot, H. 1994. Public and private R&D in Latin America and the Caribbean. International Conference of Agricultural Economists. Harare, Zimbabwe.
- Feynes, T. I. 1996. Conference review: The role of information in South African agriculture : Needs, Sources and Technology. *Agrekon*. 35 (3): 155-156.
- Fuglie, K., Ballenger, N., Day, K., Klotz, C., Ollinger, M., Reilly, J., Vasavada, U. & Yee, J. 1996. Agricultural research and development: Public and private investments under alternative markets and institutions. Natural resources and environment division, economic research service, U.S. Department of Agriculture. *Agricultural Economics* Report No. 735.
- Groenewald, J.A. 1996. Transformation: The challenge to commercial agriculture. *Agrekon*. 35(4): 180-186.
- Hough, J. 1996. Viewpoint: The development of a strategic management model for South African agricultural co-operatives. *Agrekon*. 35(1): 54-63.
- Huffman, W.E. & Just, R.E. 1994. Funding, structure and management of public agricultural research in the United States. *American Agricultural Economics Association*. 76: 744-759.
- International Service for National Agricultural Research. 1990. Newsletter. Netherlands, International Service for National Agricultural Research. 12: 1-9.
- International Service for National Agricultural Research. 1992. Summary of agricultural research policy: International quantitative perspectives. Netherlands, International Service for National Agricultural Research.

- International Service for National Agricultural Research. 1995. Proceedings of the roundtable on research policy and financing in an era of adjustment. Proceedings of a roundtable held in the Republic of South Africa. Netherlands: International Service for National Agricultural Research.
- Jansen, K. 1998. Political ecology, mountains, agriculture and knowledge in Honduras. Thesis paper. Thela Publishers. Netherlands.
- Khatri, Y., Schimmelpfennig, D., Thirtle, C. and van Zyl, J. 1996. Refining returns to research and development in South African commercial agriculture. *Agrekon*. 35(4): 283-290.
- Khatri, Y., Thirtle, C. & van Zyl, J. 1996. Public research and development as a source of productivity change in South African agriculture. *South African Journal of Science*. 92: 143-150.
- Knudsen, O. and Nash, J. 1990. Redefining the role of government in agriculture for the 90's. World Bank Discussion Papers 105, The World Bank, Washington, D.C.
- Kotler, P. 1997. *Marketing management: Analysis, planning, implementation, and control*. Ninth Edition. New Jersey, U.S.A. Prentice Hall International Inc.
- Masters, A.M., Bedinger, T. & Oehmke, J. 1998. The impact of agricultural research in Africa: aggregate and case study evidence. *Agricultural Economics*. 19: 81-86.
- McCarthy, E.J. & Perreault, W.D. 1993. *Basic marketing*. Eleventh Edition. U.S.A.: Richard D. Irwin Inc.
- Moro, A. 1993. A survey on R&D and technological innovation: Firms' behaviour, regulation and pollution control. Department of Economics, University of Philadelphia.
- Mullen, J.D., & Cox, T.L. 1995. The returns from research in Australian broadacre agriculture. *Australian Journal of Agricultural Economics*. 39 (2): 105-128.
- Nieuwoudt. 1984. Plant sizes and location in the South African sugar industry. *Agrekon*. 22 (1): 26-31.

- Nilsson, J. 1993. Competition and collaboration in farm co-operatives. *Institutionen For Ekonomi*. 57: 187-200.
- Pardey, P.G. and Alston, J.M. 1996. Making science pay: The economics of agricultural R&D policy. American Enterprise Institute Press. Washington, D.C.
- Pardey, P.G., Roseboom, J. & Beintema, N.M. 1997. Investments in African agriculture. *World Development*. 25 (3): 409-423.
- Pray, C.E. & Echeverria, R.G. 1991. Private sector agricultural research in less-developed countries. Pardey, P.G., Roseboom, J. & Anderson J.R. *Agricultural Research Policy: International Quantitative Perspectives*. England: Cambridge University Press.
- Roseboom, J., Pardey, P.G., von Bach, H.S., van Zyl, J. 1995. Statistical brief on the national agricultural research system of South Africa. Netherlands, International Service for National Agricultural Research.
- Roseboom, J. 1998. Mapping technological innovation in the agricultural production column. Presentation to the INIAs/BID/ISNAR project. Netherlands, International Service for National Agricultural Research.
- Rukuni, M. 1996. A training manual on R&D evaluation and impact assessment of investments in agricultural and natural resources research. Department of Agricultural Economics. University of Zimbabwe. Zimbabwe.
- Ruttan, V. 1989. Towards a global agricultural research system. Changing dynamics of global agriculture. Edited by Javier, E.Q. & Renborg, V. Netherlands, International Service for National Agricultural Research.
- South African Sugar Association. 1998. Annual Report. Durban, South African Sugar Association.
- South African Agricultural Union. 1998. Proposal for structural adjustments to the South African agricultural research system. Pretoria, South African Agricultural Union.

- Schimmelpfennig, D. and Thirtle, C. 1994. Cointegration, and causality: exploring the relationship between agricultural R&D and productivity. *Journal of Agricultural Economics*. 45 (2): 220-231.
- Schuh, G.E. 1986. *Revitalizing Land Grant Universities: Choices*. Second quarter: 6-10
- Shepherd, D. 1996. Economics, sustainable development and the greening of agricultural policy in the European Union. *Zemledska Ekonomika*. 42 (12): 983-987.
- Swart, P.J.A. 1997. South African agricultural in the world economy. Conference issue papers read at the 34th annual conference of the agricultural economics association of South Africa. *Agrekon*. 35 (4): 200-203.
- Tabor, S.R. 1995. Structural adjustment and agricultural research. Proceedings of the Roundtable on research policy and financing in an era of adjustment. Proceedings of a roundtable held in the Republic of South Africa. Netherlands: International Service for National Agricultural Research.
- Tabor, S.R., Janssen, W. & Bruneau, H. 1998. *Financing agricultural research: A sourcebook*. Netherlands, International Service for National Agricultural Research.
- Thirtle, C. 1992. Total factor productivity in UK. Agriculture, 1967-1990. *Journal of Agricultural Economics*. 43 (3): 381-400.
- Tollini, H. 1995. The economic contribution of agricultural research. Proceedings of the roundtable on research policy and financing in an era of adjustment. Proceedings of a roundtable held in the Republic of South Africa. Netherlands: International Service for National Agricultural Research
- Townsend, J., van Zyl, J. and Thirtle, C. 1997. Assessing the benefits of research expenditures on maize production in South Africa. *Agrekon*. 36 (4): 585-595.
- Umali, D.L. 1992. Public and private sector roles in agricultural research: Theory and experience. World Bank Discussion Papers, No. 176. Washington D.C., U.S.A. World Bank.

- van der Merwe, A. & Otto, R. 1997. International marketing developments and the effect on South African agriculture. *Agrekon*. 36(4): 434-452.
- van Niekerk, J. 1996. Agricultural education and training in South Africa with specific reference to the colleges of agriculture. Working paper – land and agriculture policy centre. Johannesburg, South Africa. No. 22: 111
- van Zyl, J., Townsend, R.F. & Vink, N. 1997. Economic effects of market and trade liberalisation on agriculture in the Western Cape province of South Africa. *Agrekon*. 36(4): 461-472.
- Vorwerk, E. 1999. Manager - Co-operative Farmers' Butchery, KwaZulu Natal. Interview conducted in April.
- Webster F. E. 1999. Is your company really market driven?. *Global Business*. June: 10-11.
- World Bank. 1994. South African agriculture: structure, performance, and options for the future. Discussion paper on aspects of the economy of South Africa. No. 6. World Bank Washington, D.C.