FACTORS INFLUENCING THE SUCCESS OF SMALL-SCALE IRRIGATION FARMERS IN NKOMAZI

(MPUMALANGA)

By

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Submitted in partial fulfillment of the requirement of the degree of

MSc Agric (Agricultural Extension)

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PRETORIA

September 2003

ACKNOWLEDGEMENTS

At this special moment, I would like to thank all the people who assisted me throughout the research as well as the writing of the thesis.

First of all I glorify the most high and merciful God and My Lord Jesus Christ, for making this moment happening.

A very special thanks to Professor Güstav H. Duvel who promoted the study. His inspiration, able leadership and guidance, encouragement and friendship are here greatly appreciated.

A very sincere appreciation to the Ford foundation for your contribution in the completion of this study, this study would not have been possible without your assistance.

To my parents Patrice Muleba and Marie Therese Mujinga, all your efforts, prayers and wishes are here greatly acknowledged.

To my wife Tyty, children Terry, Lynn and Irvine Patrice for their patience in privation as well as perseverance in allowing me doing it my way

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ABSTRACT

The purpose of the study was to identify the main factors influencing the small-scale production of sugar cane in Nkomazi , Mpumalanga province.
The study assesses the influence of some selected personal and environmental, and intervening factors on the adoption of recommended agricultural practices and farming success or production efficiency of small-scale sugar cane growers.

A total of 139 farmers were randomly drawn from two distinct districts of Komatipoort and Malelane in Nkomazi, which represented a 10% stratified sample. In the analysis of data, correlation, chi-square analysis, as well as multiple regressions analysis were used in order to identify the most important determinants associated with behavioural change and to calculate their contribution to the variance of farming success.
The results indicate that, the intervening variables tended to have the highest prediction value. They were found to explain 87,13% of the variance of behaviour associated with the production efficiency, while the independent variables had R^2 of 0.50 thus contributing significantly less to the variance of farming success. Amongst the intervening variables, needs and knowledge were found to have the greatest effect on the farming success or dependent variables ($P<0,0001$). These findings imply that managerial skills or farming success of small-scale sugar cane farmers in Nkomazi is dependent on intervening variables. The intervening variables are the best prediction of decision making, practices adoption behaviour and farming success, so that they should be the focus of extension programs, and also the criteria for monitoring.

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CHAPTER 1
INTRODUCTION

1.1 Irrigation development in South Africa

In most of South Africa, conditions are dry and crops are subject to moisture deficits during part or all the growing season. Under such conditions, full or supplementary irrigation is an attractive technological approach to increase food and fibre production. At present, South Africa has an estimated 1,2 million ha of land under irrigation. On 33% of this total area, surface irrigation is practised. The rest is under overhead irrigation (55%) and micro-irrigation (12%). Full irrigation is practised on about ¾ of the total land area (78%) supplementary irrigation on 14% and opportunistic irrigation on 8% (Bruwer and Van Heerden, 1995).

Irrigation was introduced to South Africa soon after the arrival of European settlers. Several small-scale irrigation projects were developed during the period 1652 to 1912. These projects were often part of town developments, and canals enabled plot owners to irrigate their gardens (Bruwer and Van Heerden,1995).

From 1912 to the 1930s,development of irrigated land became more co-ordinated, and several large-scale irrigation projects were established, involving the erection of fairly large-scale dams (e.g. Great Fish scheme under the Lake Arthur and Grassridge dams). In many of these early schemes, water allocations were inadequate to practise full irrigation, and irrigators often failed to meet repayments of the infrastructure resulting in debts being written off by the state (Bruwer and Van Heerden, 1995).

The great depression of the 1930s caused by drought and a worldwide decline in the economy, gave rise to the "poor white "problem in South Africa. The 'poor white' grouping consisted mainly of unskilled people who had very little opportunity to find employment. The development of large-scale irrigation schemes was one of the ways in which the South Africa Government tried to address the ''poor white" problem. Example of schemes developed during that period are Viooldrift, Boegoeberg, Ret river, Pongola Boskop and Vaalharts, (Bruwer and Van Heedern, 1995).

1.2 Relative Importance of Irrigation

Agricultural output in South Africa is greatly influenced by the inconsistencies in rainfall. Irrigation plays a vital role in stabilising production and facilitating the production of high-value crops. Although over 1% of the agricultural land is irrigated, the contribution to the gross domestic product is about 4.5%, of which an estimated 25% and 30% of gross agricultural production (Backeberg and Klopper,1991). The same finding was supported by a study of the Department of Water Affairs and Forestry (1986).

Water is an essential factor in crop production. In areas where natural rainfall is not plentiful, irrigation water is often the base of production. As a matter of fact, irrigated agriculture is considered to be the best way to alleviate food shortages in Africa in general and in Sub-Saharan Africa in particular. Thus, the availability and cost of obtaining water for irrigation is of major economic concern.

Agricultural irrigation in South Africa represents close to 60% of the total water requirements resources (Backeberg and Oosthuizen, 1995). In South Africa, irrigation water is scarce and hence its efficient and optimal application is of paramount importance.

1.3 Small-scale farmer irrigation in South Africa

Small-scale farmer irrigation schemes in South Africa comprise approximately 46,000 ha or 4% of the total area irrigated. However, from a rural development and socio-economic point of view, such schemes are of cardinal importance, since more than 223,000 people are dependent, at least partially for a livelihood on small-scale farmer schemes. Despites huge investments the performance of most small-scale farmer irrigation schemes are beset by varying combinations of economic, institutional and social problems (Bembridge, 1986a).

A review of the limited literature available shows that with a few exceptions, the economic success of small-scale farmer irrigation schemes in South Africa falls far short of the exceptions of planners, politicians, development agencies and the participants themselves (Bembridge, 1986 a). And the existing small-scale farmer irrigation in South Africa conform to one of five types:

- **"Top down" bureaucratically managed smallholder schemes:** These are fully administrated by government. Practically all farming operations are carried out by the management on behalf of farmers. Usually, there is no selection of participation on the basis of farming ability. The majority of schemes in South Africa conform in varying degree to this category. Such projects have high recurrent costs and returns to farmers are only a fraction of recurrent costs.

- **There are a number of jointly managed schemes in which some functions are** performed by the irrigation development agency, while others are the function of project participants. Such schemes are usually aimed at eventually developing farmers to produce their own food and a surplus for sale. There is

also little selection of farmers on farming ability . This type of scheme is usually a large financial burden to the state.

- **Community schemes** are usually small in size, operated and maintained by the water users themselves and/or their representatives. There are relatively few such schemes.

- **State or corporation financed schemes**, such as sugar cane where farmer participants are selected on entrepreneurial and farming ability, as well as on their financial and other resources. Government provides infrastructure . Farmers pay a subsidised water charge and farmers are left to their own decision-making and management. Such schemes are rare in South Africa.

- There are a number of **large estate schemes**, which are state or private sector financed, often managed by agents aimed at maximum use of resources through production of high return cash crops such as tea, coffee and various fruit and vegetable crops. Although some schemes have a number of out growers on a pilot scheme basis, there is generally little farmer participation, except in the form of supervised labour.

1.4 Background to the Current study

An important component of the South African agricultural policy is to increase income of the poorest groups in society through opportunities for small-scale farmers. The national agricultural policy (Ministry of agriculture & Land Affairs,1998) gives particular attention to small-scale agriculture with three strategic aims:

- making the sector more efficient and internationally competitive.
- supporting production and stimulating an increase in the number of new small-scale farmers and
- conserving agricultural natural resources.

Land reform involving the provision of access to a large number of landless South African households is a policy actively pursued by the present government. Providing rural households with access to agricultural land is
one of the land reform strategies, which also lead to the alleviation of rural poverty. According to Lipton (1996), small-scale farming may be one of the only options available to South Africa to absorb the expected increase in the number of the local work seekers, whereby small-scale irrigation systems are considered best suited to the dry conditions prevailing in most of the country.

South Africa as stated above, is a land with a history of water shortage, which is one of the major problems facing South Africa particularly in view of the increasing population and expansion of industry. In the field of agriculture, this increases the need for a rational water utilisation and an efficient agricultural production. However, the settlement of small-scale farmers is a priority of the country therefore for

sustainability, success in terms of sound management and production efficiency is of major importance. This applies particularly to the irrigation schemes with particularly scarce and valuable resources.

Irrigation settlements in Nkomazi area of Mpumalanga are characterised by sugar cane yields that vary tremendously between the small producers. Some farmers are successful while others fail dismally. Identifying successful farmers and selecting the factors that have the potential of efficient production is likely to have a socio-economic benefit in the less developed areas and for future farmer settlement schemes.

CHAPTER 2
TOWARDS PROBLEM CONCEPTUALISATION: LITTERATURE REVIEW

2.1 Introduction

Agricultural development is a process involving a shift from old methods of production to new, science-based methods of production that include new technological components (Swamson, 1984). Development is a widely participatory process of social change in society intended to bring about social and material advancement, including greater equality, freedom, and other valued qualities for the majority of the people through their gaining greater control over the environment (Rogers, 1976, p133).

The key to economic growth and poverty reduction has to be rural transformation since the bulk of the region's population lives there. Local land and resource control has to be the key material basis for any rural enterprise approach backed by appropriate institutional arrangements such as decentralisation, governance, power sharing, access to markets, access to land, skills development, technology transfer and infrastructure development
(Roth, 1990). Rural people require assurance over present and future cost-benefit streams from the land as well as the right to change from a supply to a demand driven rural economic development agenda.

2.2 Land Reform Policy

The government has embarked on a land reform programme. The objective of this policy is to reduce the imbalances of the past and to do justice to those who were directly deprived of their land. The national policy has different components. There is a land redistribution programme, a land restitution programme, a programme to secure tenure rights in tribal land and a law to secure rights of farm labourers.
As far as the restitution program was concerned, every disadvantaged person could submit a claim. The regional offices of the Land Reform Office are processing righteous claims. If the farmer is willing to sell his farm he will be compensated for his land. Although many farms have been in possession for more than 20-50 years, many of present owners are not the original owners. If he does not want to sell, either land or monetary compensation can be offered to the claimant.
Both groups must come to terms to resolve the claim. Since many of the black communities were evicted from the farms across the river, there are claims on many farms spread through the entire Nkomazi / Onderberg area.

Redistribution is another pillar of the policy. Without direct deprivation, it still holds that through racist legislature, access to land has been restricted to the majority of the population. Redistribution is based on a willing seller- buyer principle. A group of willing buyers can apply for a grant from the government and get loans from land bank. In the whole country many claims have been settled already. As for the study area of Nkomazi, the results are meagre; there have been two or three land

redistribution agreements. The reason is that the farms are extremely capital-intensive and very expensive to be bought by the government.
Improved access to land was confirmed to be one of the most important elements of successful agricultural restructuring in South Africa and the rebuilding of a strong rural class, consequently land redistribution is inevitable and necessary for a stable rural environment, which brings the settlement of the small-scale farmers, to address and restore the rights lost during the apartheid era.
To achieve food security and poverty relief and to increase income and employment in the economy, the agricultural sector must perform efficiently.
Any land reform programme should clearly take the above in to consideration
High potential areas are observed to be under utilised and thus provide space for more intensive small-scale farming.

2.3 Selection of small-scale farmers

Farmer selection processes are an important feature of farmer settlement schemes. It is however virtually impossible to select successful farmers from the outset with a high degree of accuracy.
In practice, one of the major problems with selection / screening processes is that of bias and interference whereby certain individuals are favoured above others. In some cases blatant political interference and nepotism are apparent. (Ngoni M, 1991)
In other cases, more fundamental issues such as historical land rights came in to play, while gender sensitivity and balance are seldom adhered to. The transparent, impartial and objective application of selection criteria must be viewed as an essential part of a successful settlement project. (Kinsey and Binswanger, 1993)

In any case, the land is limited and, they cannot afford to under use this valuable natural resource with impunity (Ngoni M, 1991).

2.4 Present criteria

The criteria that are being used are very subjective and unreliable and are according to Kinsey & Binswanger (1993) based on personal rules and prejudice, rather than on scientific founded criteria.

Njobe (1993:2) talks about considerations that could be taken into account for participation in the Reconstruction Program in South Africa. Lombard (1992) indicated that the so called "settler selection rules" which are being used internationally is very subjective in nature, and the only objective criteria used are age, training and experience. All three are independent variables. Therefore, they don't necessarily have any direct influence on farming success.

A more acceptable approach is the "point scoring system" of the Malaysian Federal Land Development Authority. According to Bahrin (1988:82-128), this system is also subject to the prejudice of decision-makers. Bembridge (1985:20) also supports this concept and indicated that it is due to the lack of pro-active selection of farmers on the Qamata irrigation scheme in the Transkei that they have failed.

2.5 Change In Adoption Behaviour

Whether through the influence of formal or informal leadership or through extension, the object of agricultural development directly revolves around change in adoption behaviour. The adoption of practices or innovations is associated with more efficient agricultural production. This behaviour change needs to be understood in order to determine or trace its relative influence on agricultural development.
Rogers (1983,pp.251-252) summarizes research findings on variables related to innovativeness in a series of generalisations which imply amongst others that the earlier adopters have more years of education, higher social status and a greater degree of upward social mobility, larger-sized units, more commercial economic orientation, more favourable attitudes toward credit, more specialised operations, and are more literate.

The value of this present research is mostly focused on the necessity of understanding and predicting adoption behaviour, and environmental factors in sugar farming.
-Firstly, it has been established (Albrecht, 1965, Duvel, 1975) that the potential influence of these variables, that is, whether and to what extent they can become functional is situation-specific.
However, the number of variables that have already been found to be related to adoption behaviour is so extensive, that their identification in a given situation is totally impractical for extension.

Duvel (1991) proposed a solution based on the pre-supposition that the variables or determinants of behaviour have varying positions on the cause /effect or independent / dependent continuum, with the more independent variables having a casual effect on the dependent ones. The intervening or mediating variables he identified as being critical precursors to behaviour or decision-making and through which the influence of all independent variables become manifested are needs, perception and knowledge.

The more specific aspects of needs, perception and knowledge are further specified by Duvel (1991) in a model (Fig.2.1), which serves as a guide to the systematic analysis of what he believes to be direct precursors of behaviours.

These factors are associated with or seen to represent the psychological field forces which according to Lewin's (1951) field theory are instrumental in bringing about change and Duvel (1991) makes a clear distinction between the mediating variables, and the more indirect and independents variables.

2.6 Objectives and Hypotheses

The present study aimed at a better understanding of the factors contributing towards the success of sugar cane farmers in Nkomazi area of Mpumalanga. The study was guided by following objectives:

1 To develop measures of farming success and characterise respondents accordingly.

2 To identify and measure various personal and environmental factors and establish their relationship with farming success under irrigation.
3 To develop a scale for the selection of potentially successful small –scale irrigation farmers.

The hypotheses upon which the research design were based on:

- 1.1. Managerial and farming success is dependent on, or function of certain personal and environmental factors.
- 1.2. Behaviour determinants vary in terms of their contribution to the variance of farming success

While the findings of this study will serve to some extent as useful insight, it is however, acknowledged that much can still be done to render them trustworthier. It is with the objective of encouraging further research endeavour in this direction that these findings are presented.

CHAPTER 3
THE ENVIRONMENTAL SITUATION OF SMALL- SCALE IRRIGATION IN

3.1 Introduction

This chapter to describes some of selected issues all the Nkomazi's environmental issues and this refers to the physical factors such as topography, climate, soils as well as the water related issues.

3.2 Physical Factors

3.2.1 Locality

The survey area is called Nkomazi situated in the Southern lowveld of Mpumalanga province. This low-lying piece of land is confined to the eastern border of the province and comprises of land west of the Lebombo Mountains and east of the Drakensberg foothill, extending from the Kingdom of Swaziland in the south to the Crocodile River in north and it consists of an area of 3500 km^2 (Dany, 1998).
The Komati River is one of the rivers in the Inkomati Water Management Area and is sub-catchments of the Inkomati River Catchment. This water management area falls almost entirely within the province of Mpumalanga. The catchment extends from the origin in the Transvaal Plateau west of Carolina to the Lebombo Mountain Range at Komatipoort in the east. The total catchment area of the Komati River and its tributaries (under which the Lomati with 1,493km^2) is approximately 11,210 km^2 (MBB, 2000).

3.2.2 Climate

The topography of this area results in a myriad of micro-climatic regions and therefore it is needed to give as much data as possible of the production factors that are involved in agricultural production. Except for the northern boundary the lowveld is shut in by mountain chains, which play an important role in the prevailing climatic conditions, namely rainfall and temperature. The climate of the lowveld is sub-tropical.

The long-term meteorological data used in this study is obtained from the stations listed in Table: 3.1.

Table 3.1 Location of meteorological stations in this survey area

STATIONS	LATITUDE *(degr.min.)*	LONGITUDE *(degr.min.)*	ALTITUDE *(Metres)*
Vergelgen *(Malelane)*	25°30'	31° 30'	369
Kaalrug (Malelane)	25°37'	31° 37'	390
Hoechst (Malelane)	25°38'	31° 38'	272
Tenbosch (Komatipoort)	25°24'	31° 58'	189
Coopersdal (Komatipoort)	25°38'	31° 57'	200

The variation in data is a reflection of the variation in topography and particularly in the altitude.

The precipitation of the lowveld area varies from as high as 855 mm at Kaalrug to as low as 581mm at Vergelegen. Normally, the rainfall season falls between October and May, peaking in January, February. During this period, namely October to May, almost 90% of the annual precipitation is received (Fig.3.1).

3.2.2.1 Rainfall

The rainy season coincides with the summer months – September to April. The winters are generally dry, but fairly severe droughts are experienced during the summer months. (90% of the rainfall fall during October and May, these variation in rainfall figures are reflected in Table 3.2) .The rainfall, which is rather erratic, generally occurs in thunderstorms and heavy down pours, causing high run-off, notwithstanding the fact that the soils are light textured and generally well covered with grass-and bush-vegetation.

Table 3.2 Average long-term rainfalls during October-May (90% of the total rainfall)

	Vergelgen	Kaalrug	Hoechst	Tenbosh	Coopersdal
Average rainfall (OCT-MAY)	539.2	781.2	729.2	537.5	589.2

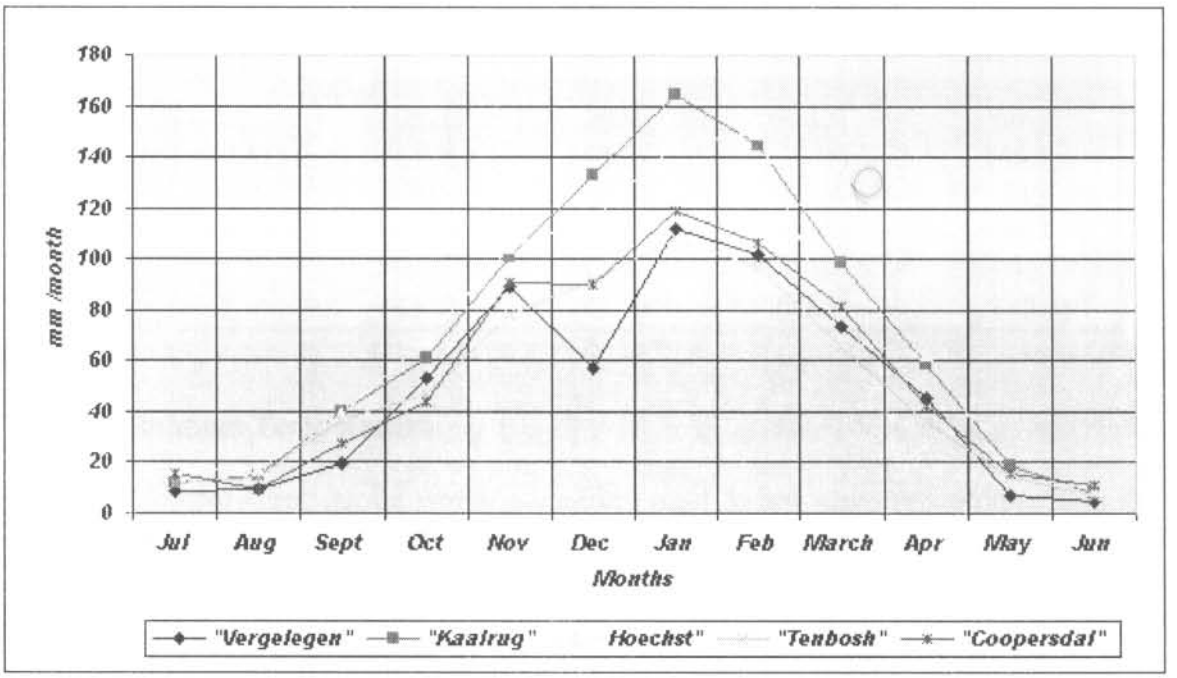

Figure 3.1 Monthly Rainfall Distribution in Nkomazi (2000)

Hailstorms are of rare occurrence, but can result in severe crop damage.

3.2.2.2 Temperature

The average daily temperatures of the lowveld throughout the year are of the highest in the Republic of South Africa.The summers are extremely hot with mild to hot winters.

(a) Maximum Temperature

The maximum temperature in the Lowveld varies from hot, in the East, to very hot in the summer time, and mild to hot during winter. During November, December and January the highest temperatures sometimes above 40°C are recorded with an average maximum temperature above 30°C during the same period. (Table 3.3)

Table 3.3. Average daily and maximum temperature during November-January. (°C)

Month	*Vergelgen*	Kaalrug	Hoechst	Tenbosh	Coopersdal
NOV	29	28.3	29.4	30	30.1
(High)	(40.4)	(43.4)	(40.7)	(41)	(40.5)
DEC	30.5	30	30.9	31.6	.31.6
(High)	(41.7)	(45.5)	(41.6)	(41)	(40.7)
JAN	30.7	30.2	31.6	32	32
(High)	(41.6)	(43.4)	(42.9)	(42.5)	(42.5)

(b) Minimum Temperature

Minimum temperatures during winter vary from mild to hot when proceeding from West to East. The coldest months in the Lowveld are June, July and August, with the rare occurrence of frost during about 3 to 5 nights during the winter season (Table 3.4.). Because of these mild winters it is possible to cultivate most of the tropical and sub-tropical crops and this fact gives the area a high agricultural potential (NOWAC, 1997).

Table 3.4 Average minimum daily temperatures during June-August

Month	Vergelgen	Kaalrug	Hoechst	Tenbosh	Coopersdal
June	9.8	11.6	7	8.8	8.4
July	9.8	11	7.4	9.1	8.9
August	11.9	13.3	10.4	11.2	11.5

(c) Frost

Frost is generally absent except near perennial streams where it occurs in a very mild form during June and July causing a certain amount of damage to tropical crops.

3.2.2.3 Humidity

Humidity is one of the important factors that must be considered when selecting a crop that is suitable for this region. Maximum humidity is recorded early in the morning (8h.00) the highest maximum humidity is recorded from November to May. A maximum of 90% and higher is recorded during this period. Minimum humidity is recorded at 14h.00 '. The lowest minimum humidity is recorded from May to September, when the humidity comes down to 40%.

3.2.2.4 Topography and physical system

Nkomazi region is situated on the high plateau grasslands of the middleveld, which roll eastwards for over hundred kilometres. In the northeast, it rises towards mountain peaks and then terminates in an immense and breathtaking escarpment. In other places, this escarpment plunges hundred of metres down to the low-lying area known as the lowveld. Looking down from the Drakensberg, the Lowveld appears to be monotonous level stretch of bush-covered country, but in reality it consists of gentle undulating ridges drained by well-defined watercourses. Rocky outcrops break the monotony of this section of gentle undulations; sometimes the outcrops consist of big solid granite boulders (South Africa local government Yearbook 2000)
The elevation above sea level rises from 189m along the Lebombo Mountains to 369m at the foothills of the Drakensberg at Malelane.

3.2.2.5 Geology

Practically, archaic granite and geneiss rock with prominent outcrops of granite blocks cover the entire stretch of country comprising the lowveld. Sandwiched between the archaic granite on the west and the rhyolites of the Lebombo Mountains, on the east are four narrow parallel strips of the Eca and the Beaufort series[1], the cave Sandstone and the Amygdaloildal Basalt (Klausner and Reid, 1979)

3.2.2.6 The soils

The soil types in the study area vary tremendously, from highly suitable for irrigation purposes to very unsuitable. The most important soil types are shown in Table 3.5, which also shows the geological origin and gives indication of their agricultural usefulness.

With the tremendous variation in soil types, it can be assumed that a significant degree of production variation in sugar cane between the different projects can be attributed to soil types.

The main limitations of the soil in Nkomazi, are the soil's depths as well as its texture. At some farms, the soil is not deeper than 20cm,and they are normally sandy to clay. Many soils have a high content of rocks, they have a high Mg and Ca^{+} content and a pH higher than 7 (SASA, 2000).
With careful management, it is possible however to get good returns of the soils. The limitations restrict choice alternative uses and sometimes the intensity of crop production. (MBB, 2000; BKS, 1997).

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1 Beaufort as (Bath, Valois and lancing soils with 35%-60% slopes), Eca as (Eliery, Chippewa and Aldens soils:0-8% slopes ¦ Source: Klausner and Reid ,1979¦

Table 3.5 The main soil types found on irrigation projects in Nkomazi and their parent material

Dominant Parent material	Soil Types	Remarks
♦ *BEAUFORT SERIES* [1] *Swaziland Basic Rock*	*RED SOILS*	
	1 Hutton	*Very good Irrigation soils*
	2 Shortlands	*Very good Irrigation Soils*
	BLACK BLOCKY STRUCTURED SOILS	
	1Arcadia	Marginal soils for irrigation
	2 Rensburg	Marginal soils for irrigation
	3 Milkwood	Marginal soils for irrigation
•ECA SERIES [1]	GREY COARSE&FINE SANDS	
Granite	1 Glenrosa	Marginal soils shallow in places
	2 Cartref	Marginal soils shallow in places
	3 Sterkspruit	Marginal –poor drainage
	4 Estcourt	Totally unsuited for irrigation
	5 Longlands	Marginal-poor drainage
	6 Kroonstad	Marginal poor drainage
	7Katspruit	Totally unsuited for irrigation
	8 Mayo	Marginal soils shallow in places
	9 Hutton	High Quality irrigation soils

Source: Stoch (1976)

3.2.2.7 Vegetation

The bush-clad expense is overgrown mainly by deciduous, interspersed by evergreen trees, Reeds and evergreen trees cover the banks of the rivers. On the western and central sections of the Lowveld west of the Lebombo Mountains and south of the Crocodile River is found a fairly dense growth of dry thorn forest consisting mainly of the Acacia species. The dominant veld type being Knob-thorn (*Acacia nigrescens*)

/Marula (*Sclerocarya birra*), veld, especially on the basalt and dolorite strips of Lebombo Mountains. The dominant grasses found here belong to the genera Themeda, Panicum, Urochloa, digitaria, Hypharenia and Cymbopogon.

The dominant veld type on the Granite section is known as Silver Terminalia (*Terminalia seracea*) / Sickle Bush (*Dichrostachus cinera*). The dominant grasses found here belong to the following genera viz. Hypherthelia (*Thatching grass*), This veld type is normally associated with a sandy. (South African local government Yearbook, 2000)

3.2.2.8 Water

The supply of water for irrigation is a function of accessible water sources, the quantity of water that is available from these sources and the quality of that water (Thompson, Spiess and Krider, 1980).

The quantity and timing of potential water deliveries affect planning and selection of farm irrigation systems and cropping systems, because the available flow from the source may be inadequate to enable full irrigation of all crops throughout the year. When the quantity of water is limited, appropriate cropping cycles may be needed in order to optimise economic returns.

The availability of a reliable source of water is a pre-requisite for the successful production of all major crops in the project area. Several streams and rivers of which the Lomati and Komati rivers are the most prominent traverse the Nkomazi region. A development plan for water resources was formulated during the 1980's by South Africa and Swaziland to make provision for increasing demands.

Two treaties were concluded in 1992 to establish the Joint Water Commission (JWC) and to proceed with the implementation of Phase 1 of the development plan. Lake Matsamo (Driekoppies) with a capacity of 251 million cubic meters was completed during 1997. Lake Matsamo stabilised the supply of irrigation water to projects from the Lomati River.

Other projects are depending on water from the Mbambiso dam (10 million cubic meters) as well as four weirs and off-channel storage (13,3 million cubic meters) that were constructed in the Komati as an integrated part of the NIEP*. With the completion of the Maguga dam with a storage capacity of 332 million cubic meters during 2001, the water supply of existing and planned irrigation projects in the Nkomazi will be stabilised.
The agreement between the Governments of South Africa and the former KaNngwane made provision for an allocation of sufficient water to develop 7500 hectares of irrigation water. (NOWAC, 1997)

3.3 Social structure in Nkomazi

3.2.1 General history

The only inhabitants known of 2000 years ago were a Karanga group from Zimbabwe that mined ochre in the area. In the middle of the 18th century, the Swazi people occupied present Swaziland (KaNgwane)[2]. At the time, Sotho speaking tribes living in the area occupied by the Ngwane moved to the north of Swaziland.
During the beginning of the 19th century, more people of different groups entered the area. Europeans avoided the Lowveld. Apart from a few expeditions, the Europeans settlers arrived in the second half of the 19th century, looking for gold. In 1894 a railway line was built between Pretoria and Lourenco Marques (now Maputo). Virtually, all the commercial farms in the area are less than 100 years old and most of them much younger.
After World War II, veterans were allocated farms in the region. During the 1950's, there were only few farms. The major increase came after1965 when Transvaal Sugar Limited, or Transvaal Suiker Beperk (TSB) was founded and electricity was brought to the area .In the 1980's there were still vast stretches of bushveld. Along the rivers there was some development. Tarred roads are very new. With the expansion of the commercial agriculture, came the expulsion of the north. Initially, farms were allocated for commercial farmers in the southern areas, but since it was far from the markets and the railroad, they moved to the northern part near Komatipoort and Malelane and more people were evicted. In 1977, the KaNgwane homeland was set-aside for the Swazi people of South Africa. In 1984, it got self-governing status by promulgation of the KaNgwane legislative Assembly (MBB, 1994). The KaNgwane territory consisted of four regions; Nsikazi, Mweti, Mlondozi and Nkomazi. The Nkomazi region falls totally within the lower Komati catchment. This area was highly populated, poor and remained underdeveloped as compared to the 'white' South Africa.About 95% of the total population of the lower Komati lives in the homeland

3.2.1 Nkomazi region

The homeland history has caused the present high population density, living in semi-rural areas in large townships. There are no 'real" cities in the area. Unemployment is very high in the Nkomazi region. Over 33% are unemployed, some 20% are active in the informal sector and 47% is formally employed. (1995 data of statistical macro-economic review of DBSA in NOWAC, 1997).
In the Nkomazi region 48% of the households have no fixed annual income and 80,1% of the households have a fixed income of less than R 5,000 (idem, 1997). This however gives a distorted image. The informal sector including day labour is not included in the survey. Since 1995, NIEP has created jobs in the area. It is still true, however that many people are unemployed and the situation might have worsen in other sectors than agriculture. There is a large percentage of male absenteeism due to migration labour, which is to many households a very important source of income.

2The original name of Swaziland was KaNgwane: " land of the Ngwane" and Swazi's were bakaNgwane

Water services and sanitation are very new in the area. Domestic water was not supplied to the homesteads in Nkomazi during the apartheid era. Presently, many villages have a water services system and more are under construction (NOWAC, 1997).
The general economic situation in Nkomazi area still much lower than in the rest of South Africa.This is accentuated within farming sector where tremendous differences have been observed in farming income. White farmers are generally high educated and managing agricultural enterprises, which comprise several hundreds of hectares and employ many people, grow a variety of crops for exportation and sometime for the local market.
On the contrary, the black farmers are almost without exception small-scale farmers with 2-20 hectares, with an average of 6 ha. All of them are sugar cane farmers; mostly their farm is part of a larger irrigation scheme. These farmers are in general not trained farmers and do not have access to the networks of the commercial farmers.

3.2.2 The sugar production system in Nkomazi

Fifteen percent of South Africa's sugar cane is cultivated in the Nkomazi / Onderberg Region. The other 85% are grown in Kwazulu Natal. The Nkomazi region is the only region where sugar cane is intensively irrigated. Yields are higher on average than in the rest of the country. The cane is processed in two sugar mills; one at Malelane (1965) and a new mill, built in 1997 to allow for expansion of the sugar area. Transvaal Suiker Beperk (Transvaal Sugar Beperk, TSB) owns both mills. About 41% of total delivery to the Komatipoort mill come from small-scale agriculture, the rest from commercial farms, estates and miller estates.
The total area under sugar cane has expanded, mainly through the NIEP(Nkomazi Irrigation Expansion Program or project) .The sucrose percentage increases slightly due to better practices and varieties and was 13,8% on average. The average plot is considerably larger in Nkomazi than in Kwazulu Natal, 7-9ha compared to 2 ha in KZN. In Nkomazi where average yield per hectare is 40-50t in KZN, while it is on average 90t and the recoverable value is higher in most instances. In Nkomazi, the harvest is done every 24 months, while in KZN the cycle is 12-24 months (Pienaar, TSB public officer, Farmer's weekly, 2002)

3.2.3 Infrastructure in Nkomazi

The survey area is called Nkomazi region and it comprises two locations: Komatiport and Malelane. Komatipoort is located at 102 km from Nelspruit and 56km from Malelane while Malelane cane supply is at 60km from Nelspruit.

The survey area has very good network of roads. The main road (N4) from Gauteng to Mozambique (Maputo harbour) and the Kruger National Park goes through this area, with links also to Swaziland and Richards Bay. The Maputo Corridor project will further develop the infrastructures and be very beneficial for farmers in providing additional outlets for the marketing of their produce.
Two major railroads from Gauteng to Maputo harbour and from the Richards Bay harbour link this area with international markets

CHAPTER 4
METHODOLOGY

4.1 Introduction

This chapter outlines the methodology adopted to investigate the various interacting groups of factors which determine the success of small-scale irrigation farmers.
The choice of study area, orientation and planning of the survey, sources of information, questionnaire design, sampling and interviewing procedure and analysis of data are discussed in this chapter.

4.2 Orientation and planning

The planning of the study commenced in October 2000 and took two months to complete. A personal visit was made to the research area.
The purpose of this preparatory stage was to obtain a clear picture of the farming situation in the area selected. During this period, discussions were held with various government officials, irrigation farmers and all members involved in the development and management of the settlement.
At the same time a complete list was compiled from the local records of all landowners, which was for the selection of stratified sample representing twenty schemes in Nkomazi.

4.3 Sources of information

Following the orientation phase it was decided to use two basic sources via library research, which included a range of research, report articles in journals, and local sources.
Demographic information on individual farmers, such as age, size of farm, gender, communication and participation were not available and had to be obtained from the irrigation farmers themselves. Little was known about the personal and socio-psychological factors, which form an important aspect of this investigation.

4.4 Orientation of the research

Prior to the investigation, the research procedures and questionnaire used in the study were discussed with government official at all levels, members of the local farmer's association and more importantly the questionnaire was tested and enumerators were well briefed and trained.

4.5 Research objectives

1. A questionnaire method for the collection of data formed the basis of the study. The main objectives of the questionnaire were:

2. To develop measures of farming success and characterize respondents accordingly

3. To identify and measure various personal and environmental factors and establish their relationship with farming success under irrigation.

4. To develop a scale for the selection of potentially successful small-scale irrigation farmers.

4.6 Questionnaire design

The questionnaire provided the main body of information concerning the sugar cane farming in Nkomazi region of Mpumalanga.
Information was collected on the following aspects:

_ Personal aspect of respondents
_Irrigation at Komatipoort and Malelane overview.
_Perception of respondents towards farm management
_Perception of institutional factors and their influence on the production
_Knowledge of respondents towards recommended agricultural practices

4.7 Sampling procedure

A complete list of landholders on the settlement was compiled from available information derived from local government officials. A stratified random sample size of twenty schemes was obtained, representing 80% of the total of twenty –fives schemes in Nkomazi, which comprises Komatipoort and Malelane. A total sample of 139 respondents of whom 104 farmers from Komatipoort and 35 farmers from Malelane cane supply representing a 10% stratified of the overall farming population.
Structured and semi-structured questions were used to measure the different independent variables with various responses.
Dichotomic questions were avoided, whilst a certain number of open-ended questions were included. The multiple-choice questions or closed questions were arranged in a logical sequence according to the problem conceptualisation.

4.8 Data analysis

In analysing data, use was made of frequency distribution with percentages. Pearson correlation and Chi-square test, in combination with frequency distribution were used as indicators of relationships between the various variables. Stepwise regression analysis was performed to determine the relative contribution of the independent variables to the indicators of agricultural development.

Data Management &Statistical Analysis (DMSA cc) using the SAS statistical package processed the data collected in this study.

4.8.1 Statistical Analysis

The statistical analysis in this section is design to:

- Determine through multiple regression analysis the independent variables that significantly contribute to the variance of farming success aspects of the small -scale farmers in Nkomazi.
- Establish the degree of correspondence (if at all) via correlation analyses between one set of dependent variables on the one hand and between a set of independent variables on the other.

4.8.1.1 Regression analysis

Regression analysis is a technique often used in exploratory fashion to look for an empirical relationship between one variable and a set of other variables. The relationship is often expressed in the form of:

$$\mathbf{Y_i = B_o + B_j\ X_{ij} + E_i}$$

An equation that predicts a response variable, Y_i (also called a dependent variable) from a function of regression variables, Xij called independent or predictor variable) and the Unknown E_i.

The parameters are estimated in such way that a measure of the fit is optimised, E_i is known as an error term.

4.8.1.2 Procedures followed to determine the significance of variables towards farming success.

Preliminary lists of variables were selected according to the formulated hypotheses for statistical significance, and logical interrelation by means of Pearson correlation and Chi-square analyses .The variables were grouped in three different classes: independent, mediating and dependent (results of behaviour or farming success) as presented in Table 4.1.
A variable was considered when it has shown a direct relation with the next class, which also showed a relation with farming success. There was also tested in correlation matrix; the variables showing lowest correlation with farming success were left out until the best fit was selected. The overall set of variables that interact as determining factors of behaviour are summarised in Table 4.1

Table 4.1 The interrelation between different variables

HUMAN (PSYCHOLOGICAL)		ECONOMIC-TECHNICAL	
Independent variables	Mediating variables	Dependent variables	
		Behaviour	Consequence of behaviour
Personal and Environmental	Knowledge Needs Perceptions	Adoption of practices P_1 . . . . P_x	Efficiency: Yield/tons/ farm and /hectare = Farming income

From this set of variables that interact as determining behaviour, a final list of variables that showed a continuous influence or relationship with farming success were selected through this process. The interrelation between these variables was eliminated by means of correlation matrix.

The final step was to group all the variables together to test the relation and to determine their R^2 (Square of the multiple correlation coefficient) towards Farming success.

The screening instrument is therefore scientifically and statistically founded and is based on the conventional extension theory. The instrument therefore, not only confirm the current theory but also consist of unique combination of quantifiable which include : personal, mediating and dependents.

Table 4.2 Interrelations between 3 quantifiable variables and farming success

Independent variables	Mediating variables	Dependent variables	Results of behaviour
Personal and Environmental factors	Knowledge Needs Perceptions	Behaviour	
$F(a)+B_{iv}$	$+C_{MV}$	$+D_{DV}$ =	Y_{FS}(Farming Success)

This following regression equation $Y_i = Bo + Bj + X_{ij} + E_i$ was altered to :

$Y_{FS} = B_1 X + B_2 X + E_i$

In which case B_o is removed from the equation in order to avoid rounding error and in such situation the line is likely to go through X=0 and Y =0, which implies that the line has got a zero intercept.
This procedure was applied in order to determine the best fit where by the statistical values or Low R^2 values obtained were left out and thus considered as meaningless. The statistical regression equation was hypothesised according to the following functional relation:

To $\mathbf{Y_{FS}= f(a) + B_{IV} + C_{MV} + D_{DV} + E_i}$

Where Y= farming success (result of behaviour)

(a) X/Y = 0 (Zero intercept)

B_{IV} = independent variable (personal and environmental)

C_{MV} = Mediating variable

D_{DV}=Dependent variable

E_i = Unknown parameter (very difficult to discover since it changes for each observation Y

SECTION B: RESEARCH FINDINGS

CHAPTER 5
FARM EFFICIENCY IN NKOMAZI

5.1 Introduction

The question to why some managers in farming are successful has been of interest to decision makers, researchers and academics for decades.
These decisive questions have centred on the differences related to the perception of the managers and the relation between such perceptions and success in agricultural production.

Some preconditions to success as efficiency, managerial ability and risk management have been accepted as cornerstones of economic success or economic satisfaction.
It has been noticed also that better management and the resulting higher profits margins normally result in the gradual increase in farm size due to efficient combination of resources (Groenewald, 1992:Satorius von Bach and Van zyl, 1992).

In this chapter, an attempt was made to evaluate the Nkomazi farmer's capacity to perform successfully and economically by relating criteria such as agricultural and management practices, to variables such as age of farm operators, farm size, solvency, farming income as well as yield.

5.2 Yield

Yield is an indication of the physical efficiency and is defined as the average weight of the output (grain or fruit) as expressed per unit area (F.A.O 1997).
The knowledge of the yield is of utmost importance because it is considered as the main factor determining the profit, and is also a function of management and the level of adoption of recommended practices which means that the more yield in farming, the more adequate management and practices adoption and thus the higher the profit.

One of the most significant indications of the success of a grower is the productivity of his land expressed as the yield tonnage per hectare and per annum (FAO 1997). In the present study of sugar cane production, the yield is expressed in terms of cane tonnage per hectare and per farm.

The current sugar-cane production was determined based on two parameters namely :

- The average yield per farm
- The average yield per hectare

The average sugar-cane yield per farm in different schemes of Nkomazi is presented in Table 5.1.The finding in table 5.1 shows clearly that farm yield was considerably different between schemes. This is shown by the fact that in Malelane the yield /tons/farm ranged from as low as 190t in Nhlangu East scheme to as high as 778,40t in Buffelspruit scheme.

While in Komatipoort, the yield per farm ranged from as low as 395 tons in Mbhunu C to as high as 1145,71 tons in the Walda scheme .a factor significantly influencing the farm yield was the farm size, r=0,53 P<0,01

Table 5.1 The average yield in tons per farm in the different schemes of Nkomazi

Code	Schemes*	Tons / farm
A KOMATIPOORT		
1	Figtree C	713.32
2	Figtree D	484
3	Lunghenlane/Shinyokane	494.24
4	Mbhunu B	1068
5	Mbhunu C	395
6	Mhangane	607
7	Mfufane	614
8	Madadeni	783
9	Mangeweni	508
10	Spoons 7	946
11	Spoons 8	1027
12	Sibange	859
13	Walda	1145.71
	AVERAGE	741.86
B MALELANE		
14	Boshfontein	679
15	Buffelspruit	778.40
16	Low's creek	719.10
17	Mbongozi	582.33
18	Nhlangu East	190.33
	AVERAGE	589.83

* No data available for two schemes (Fig tree A & Tonga) from Komatipoort

Table5.2. presents Average yield per hectare in Nkomazi during the year 2000.The average yield per hectare is reflective of the variations observed earlier in the average yield per farm.

The variation in yield per hectare is shown by the fact that in Mangweni scheme the yield /hectare was as low as 48,63t/ha while the highest yield /ha was 128,85t/ha recorded in the Fig tree D (Komatipoort). On the contrary, in Malelane the lowest yield t/ha was recorded in the Low's Creek scheme and the highest 118/ha in Mbongozi.

As far as the average yields per hectare are concerned, the variations are similar, although the differences between the two districts of Komatipoort and Malelane are not as big (Table 5.2). As was the case with the average yield per farm, the average

yield per hectare was expected to be a result of different levels of management skills and environmental factors such as soil types and irrigation efficiency.

Table 5.2 Presents the average yield per hectare

Code	Schemes	Yield per hectare
A KOMATIPOORT		
1	Fig tree C	93.65
2	Fig tree D	128.85
3	Lungendlane/Shinyokane	71.73
4	Mbhunu B	82.14
5	Mbhunu C	70.33
6	Mhangane	113.03
7	Mfufane	117.12
8	Madadeni	113.34
9	Mangeweni	48.63
10	Spoons 7	107.94
11	Spoons 8	116.70
12	Sibange	105.58
13	Walda	109.11
	AVERAGE	98.33
B MALELANE		
14	Boshfontein	68.25
15	Buffelspruit	97.00
16	Low's creek	64.40
17	Mbongozi	118.29
18	Nhlangu East	93.13
	AVERAGE	88.21

*No available data for two schemes from Komatipoort (Figtree A and Tonga)

5.3 Farming income

The farming income in Nkomazi during the year 2000 was determined based on two following parameters:

- The gross farming income per hectare
- The net farming income per hectare

Gross farming income is defined as the difference between production sales and the cost of goods sold, it consists of operating expenses plus profits and it includes non–cash as well as cash income (Carter et al 1997).

Data in Table 5.3.summarises the average gross farming income per hectare in different schemes of Nkomazi region.
From Table 5.3,the average gross farming income per hectare was R12 019,43 in Malelane and R13 392,12 in Komatipoort. Between the irrigation schemes however, both in Komatipoort and Malelane the average gross farming income per hectare varied tremendously, the lowest gross farming income per hectare was R6 625,93 in

Malelane while in Fig tree D it was almost three times as high as R 17 570.This variation may be partially explained by the difference in farm size ,which was positively correlated with the gross farming income $r = 0.16$ $P < 0.05$

Table 5.3 The average gross farming income per hectare in the different schemes of Nkomazi

Code Schemes	Gross farming income/ Ha in Rand	Gross farming income /ha in Rand
A KOMATIPOORT		
1	Fig tree C	12.684,52
2	Fig tree D	17.560
3	Lungedlane/Shinyokane	9.773,55
4	Mbhunu B	11.192,17
5	Mbhunu C	9,585,97
6	Mhangane	15.405,50
7	Mfufane	15.962,32
8	Madadeni	15.448,50
9	Mangeweni	6.625,93
10	Spoons 7	14.708,24
11	Spoons 8	15.902,95
12	Sibange	14.382,03
13	Walda	14.865,71
	AVERAGE	R 13.392,16
B MALELANE		
14	Boshfontein	9.301,98
15	Buffelspruit	13.215,56
16	Low's creek	8.770
17	Mbongozi	16.119,59
18	Nhlangu East	12.690,05
	AVERAGE	12.019,43

No available data for Fig tree A and Tonga (schemes from Komatipoort area)

5.4 Net farming income / hectare

The net farming income is the gross farming income less variable expenditure (excluding the remuneration capital, like interest and rent).
The net farming income is therefore that amount remaining as remuneration for the management of a farming business project (Louw, 1981,p 82).

Table 5.4. Summarises the mean of the net farming income in the different irrigation schemes in Nkomazi.

The finding in this Table reveals significant differences between Komatipoort (R5 769,06 Nfi/ha)and Malelane(R4 778,4NFI/ha).The difference in net farming income was approximately R 990,60 and can be probably attributed to higher yield per farm, higher average yield per hectare and to the higher gross farming income in Komatipoort. More importantly ,these variation could be related to the farm size ,which was found positively correlated with the net farming income r =0.16 at P<0.05)

Table 5.4 How the net farming income varied between different schemes in Nkomazi

Code	Schemes	Net farming income per hectare in Rand
A KOMATIPOORT		
1	Fig tree C	4.268
2	Fig tree D	5.909
3	Lungendlane/Shinyokane	9728
4	Mbhunu B	3766
5	Mbhunu C	3225
6	Mhangane	5.183.67
7	Mfufane	5371
8	Madadeni	5198
9	Mangeweni	2.229
10	Spoons 7	13.329
11	Spoons 8	6 946.06
12	Sibange	4 839.05
13	Walda	5 001.79
	AVERAGE	5.769.06
B MALELANE		
14	Boshfontein	3129.78
15	Buffelspruit	8120
16	Low's creek	2950
17	Mbongozi	5423.67
18	Nhlangu East	4269.75
	AVERAGE	4778.4

*No available data for two schemes in Komatipoort (Fig tree A and Tonga)

As indicated in Table 5.4 the farm size was positively correlated with the net farming income per hectare. The same observation applied on the overall average net farming income in the two districts of Komatipoort and Malelane where substantial differences are found among the scheme while between districts these differences are not as big as shown in Table 5.5

Table 5.5 Average net farming income in Rand per scheme /Average farm size

Code	Scheme	Average farm size	Total average net farming income/ average farm size	Overall average Net farming income /ha /scheme in Rand
A KOMATIPOORT				
1	Fig tree C	7.8	33279.55	4 266,60
2	Fig tree D	4.5	26586,9	5 908,2
3	Lungendlane /Shinyokane	15.6	151756,8	9 728
4	Mbhunu B	6.1	22 972,6	3 766
5	Mbhunu C	5.9	19 027,5	3 229
6	Mhangane	7.0	36 281	5 183
7	Mfufane	6.3	33 837,3	5 371
8	Madadeni	7.5	38 985	5 198
9	Mangeweni	12.3	27 416,7	2 229
10	Spoons 7	9.0	119 961	13 329
11	Spoons 8	7.7	53 507,88	6 949,07
12	Sibange	7.5	36 292,5	4 839
13	Walda	9.7	48 519,5	5 002,01
	AVERAGE	8.2	49 878.78	5 769.06
B MALELANE				
14	Boshfontein	10.0	31 300	3 130
15	Buffelspruit	7.1	57 652	8 120
16	Low's creek	8.4	24 788	2 950
17	Mbongozi	6.7	36340,8	5 424
18	Nhlangu East	2.1	8 967	4270
	AVERAGE	6.8	31 809,56	3 681,61

*No available data for Figtree A and Tonga schemes from Komatipoort

CHAPTER 6
SOLVENCY OF FARMERS IN NKOMAZI

6.1 Introduction

Solvency indicates the extent to which assets exceed liabilities and thus the ability of the farm to fulfil all its liabilities in the event of a possible cessation of its activities (Louw, 1981, p30). Given the available data in Nkomazi during the year 2000, the solvency of farmers was measured only by means of the Net capital ratio (Current ratio), which is the ratio between total assets and total liabilities. It indicates whether the outstanding liabilities will be met if all the assets are sold and most importantly, the Net capital ratio is used to judge a farm's short - term capacity to meet its financial responsibilities.
This ratio should be greater than 1 as a figure of less than one implies bankruptcy in the case of liquidation.

The ratio is defined as follows:

$$\text{Current ratio} = \frac{\text{Current assets}}{\text{Current liabilities}}$$

The current solvency among different schemes in Nkomazi during the year 2000 is presented in the following Table 6.1.
According to the data summarized in Table 6.1, one can conclude that no very important margin was found between Komatipoort and Malelane as far as the solvency was concerned, the net capital ratio that determines the solvency position of farmers in Nkomazi ranged from as low as 1.04 to as high as 1.27.On the contrary however, tremendous differences of the solvency ratio were found among schemes.

Generally a ratio of more than 2:1 is accepted as safe (Louw.1981), and based on the correct valuation of the assets of farmers in Nkomazi in 2000, 3 following schemes (Fig tree C, Madadeni in Komatipoort, and Low's creek in Malelane, have shown a secure solvency ratio, while the majority of schemes in Nkomazi region did not present a safe solvency position, as a consequence were not in position to offer a security for the claims of short term creditors.
The difference in solvency ratio between Komatipoort and Malelane was very significant although these differences were more important within schemes than between districts. Obviously, there are good reasons to that for example the average yield, total income per hectare, perhaps the most important factor was the willingness to take a moderate risk which characterised the 3 schemes that had a financially secure solvency as shown by the following Chi-square equation:

X^2= DF 6,Value 79,39 at $P < 0.001$

Taking moderate risk had significant positive relationship with the solvency ratio. Furthermore, no significant and positive correlation was found at 5 or 10% level between solvency of farmers in Nkomazi and yield per farm and per hectare, which is

not surprising given the poor farming income figure observed earlier in the region (Table 6.2).

Table 6.1 Solvency of farmers in different schemes

Code	Schemes	Current assets	Currents liabilities	Solvency Ratio
A KOMATIPOORT				
1	Fig tree A	53.000	28000	1.89
2	Fig tree C	62016.75	23546	2.66
3	Fig tree D	79320	120.200	0.65
4	Madadeni	156.650	42.650	3.67
5	Mhangane	13900	57000	0.2
6	Mbhunu B	68.666.66	55704.16	1.2
7	Mbhunu C	51.000	57000	0.89
8	Mfufane	48.666.66	53.200.00	0.91
9	Sibange	118.868.57	88.256	1.34
10	Spoons 7	139028.57	76238.57	1.8
11	Spoons 8	83791.66	74325	1.12
12	Tonga	19.466.66	14100	1.38
13	Walda	28.717.74	32325	0.99
	AVERAGE	71.007.17	55.503.51	1.27
B MALELANE				
14	Boshfontein	75000	104166	0.72
15	Low's creek	179.000	31.666	5.65
16	Nhlangu East	267	100840	0.002
17	Mbongozi	39.866.66	44.400	0.53
	AVERAGE	73.533.41	70.268	1.04

**No available data for 3 schemes: 2 from Komatipoort (Mhangeweni +Shinyokane) and 1 from Malelane (Buffelspruit)

Table 6.2 Correlation of the Solvency with the yield in Nkomazi

Solvency	Average yield/farm	Average yield /ha
	0,04124	0,00419
	0,6883	0,9675
	97	97

* No available data for 42 farmers

CHAPTER 7
PRACTICE ADOPTION IN NKOMAZI

7.1 Introduction

The proficiency in farm management and a rapid rate of adoption of recommended practices are highly commendable and undoubtedly powerful indicators of progressive personality. It may be deducted that the good farmer exhibits a brand of the managerial ability which recognises the importance of science and technological change for the continued development of the enterprise and secondly incorporates the inherent skill and rationality to apply with discretion and integrate successfully those practices which will increase the level of agricultural productivity on a productivity on a permanent scientific basics (Morris, 1967).
In this chapter, the adoption of the recommended agricultural practices will be assessed among irrigation farmers in Nkomazi, given the fact that an adequate adoption of agricultural practices has a positive impact in determining the yield and consequently the farming income.

7.2 Current Level of adoption of Recommended Agricultural practices

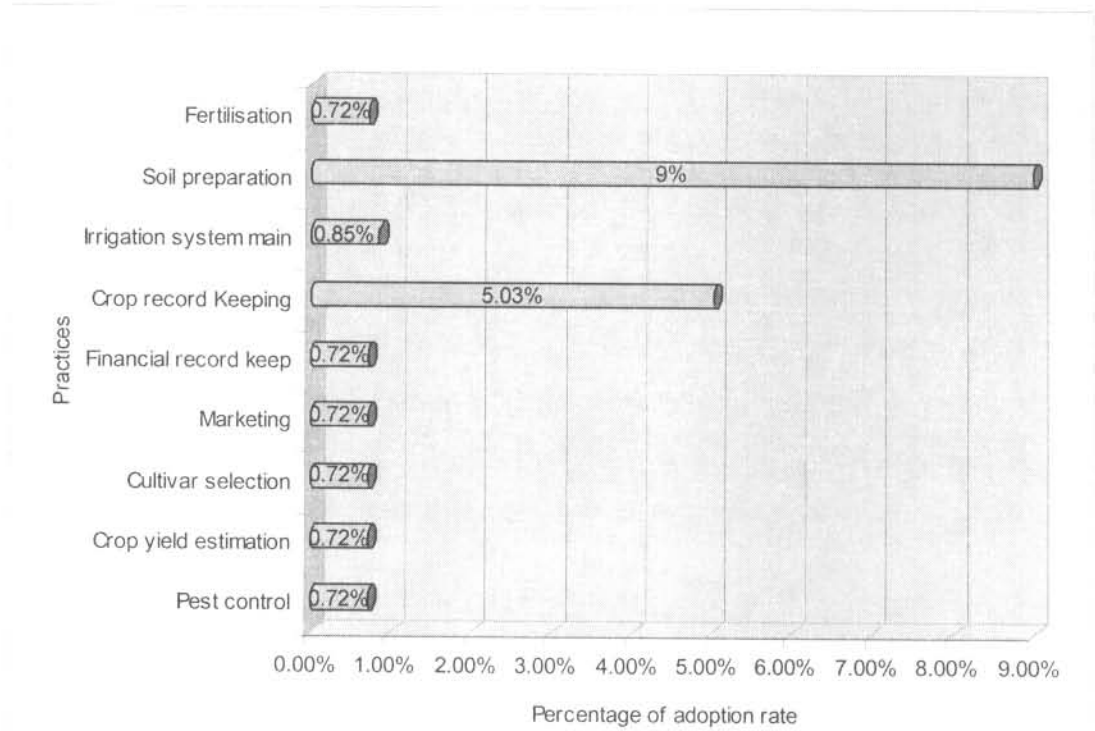


Figure 7.1 Adoption of recommended Agricultural practices in Nkomazi

Figure 7.1 presents the adoption rate of the recommended agricultural practices. The overall view is that the rate of adoption of recommended practices during the year 2000 was found very low, it ranged from 0,72% for the adoption of the following practices: pest control, scouting for diseases, cultivars selection, marketing, financial

record keeping to as high as 5 to 9% for the crop record keeping and soil preparation. Which means that out of 18 selected agricultural practices in sugar cane farming, 9 practices only were found to be known as well as adopted even though with a low rate by the Nkomazi farmers.

It appears from the figure 7.1 that there was a poor adoption of recommended practices in sugar cane farming. In the following Table is presented the correlation of the current adoption of the agricultural practices with the yield as well the farming income in Nkomazi during the year 2000.

Because of the appalling adoption rate observed in the figure 7.1, the significant correlations of the current level of practices adoption were found between the fertilisation and net farming income per hectare r= 0.46 at P<0.01% as well as the marketing with the net farming income r=0.19at P<0.01%.Soil preparation r=0.1with the yield /farm P<0.01%,pest control r=0.2 with the yield/farm at p<0.05%,cultivars selection r=0.2 with the yield/farm at P<0.05%, crop yield estimation r=0.2 with the yield /farm at P<0.01,irrigation system maintenance r=0.2 with yield /farm at P<0.05 and r=0.3 with the net farming income at P<0.01

Table 7.1 Correlation of the current adoption of recommended practices with Farming income (Yield and farming income) N=118

Code	Agricultural Practices	Yield /tons/farm	Yield /tons/ ha	Gross farming income/ ha	Net farming Income / ha
1	Soil preparation	0.11	0.12	0.12	-0.03
2	Taking soil Preparation	0.10	0.03	0.03	0.01
3	Fertilisation	0.08	0.09	0.06	0.46**
4	Scouting for pest	0.02	0.14	0.14	-0.01
5	Pest control	0.11	0.03	0.003	-0.11
6	Scouting for diseases	0.08	-0.11	0.11	0.12
7	Disease control	0.07	-0.05	-0.05	0.08
8	Irrigation scheduling	0.01	-0.01	-0.01	0.06
9	Planting	0.06	-0.03	-0.03	-0.03
10	Cultivars selection	-0.06	-0.04	-0.04	-0.04
11	Crop yield estimation	0.00	-0.10	-0.10	-0.11
12	Harvesting	0.10	-0.04	-0.04	-0.04
13	Marketing	0.10	0.09	0.09	0.19**
14	Financial record keeping	0.05	-0.07	-0.07	0.14
15	Crop record keeping	-0.02	0.11	-0.11	0.00
16	Pump maintenance	0.00	0.01	-0.11	0.00
17	Irrigation system maintenance	0.03	0.03	0.03	0.00
18	Weed control	0.03	0.08	-0.08	-0.12

7.3 Summary

In conclusion, the assessment of the current rate of adoption of recommended practices in Nkomazi has revealed that the overall rate of adoption was less than 10% for the majority of recommended practices in different schemes of Nkomazi.
The reason has to do with the personal skills of farmers, coupled with problems such as access to credit, managerial issues as well as the willingness to risk taking.

CHAPTER 8
BEHAVIOUR DETERMINANTS: THE NEEDS AND PERCEPTIONS OF FARMERS IN NKOMAZI

8.1 Introduction

Adoption behaviour is a function and direct result of intervening variables such as needs, perceptions and knowledge. These variables in turn are influenced by independent personal and environmental variables whose indirect effect becomes manifested in behaviour via the mediating variables.
The knowledge of the behaviour determinants or mediating variables is very important since it is the largest contributor towards farming success. Duvel (1975) found that the independent variables surface through the intervening variables in order to determine the farming success. Subsequent studies by Botha and Lombard (1995) support the same finding in the way that the knowledge, perception as well as aspirations are the factors to be addressed if desired change has to be initiated.

In this chapter, the impact of the mediating variables on the overall farming success will be assessed based on the perception, needs and knowledge of Nkomazi farmers during the year 2000.

8.2 Knowledge of recommended agricultural practices

A definite constraint to the success of small-scale sugar cane production in Nkomazi is the lack of knowledge of certain key agricultural practices.
Considering the importance of knowledge in farming, the Nkomazi farmer's knowledge of recommended agricultural practices was assessed based on the following parameters:

- The perceived previous level of knowledge of recommended agricultural practices before joining the current project in Nkomazi
- The need to undergo more training in the future

8.3 Assessment of the Nkomazi farmer's level of previous knowledge of recommended agricultural practices

Figure 8.1 Shows that the overall level of the previous knowledge of recommended practices in Nkomazi was found very low.
The previous knowledge level of practices ranged from as low as 11.51% for (planting and irrigation scheduling) to as high as 23.74% (for the marketing and harvesting). No data was obtained regarding the practices of weed control, irrigation system maintenance and pump maintenance.

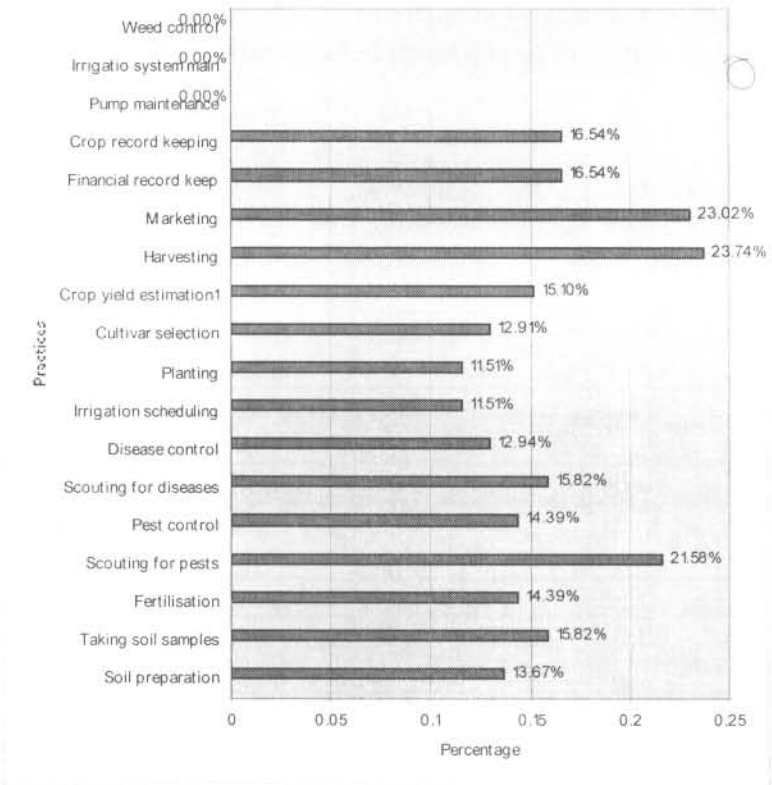


Figure 8.1 Assessment of the previous knowledge of recommended agricultural practices in Nkomazi 2000

While the level of previous knowledge of the following recommended agricultural practices were not formally expressed: weed control, irrigation system maintenance and pump maintenance.

From the findings in Figure 8.1 it appears that most farmers in the region did not get much exposure to the modern farming prior to the current sugar cane project which could have provided them the better understanding of commercial farming.
The more specific contribution or the value of the previous knowledge is analysed in Table 8.1 and related to some physical and economic variables that are indicators of the overall efficiency in sugar cane farming.

Table 8.1 Correlation of efficiency variables with previous knowledge of recommended practices of farmers

N=118♦

Code	Previous knowledge of practices	Average yield/tons/farm	Average yield/tons/ha	Gross farming income/ha	Net farming income /Ha
1	Soil preparation	0.23	-0.003	-0.003	-0.11
2	Taking soils samples	0.18	0.11	-0.11	-0.12
3	Fertilisation	0.11	-0.07	-0.07	-0.14
4	Scouting for pest	0.13	0.02	0.02	0.02
5	Pest control	0.31**	0.03	0.03	-0. 6*
6	Scouting for disease	-0.07	-0.08	-0.08	0.81*
7	Diseases control	0.13	0.10	0.10	0.06
8	Irrigation scheduling	0.12**	0.01	0.01	-0.07
9	Planting	0.15	0.01	0.01	-0.09
10	Cultivars selection	0.25**	0.01	0.01	-0.09
11	Crop yield estimation	0.24**	0.0008	0.0008	-0.12
12	Harvesting	0.20**	0.0018	0.0017	-0.02
13	Marketing	0.21**	-0.01	-0.01	-0.07
14	Financial record keeping	0.03	-0.007	-0.007	0.18*
15	Crop record keeping	0.10	-0.05	-0.05	-0.15
16	Irrigation system maintenance	0.19	0.07	0.07	0.39*
17	Weed control	0.08	-0.03	-0.03	-0.01

*= Significantly correlated at 1 % and **= significantly correlated at 5%
♦= 21 data missing
No available data for the practice: pump maintenance

From the findings in Table 8.1,it It appears that the previous knowledge of the pest control was the only knowledge aspect found to be significantly correlated with the

efficiency both yield/farm r=0.31 at P< 0.05 and with the net farming income /ha r=-0.6 at P< 0.01.
Significant correlations were found with the yield per farm in the case of irrigation scheduling r=0.12 at P<0.05, cultivars selection r=0.25 at P < 0.05, crop yield estimation r=0.24 at P<0.05, harvesting r= 0,20 at P< 0.05, marketing r=0.21 at P< 0.05. Also, significant in the case of the net farming income per hectare were the previous knowledge of irrigation system maintenance r= 0.39 at P< 0.01, scouting for diseases r= 0.81 at P< 0,01 and financial record keeping r= 0.18 at P< 0.01.
While the previous knowledge of the following practices:
Irrigation scheduling, cultivars selection, crop yield estimation, harvesting and marketing was found only significantly correlated with the yield/ tons / farm at (P<5%).
In the meantime, previous knowledge of irrigation system maintenance, financial record keeping and scouting for disease was found only significantly correlated with the net farming income per hectare (P<5%).

In conclusion, there is strong evidence that the previous knowledge of recommended agricultural practices was found positively linked to the efficiency (both physical and economic) in Nkomazi.
Thus previous knowledge has a significant contribution to the efficiency of sugar – cane production through its correlation with some key practices, which means that previous knowledge provides farmers with personal enrichment, commitment and confidence in decision making.

8.4 Need for Training in Nkomazi

The need for more training is assumed to be an important precondition as it can reflect a willingness to change or improve the production efficiency. This is particularly meaningful in the light of the general low level of current adoption rate of practices (Figure 7.1) as well as the low level of the current previous knowledge (figure 8.1) and that illustrates a necessity for further investment in human capital particularly in addressing the issue of farming knowledge and skills.

Figure 8.2. Summarizes the level or the need for more training in agricultural practices expressed by the farmers in Nkomazi. According to the findings in this Figure, the overall need for more training ranged from as low as 7.91% to as high as 28.06%. Most farmers have shown a willingness to have more training since it increases knowledge and personal enrichment, motivation, commitment as well as confidence in the management.
The more specific contribution of the willingness to undergo more training is further analysed in Table 8.2 through its correlation or relationship with the success criteria.

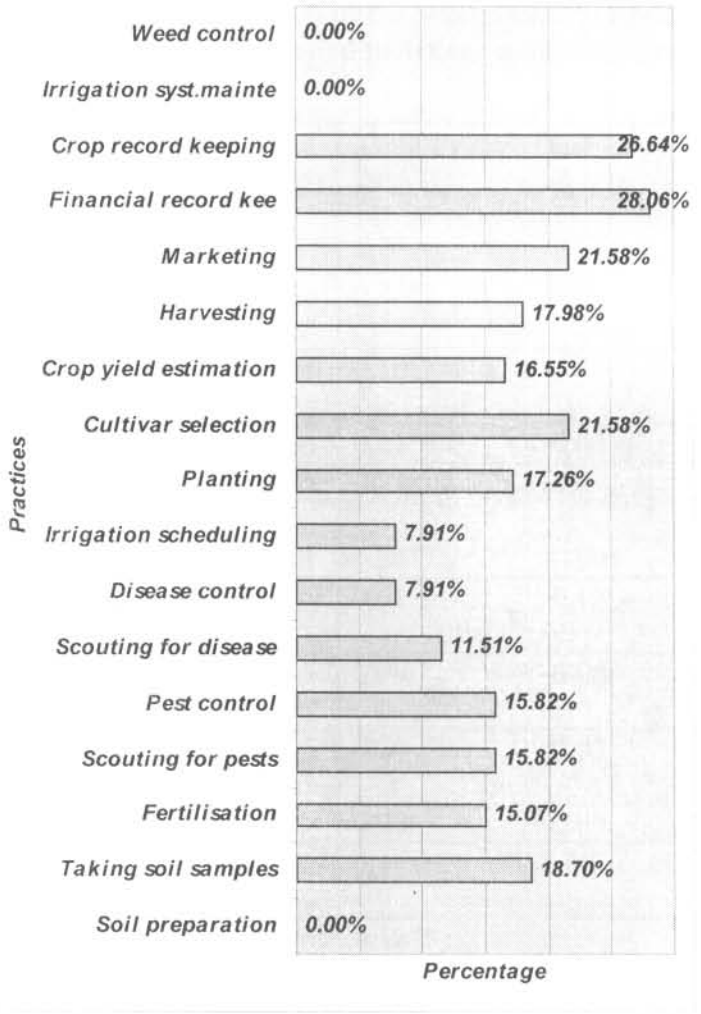


Figure 8.2 Training needs as expressed by Nkomazi farmers 2000

Table 8.2 Correlation of the willingness to undergo more training in recommended practices with efficiency

N= 118♦

Code	Willingness to undergo more training in	Yield / tons/ farm	Yield/tons / hectare	Gross farming income / ha in Rand	Net farming income/ha in Rand
1	Soil preparation	0.22**	-0.02	-0.02	-0.012
2	Taking soil samples	0.10	-0.03	-0.03	-0.16**
3	Fertilisation	0.21**	-0.03	0.03**	0.12
4	Scouting for pests	0.22**	0.01	-0.01	-0.06
5	Pest control	0.26**	-0.001	-0.001	0.10
6	Scouting for diseases	0.01	-0.13	0.13	-0.13
7	Disease control	0.09	-0.08	-0.08	-0.08
8	Irrigation scheduling	0.20	-0.03	-0.03	-0.11
9	Planting	0.006	-0.03	-0.03	-0.14
10	Cultivars selection	0.17	0.00	0.00	-0.09
11	Crop yield estimation	0.18**	0.03	0.03	0.06
12	Harvesting	0.019	-0.05	-0.05	0.25**
13	Marketing	0.07	-0.12	0.12	0.23**
14	Financial record keeping	-0.13	0.14	-0.14	-0.25**
15	Crop record keeping	-0.12	0.22**	-0.22**	0.27**
16	Pump maintenance	-0.04	-0.16**	-0.15**	-0.11
17	Irrigation system maintenance	0.07	-0.03	0.03	0.01
18	Weed control	-0.07	0.10	0.13	0.02

** = Significantly correlated at $P < 0.001$

♦= 21 data missing

Significant correlations were found in the case of the willingness to undergo more training for the soil preparation with yield/farm r= 0,22 at $P<0.05$, Taking soil

samples with NFI/ha r= 0.16 at P< 0,05, fertilisation with yield /farm r= 0,21 at P< 0.05 and gross farming income/ha r=0,03 at P<0,05, Scouting for pests with yield/farm r= 0,22 at P< 0.05,pest control with yield/farm r= 0,26 at P < 0,05,irrigation scheduling with yield /farm r= 0,20 at P< 0,05, cultivars selection with yield /farm r= 0,17 at P<0.05, crop yield estimation with yield /farm r=0.18 at P<0,05 , harvesting with net farming income r= -0.25 at P<0.05 , crop record keeping with yield /ha r= 0.22 at P< 0,05, gross farming r= -0.22 at P<0,05 and NFI r=-0.27 at P<0.05, finally the pump maintenance with yield /ha r= -0,16 and gross farming income r=-0.15 at P<0.05.

** Training need concerning Weed control and Irrigation system maintenance was not expressed

8.5 Willingness to take Risk in Nkomazi

By its nature, farming has considerable uncertainty and risk associated with. South African agriculture is inherently more risky than that of other countries because of low average rainfall and the wide variability both between and within seasons in most parts of the country. In addition to risk associated with drought, farmers are confronted also with a range of other hazards including hail storms, fires, pest and diseases (Green paper on agriculture, 1988). In the following Table (8.3) farmer's willingness to take risk is summarised.

Table 8.3 Frequency distribution of respondents according to their willingness to take risk and borrow at 18.5% interest rate in Nkomazi

N=139

Code	Risk category	Frequency	Percent
1	No comment	9	6
2	Low risk category borrowing less than R20 000 at 18,5%	65	46,76
3	Medium risk borrow up to R 60 000 at 18,5%	57	41,0
4	High risk category, borrow up to R 250 000 at 18,5%	8	5,8
	Total	139	100%

According to the data presented in Table 8.3, most farmers in Nkomazi were found willing to take risk for their farming activities. However, few farmers were willing to take high risk. While the remaining farmers, were divided with 41% for moderate risk 46% of farmers were prepared to take a lower risk .

8.5.1 The relationship between Risk taking and Practices adoption

In the following Table the willingness of risk taking was assessed in order to determine which risk category was more suited or more positively related to practices adoption and thus to the efficiency.

Table 8.4 Correlation of Practices adoption and risk taking in Nkomazi

N=118

Practices	Low risk category borrow up to R 20 000	Medium risk borrow up to R 60 000	High risk category borrow up to R 250 000
Soil preparation	0.01	0.84**	0.07
Taking soil samples	-0.05	0.84**	0.03
Scouting for pests	-0.08	0.78**	0.06
Pest control	-0.01	0,75**	0.06
Scouting for diseases	0.05	0.80**	0.05
Disease control	0.02	0.03	0.08
Irrigation scheduling	0.05	0.01	0.01
Planting	0.07	0.53**	0.04
Cultivars selection	0.02	0.76**	0.03
Crop yield estimation	-0.06	0.02	0.07
Harvesting	0.04	0.76**	0.07
Marketing	0.06	0.55**	0.09
Financial record keeping	-0.09	0.55**	0.05
Crop record keeping	0.04	0.50**	0.56**
Pump maintenance	-0.01	0.07	0.57**
Irrigation system maintenance	0.03	-0.003	0.04
Fertilisation	0.02	0.53**	0.05
Weed control	-0.06	0.02	0.01

To the question of whether or not the risk taking in Nkomazi was related to the practices adoption the answer was yes, as summarised in Table 8.4. Significant correlations were found mostly in the case of the medium risk category where moderate risk was significantly correlated with: the soil preparation taking r=0.84 at P<0.05, taking soil samples r=0, 84 at P<0,01, fertilisation r=0.53 at P<0.05, scouting for pest r= 0.78 at P< 0.05, pest control r=0.75 at P< 0.05, scouting for diseases r= 0.80 at P<0.05, planting r=0.53 at P<0.01, cultivars selection r=0.76 at P<0,655,

harvesting r=0.76 at P<0,05, marketing r= 0.55 at P<0,01, financial record keeping r=0.51 at P< 0.05, and crop record keeping r=0.50 at P< 0.05.

In high risk category, the significant correlation were found between Crop record keeping r=0.56 at P<0.05 and pump maintenance r=0.57 at P < 0.05. While non-significant correlation could not be found between the low risk category with any practice adoption.
The medium risk category was the only risk category that was found more positively correlated with several practices adoption among small-scale irrigation farmers.

8.6 Perceived problems in Nkomazi

Understandably, the most important and crucial perceived problems on the schemes are prioritised and presented in figure 8.3.
According to this figure, the majority of respondents (52.5%) have expressed a concern with the shortage of water, followed by the weed control expressed by 20.16% of respondents, thirdly the funding of farming activities(15.83%).
Finally, there was the problem of the electricity supply with (6.47%) and the fencing issue expressed by (5.04%).

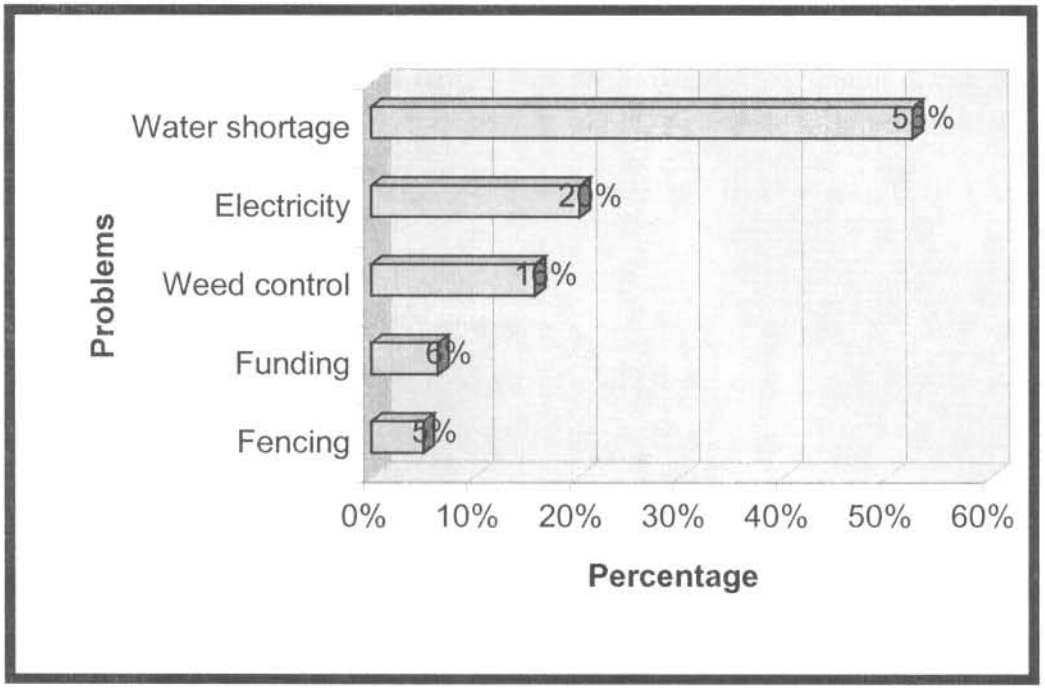


Figure 8.3 Main Farming problems in Nkomazi 2000

CHAPTER 9
SOCIO-ECONOMIC CHARACTERISTICS OF THE POPULATION IN NKOMAZI

9.1 Introduction

Bembridge (1986 b: 77) citing Jones & Rolls (1974) and Crough &Chamala (1981) noted that a situation analysis of the social and cultural environmental of a community is an essential prerequisite in developing strategies for successful agricultural and community development.
However, more productive farmers have more progressive attitude towards farming. Similarly, Rogers &Shoemaker (1971:187) showed that innovators and early adopters had a more favourable attitude towards change and science. The relationship between personal and environmental factors has been extensively studied and although the findings are sometimes of a divergent and contradictory nature, clear evidence of an influence relationship has been provided (Rogers 1983,pp.251-252, 307-311).The personal and economic factors investigated here include : age, gender, job experience , development of knowledge and socio-psychological factors.

9.2 Gender

In South Africa, studies found that males, fared better than females on commercial agricultural projects (Botha &Lombard, 1992). However, this is contradicted by evidence in many of DBSA's farmer support programmes (Singini &Van Rooyeen, 1995).

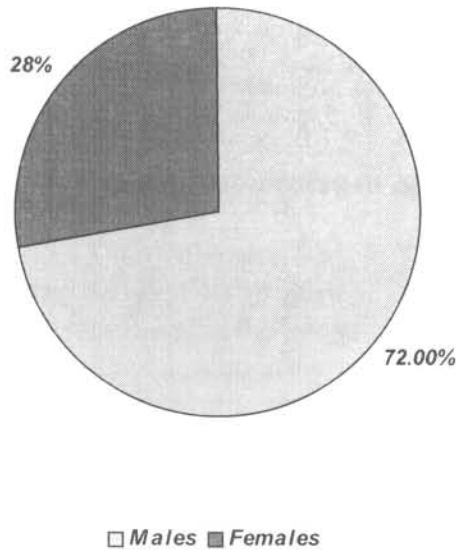


Figure 9.1 Farmers in Nkomazi according to gender (2000)

Figure 9.1 presents the gender composition in Nkomazi. According to the figure it appears that 72% of farmers are males while 28% of farmers are females which is not

typical in the rural South African areas where there is a high labour out migration of males to the industrialized cities like Johannesburg.

9.3 Age of respondents

According to the available literature, Rogers & Schoemaker (1971 pp 185-186) concluded that there is inconsistent evidence about the relationship of age and innovativeness.In Nkomazi during the year 2000, the age of farm operators was determined and is summarised in the following figure 9.2:

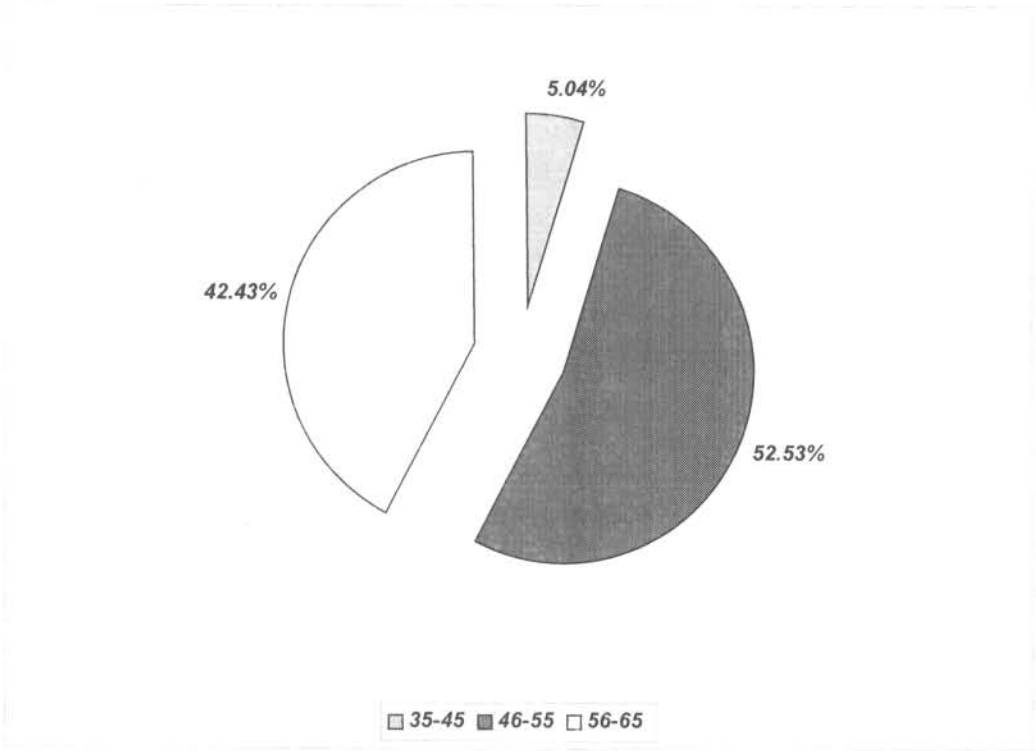


Figure 9.2 Farmers in Nkomazi according to Age (2000)

Figure 9.2. shows that 42.43 % of farmers were in 56- 65 years old age group while 52.43% had an age ranging between 46-55 years of age.
About 5.14 % of farmers were found in the age group of 35-45 years.
The conclusion is that the age of irrigation farmers is lower than in most rural areas. Furthermore, the relationship between age and other economic features such as correlation with efficiency variables, relationship with risk taking, was analysed and summarised in Table 9.1

.

Table 9.1 Correlation between ages of respondents in Nkomazi with the economic variables

N=118*

	Economic variables			
Variable Age of respondents	Net farming income	Gross farming income	Yield /tons/farm	Yield /tons/ha
	0.017787 0.1702 61	0.00489 0.9581 118	**0.17209** 0.0624 118	0.04887 0.9587 118

** Significantly correlated at 6%

* There were 21 observations missing which brings the N number to 118
***78 observations missing concerning the net farming income

From the data in Table 9.1, age of respondents does not contribute significantly to the production efficiency. In the case of the total yield per farm, there is a weak relationship r=0,17209 at P< 0,06 indicating that the older farmers tend to have higher yield. And this finding is in agreement with Rogers' (1983,p251) finding that age is not closely associated with adoption behaviour.

Table 9.2 Relationship between age and willingness to take risk

Age	No comment	Low risk	Medium risk	High risk	Total
35-45-	5	1	1	0	7
46-55	4	29	33	1	73
56-65	0	35	23	7	59
	9	65	57	8	139

When tested the independent variable age against the mediating variable willingness to take risk in Nkomazi there was a superficial relationship and non-significant between these two variables as proven by the following Chi-square equation:

X^2= Df 6 Value; 59,43 at P<0.001

9.4 Years of Previous Farming Experience

The use of the previous farming experience is based on the following assumption: the previous existence of a viable black agricultural community; farm workers who have lived and worked on white farms and, through practices, have acquired some interest and knowledge of farming, and food production activities carried out by man and woman in rural areas which serve as a basis for some knowledge of farming and

formal and /or informal training in farming practices.(Van Rooyen & Njobe-Mbuli, 1998).

Both local research (Botha &Lombard, 1992) and international experience (Kinsey & Binswanger, 1992) show that a background which includes successful farming experience and acquired skills is strongly predictive of good performance and a negative experience of farming tends to drive people in other options of economic activity.

About 18.7% of respondents that were found with a previous experience greater than 6 years while the remaining majority had a farming experience comprises 3-6 yearsas shown in Table 9.3

Table 9.3 Distribution of the current Previous farming experience of farmers in Nkomazi (2000)

N=139

Previous farming experience (years)	Frequency	Percent
<3	27	19.4%
3-6	86	61.9%
>6	26	18.7%
Total	139	100 %

In Table 9.4, the correlation between the years of previous farming experience of Nkomazi farmers with some mediating variables, there was negligible correlations between years of previous farming experience and mediating variables coupled with practices adoption as well as the physical efficiency. Only in the case of the years of farming experience comprise between 3 years to greater than 6,although with some negative which indicates the importance of previous farming.

Table 9.4. Correlation between Years of previous farming experience and some mediating variables, Practices adoption, yield, and farming income N=139

Years of previous farming experience	Mediating variables (needs, willingness to take risk, undergo more training, knowledge of previous practices)	Practices adoptions	Yield /farm	Farming income
<3	0.07402	-0.09720	0.04842	0.023986
3-6	0.065049*	-0.29712	-0.30016	0.05624
> 6	0.030885	0.19185	0.14342	-0.14334
	0.18198	0.18198	0.04238	-0.13344

*=P<0.01

9.5 Years of Previous Work Experience

Table 9.5.shows that in Nkomazi ,6 respondents (4.3%) have less than 3 years of work experience as artisan in addition to the farming activity, while the majority (88.5%) of respondents have 6 years of work experience as professional in the public and private sectors.

Table 9.5 Overview of the total years of work experience in Nkomazi (2000)

N= 139

Total years experience	Work	Frequency	Percent
<3	Artisan	6	4.3%
6	Professional	123	88.5%
>6	Others commercial farming work	10	7.2 %
Total		139	100%

Table 9.6 Correlation between Years of Previous job experience and intervening variables coupled with practices adoption, yield and farming income

N=139

Years of previous job experience	Mediating variables	Practices adoption	Yield /farm	Farming income
3	0.05779	-0.0743	-0.25900	-0.02258
6	-0.92104	0.42389*	-0.11815	0.32119
>6	0.32104	0.66089	0.51559	-0.186070
Total	-0.01478	0.6721	0.22955	-0.17068

*P<0.05

Negligible to high correlations were found between the years of previous work experience with the mediating variables, practices adoption, yield and farming income per farm and per hectare. Significantly positive correlation were found between some of the variables with extensive job experience.

9.6 Farm size in Nkomazi

It is difficult, if not impossible to determine a fixed minimum area for a farmer to supply and fulfil all family needs. Bembridge, 1984 p74) quoted Slovo to have estimated that a rural family requires 3.4 hectares of arable land in order to sustain family life. Pearse in Arnon (1981, p.449) mentioned the concept of "livelihood threshold". According to this concept, the size of the farm should enable a farmer to

produce sufficient calories for family needs plus a further 50% which could be sold to purchase supplementary foods and others essentials. Amon (1981,p.445) is of the opinion that size "...must be considered within the context of the norm of the community, the community of the land, the effectiveness of the infrastructure, the availability of the land use, population pressure, land tenure system, access to capital and know-how, the diligence of the farmers, climatic conditions and other physical aspects of the farmers " should be taken into consideration. The size of land needed by a farmer will thus have to be determined individually for each specific farmer taking into consideration the above-mentioned aspects.
Nkomazi area comprises two distinct locations, which are: Komatipoort and Malelane and separated by 56 km from each other.

Table 9.7 The average farm size in the Survey area of Nkomazi (2000)

N=139

Scheme (Project)	Total area / ha	Average farm size/ha
A KOMATIPOORT		
Figtree A	230	15,3
Figtree C	423.1	7.8
Figtree D	370.9	4.5
Lugendedlana/Shinyokane	514.5	15.6
Mbhunu B	382.2	6.1
Mbhunu C	136.6	5.9
Mhangane	98	7.0
Mfufane	292	6.3
Madadeni	413.3	7.5
Mangweni	123.1	12.3
Spoons 7	235	9.0
Spoons 8	558	7.5
Sibange	391.2	7.5
Walda	813.2	9.7
Tonga	00	00
KOMATIPOORT SUBTOTAL	4985.3	8.7
MALELANE		
Buffelspruit	220.8	7.1
Nhlangu East	122.4	2.1
Mbongozi	215.6	6.7
Low'creek	268.1	8.4
Boshfontein	238.8	10.0
MALELANE (subtotal)	1065.7	6.8

According to the findings, it appears that the farm size in the twenty schemes ranged from as low as 2.1ha in the Nhlangu East scheme in Malelane to as high as 15.6 ha in the Lugendlana /Shinyokane scheme in Komatipoort.
While the average farm size in the two areas ranged from 6.8 ha in Malelane to 8.7 / ha in Komatipoort. The conclusion that can be drawn from the findings is that in Nkomazi region as a whole there was substantial differences in the size of farms among the farms operators. However, on the assumption that approximately four hectares of dry arable land is required for subsistence farming in medium to high potential agro-ecological areas (Bembridge, 1987:104), the present study suggests that the majority of farmers (92%) in Nkomazi have a viable farming unit. When one looks at the tremendous differences of the yield observed among the farmers, it could be concluded that the farm size should be considered as one of the possible causes in the discrepancies found in the sugar cane production.
Negligible correlations were observed between the farm size with the yield /ha r= 0.16000at P<0.0001, gross farming income/ha r= -0.16014at P<0,0835 and net farming income r= 0.16328 at P<0.02286. While a high significant correlation was found between farming size and yield/tons/farm r=0.053299 at P<0.0001, which means that the larger the farm, the higher yield /tons/farm as shown in the following Table 9.8.

Table 9.8 Correlation analysis of the farm size with the efficiency in Nkomazi

N=118♦

Variables	Farm size
Yield /tons/ farm	0.53299** 0.0001 118
Yield / tons / hectare	0.16000** 0.0835 118
Gross farming income /ha	-0.16014** 0.0835 118
Net farming income	0.16328* 0.2086 61****

♦ 21 missing data for N=118

****: 78 data missing with regard to the net farming income

9.7 Distance to land

The distance to land is related to the geographical location of the farm in relation to the infrastructure and services. The importance of this factor is reflected in term of the influence it has on other factors, such as access to markets, access to infrastructure, access to extension services and spare parts as well. The distance to land is therefore an important aspect, but should be judged in term of available infrastructure and its accessibility. Table9.9.shows the distance to land for the majority of respondents (74.8%) ranged between 3.1km- 5km , while 19.4% of respondents have their distance to land ranging from 1.1km-3km, only one farmer (0.73%) had a distance to land over 5km.

Table 9.9 Frequency distribution of respondents in Nkomazi according to the distance to land

N=139

Code	Distance to land	Frequency	Percentage
1	<1km	7	5.03
2	1.1km-3km	27	19.42
3	3.1km-5km	104	74.83
4	>5km	1	0.73
Total		139	100

The main conclusion drawn from the finding in Table 9.9. above is that the distance to land should not present major limitation as most respondents have their farms units within an easy reachable and available infrastructure.
In general the farming activity in Nkomazi was not affected by the distance because the farmers have not to pay money for transportation as proven by the following Chi-square equation :

X^2= df 6,33 value 4,35 P<0.04

CHAPTER 10
OVERVIEW OF BEHAVIOUR DETERMINANTS AND STATISTICAL ANALYSIS

This chapter addresses the contribution of each category of selected variables on the sugar cane farming success in Nkomazi based on the statistical analysis of data. The independent, mediating, and dependent variables were tested against farming until there was a correct fit which gave a clear indication on the contribution of each group of variables on the farming success.

10.1 Statistical Analysis

The analysis in this section was designed to:

- Determine through multiple regression analyses the independent variables that significantly contributed to the variance of farming success aspects of the small-scale farmers in Nkomazi
- Establish the degree of correspondence (if at all) via correlation analyses between one set of dependent variables on the one hand and between a set of independent variables and mediating variables on the other hand.

10.1.1 Regression analysis

Regression analysis is a technique often used in exploratory fashion to look for an empirical relationship between one variable and a set of other variables.
The relationship is often expressed in the form of:

$$Y_i = B_0 + B_j X_{ij} + E_i$$

An equation that predicts a response variable, Y_i (which is called a dependent variable) from a function of regression variables, X_{ij} (called independent, or predictor variable) and the unknown parameter: E_i

The parameter are estimated in such way that a measure of the fit is optimised, E_i is known as an error term.

10.1.2 Procedures followed to determine the significance of variables towards farming success

Preliminary lists of variables were selected according to the formulated hypothesis for statistical significance, and logical interrelation by means of Pearson correlation and chi-square analyses. The variables were grouped in four different classes namely: independent, mediating, dependent and results of behaviour (farming success) as presented in Table 10.1.

A variable was considered when it has shown a direct relation with the next class, which also showed a relation with farming success.
Then these two groups were grouped together and tested against success. They were also tested in a correlation matrix; the variables showing lowest correlation with farming success were left out, until the best fit was selected.
The overall set of variables that interact as determining factors of behaviour are summarised in Table 10.1.

Table 10.1 The interrelation between different variables.

Human (psychological)		Economical-Technical	
Independent variables	Mediating variables	Dependent variables	
		Behaviour	Consequence of behaviour
Personal and Environmental	Knowledge Needs Perceptions	Adoption of practices P1 . : : . . Px	Efficiency : Yield/tons/(farm and hectare) + Farming income

From this set of variables that interact as determining behaviour, a final list of variables that showed a continuous influence or relationship with farming success were selected through this process.
The interrelation between these variables was eliminated by means of correlation matrix.The final step was to group all the variables together to test the relations and to determine their partial R^2 that is square of the multiple correlations coefficient towards farming success.

The screening instrument is therefore scientifically and statistically founded and is based on conventional extension theory. The instrument therefore not only confirmed the current theory but also consistet of a unique combination of quantifiable variables which include: personal, mediating and dependents.

Table10.2 Interrelations between 3 quantifiable variables and farming success

Independent variables	Mediating variables	Dependent variables	Results of behaviour
Personal and Environmental factors	Knowledge Needs Perceptions	Behaviour	
$F(a) + B_{IV}$	$+ C_{MV}$ +	$D_{DV} =$	Y_{FS} (farming Success)

The Zero intercept was applied:

The following regression equation $Y_i = Bo + B_j Xij + Ei$

was altered to: $Y_{FS} = B_1 X + B_2 X + E_i$

In which case B_0 is removed from the equation in order to avoid rounding error and in such situation the line is likely to go through X= 0 and Y = 0, which implies that the line has got a zero intercept.
This procedure was applied in order to determine the best fit whereby the statistical values or low R^2 values obtained were left out and thus considered as meaningless.
The statistical regression equation was hypothesised according to the following functional relation:

To $Y_{FS} = f(a) + B_{IV} + C_{MV} + D_{DV} + E_i$

Where:

Y_{FS}= farming success (result of behaviour)

a= X/Y =0 (zero intercept)

B_{IV}= Independent variable (personal & environmental)

C_{MV} =Mediating variables (Knowledge, Needs, Aspirations)

D_{DV} = Dependent variables (Behaviour)

E_i = Unknown parameter (very difficult to discover since it changes for each observation Y)

10.2 Results

10.2.1 Independents variables

It was proven by Duvel (1975) and by subsequent studies by Botha (1985), that the independent variables: personal and environmental factors appears to have a mere limited influence on behaviour.
However, in strategies of change, and farming efficiency these independent variables need to be considered but do not feature as forces of change (Duvel, 1975; Botha, 1985).
In the present study, independent variables as a group tested against farming success, have shown little direct influence on farming success, only two variables were selected from a list of 8 variables by means of regression analysis:

$$Y_{FS} = f\,(a + B_{IV})$$

Y_{FS} = farming success
a = x / y intercept =0
B_{IV} = independent variables

The two selected variables were:

-Years of previous farming experience
-Years of previous work experience

Table 10.3 Results of the fit: $Y_{FS} = f\,(a + B_{IV})$

Independent variables	Total R^2	P- values
Years of previous farming experience	0.5003	0.0001
Years of previous work experience		0.0573
Total F and P	53.22	0.0001

The two variables only explained 50.03% of the variation intervening in farming success when tested as a group against success.

10.2.2 Mediating variables

The 12 mediating variables were initially selected and tested against farming success but also in combination of independent variables.

Those variables that were picked in the fit are as follows:

-Willingness to take moderate risk
-Previous knowledge of recommended agricultural practices
-The need to undergo more training

Table 10.4 Results of the Fit: $Y_{FS} = f(a + C_{MV})$

Mediating variables	Total R^2	P-values
Previous knowledge of recommended agricultural practices	0.8713	0.0001
Need to undergo more training		0.0001
Willingness to take moderate risk		0.0001
Total F and P	52.6	0.0001

The results show that 3 mediating variables were selected by the fit.
The three variables explained the contribution to the farming success by 87.13% as group alone.

10.2.3 The Dependent variables

Two dependent variables were selected by the fit and the results are presented in Table 10.5

Table 10.5 Result of the fit: $Y_{FS} = f(a + D_{DV})$

Dependent variables	Total R^2	P-values
Adoption of adequate fertilisation	0.6520	0.0001
Adoption of modern marketing		0.0001
Total F and P	50.20	0.0001

The fit does explain 65.20% of farming success when tested as group alone.

Table 10.6 Summary: R^2 values of different fits

Type of variables	Fit equations	R^2
Independent	$Y_{FS} = f(a + B_{IV})$	0.5003
Mediating (alone)	$Y_{FS} = f(a + C_{MV})$	0.8713
Dependent (alone)	$Y_{FS} = f(a + D_{DV})$	0.6520
Dependent, mediating & Independent	$Y_{FS} = f(a + B_{IV} + C_{MV} + D_{DV})$	0.8897

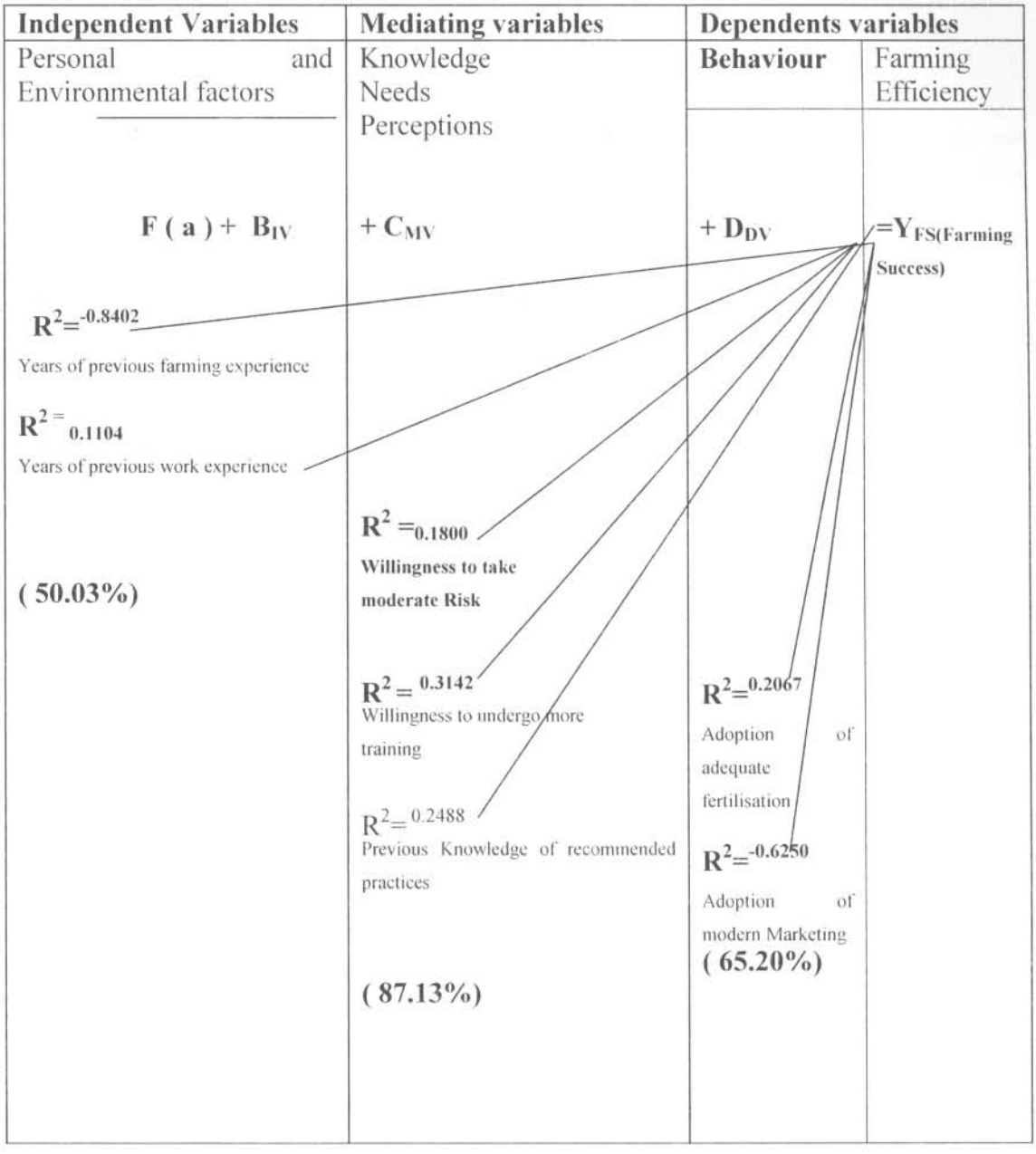
Independent, mediating and dependent variables selected by the fit:

$$Y_{FS} = f(a + B_{IV} + C_{MV} + D_{DV} + E_i)$$

In this regression analysis, all three groups of variables were tested against success, the number of initial independent variables were 8, the mediating variables were 20, and 18 dependent variables.
Through this procedure the farming success in Nkomazi sugar-cane production can be predicted by the use of the following prediction equation:

Y_{FS}= {f (0.1800 x Willingness to take moderate risk) + (0.3142 x willingness to undergo more training) + (0.2488 x Previous knowledge of recommended practices) + (-0.8402 x Years of previous farming experience)+
(0.1104 x Years of previous work experience) + (- 0.6250 x Adoption of modern marketing) +(0.2067 x Adoption of adequate fertilisation)= 88.97 percent (+Ei) ($P < 0.0001$)}

Table 10.7 Behaviour determinant's contribution to farming success in Nkomazi (2000)



The results of step-wise regression analyses in Figure 10.1 reveal tremendous differences in the influence that have the three group of variables: independent, mediating, and dependent on the farming success or farming efficiency.

The independent variables alone accounted for 50.03% of the total contribution to the variance of farming success, while the mediating variables accounted for 87.13% of the contribution to the variance and finally the dependent variables have accounted for 65.20% of the contribution to the variance of the farming success,

These results seem to single out the mediating variables as the best indicator and most important group of variables both in terms of variation accounted for as well as because it is the direct precursor of decision making, adoption behaviour and the resulting production efficiency.

Finally, in Table 10.8 the overall R^2 of the different variables: (independent, mediating, and dependent) that were selected by the fits and thus giving the percentage of prediction of farming success should this scale is used in the future selection of potential successful farm operators.

Table 10.8 Results of the fits YFS $= f(a + B_{IV} + C_{MV} + D_{DV} + E_i)$

Variables	Total R^2	Partial R^2	P-values
Willingness to take risk	0.18001771	0.0131	0.0115
Willingness to undergo more training	0.31427675	0.2005	0.0460
Previous knowledge of recommended practices	0.24884493	0.0042	0.1003
Years of previous farming experience	-0.84028226	0.0063	0.0215
Years of previous work experience	0.11047956	0.0058	0.0925
Adoption of modern marketing	-0.62504817	0.0041	0.0232
Adoption of adequate fertilisation	0.20673253	0.0035	0.0178
Total P			0.0001
Total F			52.41
Total R^2			0.8897

Given the above findings Table 10.8, one can thus with 88.97% of accuracy ($P<0.01$) predict whether a given farmer or selected farmer will be successful should he participates in a land allocation project. The scale can be used on existing farmers to determine what kind of intervention or attention that should be brought in for future implementation.

In Table 10.8, there is a scale for the selection of potentially successful small-scale irrigation farmers; this scale comprises seven variables that explain 88.97 percent of the total variation in farming success. There is another 11.03 percent that can be used to apply certain discretion or preferences in the selection procedure of farmers.
However these 11.03% of preferences are less likely to affect the scientific or statistical significance of the outcomes of the present scale.

CHAPTER 11
SUMMARY AND RECOMMENDATIONS

South Africa is a land with history of water shortage, which is one the major problems facing the South African Government particularly in view of the increasing population and expansion of the industry. In the field of agriculture, this increases the need for more rational water utilisation and efficient agricultural production. However, the settlement of small-scale farmers is a priority of the country. Therefore, for success in terms of sound management and production efficiency is of major importance.
Irrigation settlements in Nkomazi area of Mpumalanga are characterised by sugar cane yields that vary tremendously between small-scale producers. Some farmers are successful while others fail dismally. Identifying successful farmers and selecting the factors that have the potential on the efficient production is likely to have a socio-economic benefit in the less developed areas and for future farmers settlements schemes.

Based on theoretical exposition and literature survey it was hypothesized that:

- Managerial and farming success is dependent or function of certain personal and environmental factors (**1.1**)
- Behaviour determinants vary in terms of their contribution to the variance of farming success(**1.2**)

A total sample of 139 respondents of whom 104 farmers from Komatipoort and 35 from Malelane representing 10% sample of the overall farming population participated in the study.
Data collected in this study were processed by computer using Statistical Analysis System package (SAS) to determine frequencies, percentages, arithmetical and weighted means, chi-square values, correlations and step wise regression analysis. Several indicators were used namely: How do the characteristics of Nkomazi farmers and their farming operations affect their efficiency?, based on previous studies of irrigation farmer's behaviour and characteristics, total sugar production and average yield, annual gross farming income, risk index, level of solvency, farm operator age, gender, farm size, previous farming and previous work experience, land accessibility were taken into consideration and assessed in the study .

Generally, age of the farmers was lower than in the most rural South African areas, the majority of farmers in Nkomazi(52.43%) was in the 46-55years group and moreover the age of farmers does not contribute significantly to the farming efficiency because of a weak relationship ($r= 0.17209$ $P<0.06$).
These farmers have a previous farming experience comprises between 3-6 years coupled with some negligible to significant correlation between previous farming experience and farming success.
The independent variables as a group tested against the farming success has shown little direct influence on the farming success, they accounted only for 50.03% of the total contribution to the variance of farming success as stated in ***Hypothesis 1.1***
Meanwhile it was found that mediating variables accounted for 87.13% of the contribution to the farming success and therefore is the best indicator and most important group of variables both in term of variation accounted for as well as

because it is the direct precursor of decision making, adoption behaviour and the resulting production efficiency.
The finding justifies the conclusion that "behaviour determinants vary in terms of their contribution to the variance of farming success ***Hypothesis 2.2.***

Based on the overall findings and observations from the present study, it can be concluded that identifying successful entrepreneur farmers and selecting those with the potential to produce more efficiently and thus to emerge as commercial farmers is likely to have a beneficial socio-economic impact in the less developed areas and future farmers settlement schemes.
Amongst other things, it should provide for increased production of food and fibre, and local employment instead of having many people trying to seek a subsistence out on small holding at low rate of efficiency
The present study has shown that there is certainly a slight minority of small-scale sugar-cane farmers commercially oriented, farmers who have the necessary entrepreneurial and innovators / early adopters characteristics to make a success of large more viable farming enterprise.
By providing opportunities and incentives and using some of the criteria suggested in this study for farmer selection, it will undoubtedly be possible overtime to increase the number of successful and efficient black farmers in Nkomazi in particular and in South Africa in general.

Recommendations:

Considering the findings and conclusions drawn from the study as well as the observations made during the investigation in Nkomazi, the following recommendations are made:

1. It is recommended that formal liaison structures be established between all role players in Nkomazi, traditional leaders, farmers associations, Mpumalanga department of agriculture, the financial services providers, research and extension institutions, irrigation board and other stakeholders and contractors.

2. It is recommended that formal harmonisation be established between different institutions in order to avoid conflicting or contradictory extension messages.

3. Based on appropriate research recommendations, extension services should inform farmers of the availability and accessibility of services, guide them to make applicable decisions.

4. The general low agricultural development indices established in this study suggests much scope for improvement and calls for concerted effort to up-lift farmer's conditions, in this context rural leaders and institutional support need to play a key role.

5. Training is required to facilitate the development of managerial and technical skills needed both on-farm and at the project level.

6. A sound policy framework to provide an environmental conducive for productive, equitable and sustainable agricultural development.

7. It is recommended that there is a need to strengthen the local farmers associations and thus to have a farmer lobby system which allows the promotion of their interest in the political market.

8. The findings of this study should be made available to the head offices of both local and national departments of agriculture for their references in developing agricultural development strategies.

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APPENDIX: THE QUESTIONAIRE

FOR THE SURVEY STUDY OF THE FACTORS INFLUENCING THE SUCCESS OF SMALL-SCALE IRRIGATION FARMERS IN NKOMAZI (MPUMALANGA)

Name of Interviewer:

_____

Date of Interview:

_____

Name of the Scheme:

_____

Name of the Respondent:

_____

_____

1 How old are you? .....

2.Sex .....

3 Farm size.....

4 Total Years of farming experience.....

5 Total years of work experience and please indicate what kind of work.

6 What have you achieved in farming so far (as a farmer)

Code	Code
Cannot say anything at all	1
Has things to tell that make sense	2
Knows exactly his goals	3

7. What are your aspirations in farming? .....

8 How much Fertiliser have you been applying in sugar cane farming?

9 Distance to land (from farmers field)?.....

10 How do get to your field(s)

Way	Code

Not answered/ No comment	0
Walk	1
Taxi	2
Own transport	3
Other (bicycle	4

11. Time (How long does the trip take to complete)?

Time	Answer
Not answer/ no comment	0
<10 minutes	1
10,1-15 minutes	2
15,1-20 minutes	3
20,1- 30 minutes	4
30,1-60 minutes	5
> 60 minutes	6

12. Under which conditions would you settle on this project?
If question irrelevant:.....

If question is relevant.....

13. What is for you the importance of record keeping in farming?.....

14 Which factors prevent you from managing your farm better?.....

15.Entrepreneurship before joining the current project? .....

16 Business skill (Have you ever tried to sell anything for profit)? .....

17 (How much (%) of your time is spend in your farm goes into management activities).

18 To what extent are your aware and go along with traditional authority?

19 Willingness to listen to the advice of other farmers.

20 Membership (To how many organisations in your community do you belong?.....
.....

Risk assessment in Nkomazi

21 Page 6, top of the page

a) Take the total amount of the "assets at present" in the right hand column
b) Subtract from this amount, the total of the "liabilities at present" in the right hand column, below the "assets at present" column.
c) The result of the calculation is called the Net value of the farmer.
d) Now go to the " Loan amount " which is written in handwriting just after the sentence following this assets and liabilities column that you have just used. Subtract this Loan Amount " from the calculated "Net value"
e) Now take this calculated amount and divide it by the "Net value"- this gives the score
f) Take the score and multiply it by 31,43
g) This is the code that has to go into the database.

Total amount of assets at present – Total amount of liabilities at present =Net value
Net Value – Loan amount

Net Value – Amount =CODE
Net Value

22 Net Farming Income (annual Net Farming Income) is The CODE: amount mentioned

23. (Who should do the overall management of all the Nkomazi farming projects) CODE See (*)

(*) Codes for organisations
0= No answer / no comment

1=Government
2=MDC
3=Contractors
4=Eskom
5= we, the farmers to themselves
6= Dep. water Affairs
7= Hauliers
8= TSB
9= FAF

10= Mill Cane Committee 11= If any other organisations are mentioned, give next value

24 How should the overall management of the Nkomazi be done?

	Code
Not answered / no comment	0
Has no idea	1
Has idea	2
Has good idea	3

25. (Who should do the co-ordination of activities that concern all the Nkomazi) CODE (See (*)

26 who should do the management of your specific project) CODE: See (*)

27(Who should do the management of your specific project) Code: See (*)

28 (How should the management of your project be done) CODE: (*)

	Code
Not answered	0
Has no idea	1
Has idea	2
Has good idea	3

29 Who should do the co-ordination of activities that concern your project CODE: See (*)

Who should maintain the following bulk infrastructure off farm? CODE: See (*)

Infrastructure		(Org) Code
AD	Roads	1-10
AE	Pumps	1-10
AF	Weirs	1-10
AG	Elecline	1-10

AH	Canals	1-10
AI	Fencing	1-10
AJ	Pipes	1-10

Who should maintain the bulk infrastructure on Farm? Code: See (*)

Infrastructure on farm		Code
AK	Roads	1-10
AL	Pumps	1-10
AM	Sheds	1-10
AN	Shed fencing	1-10
AO	Offices	1-10
AP	Machinery	1-10
AQ	Equipment	1-10
AR	Pipes	1-10
AS	Canals	1-10

30 How important is the project clerk on your project?

Code: 0=not answered/no comment; 1= not important; 2 important; 3= very important

31 How many clerks should there be on your project: 0=not answer

Number mentioned =CODE

32 How efficient do you think is the project: 0=not answered/ no comment; 1=not efficient; 2= efficient 3= very efficient

33 Why clerk is efficient / inefficient

Reason has to do with	Code
No comment /no answer	0
Clerk's support structures (manager)	1
Clerk's office equipment	2

Clerk's training	3
Clerk's salary	4
Other	5
Combination e.g 1and 4=14	6

34 What can be done to improve the situation regarding your project clerk?

Reason has to do with	Code
No comment /answer	0
Improve clerk's support structures e.g (Manager)	1
Improve clerk's office and equipment	2
Improve clerk's training	3
Improve clerk'salary	4
Other	5

35 How much does the project clerk earn in terms of salary?
This amount is the code. If not answered, code is 00

36 How much should the clerk be earning?
This amount is the Code. If not answered, Code is 00

37Calculate the difference between what the clerks is earning and what farmer says s/he should be earning. This amount is the code (See *)

Codes:

0= no comment /no answer - 1= money – 2= Funding – 3=workshops

- 4= Markets – 5= If farmer mentioned another aspect, give a new number
- 6=, 7=, 8 = other A combination of codes may be used for more than one reason e.g. 134 and 1,3,and 4

38 What will assist and motivate your interest and ownership in Nkomazi (See Code in the box.

39 What will motivate and assist you and your local farming association (See code in the box.

40 What will motivate and assist your own farming activities (See code in the box).

41 Practices Adoption in Nkomazi

If not answered Code= 0		Codes	
		Yes	No
Soil preparation	BE (Variables)	1	2
Taking soil samples	BG	1	2
Fertilisation	BI	1	2
Scouting for pests	BK	1	2
Pest control	BM	1	2
Scouting for diseases	BO	1	2
Disease control	BQ	1	2
Irrigation scheduling	BS	1	2
Planting	BU	1	2
Cultivars selection	BW	1	2
Crop yield estimation	BY	1	2
Harvesting	CA	1	2
Marketing	CC	1	2
Financial record keeping	CE	1	2
Crop record keeping	CG	1	2
Pump maintenance	CI	1	2
Irr.System maintenance	CK	1	2
Weed control	CM	1	2

42 Previous knowledge of Recommended agricultural practices

If not answered Code= 0		CODES	
		YES	NO
Soil preparation	CO	1	2
Taking soil samples	CP	1	2
Fertilisation	CQ	1	2
Scouting for pests	CR	1	2
Pest control	CS	1	2
Scouting for diseases	CT	1	2
Disease control	CU	1	2
Irrigation scheduling	CV	1	2
Planting	CW	1	2
Cultivars selection	CX	1	2
Crop yield estimation	CY	1	2
Harvesting	CZ	1	2
Marketing	DA	1	2
Financial record keeping	DB	1	2
Crop record keeping	DC	1	2
Pump maintenance	DD	1	2
Irrigation system maintenance	DE	1	2
Weed control	DF	1	2

43 Willingness to undergo more training with regard to Agricultural practices

If Not answered Code =0		Codes	
		Yes	No
Soil preparation	BFBF	1	2
Taking soil samples	BH	1	2

Fertilisation	BJ	1	2
Scouting for pests	BL	1	2
Pest control	BN	1	2
Scouting for diseases	BP	1	2
Disease control	BR	1	2
Irrigation scheduling	BT	1	2
Planting	BV	1	2
Cultivars selection	BX	1	2
Crop yield estimation	BZ	1	2
Harvesting	CB	1	2
Marketing	CD	1	2
Financial record keeping	CF	1	2
Crop record keeping	CH	1	2
Pump maintenance	CJ	1	2
Irr.system maintenance	CL	1	2
Weed control	CN	1	2