THE DEVELOPMENT AND USE OF A BLENDED, ORGANICALLY BASED FERTILISER ON SUGAR CANE IN THE KWAZULU-NATAL MIDLANDS

by

DARRYL NEIL TWEEDALE

Thesis submitted in partial fulfilment of the requirements for the degree:

M.Agric.Admin. (Agricultural Economics)

in the

Department of Agricultural Economics
University of Stellenbosch

Study leader: Dr. J.P. Lombard

Stellenbosch
December 1999

DECLARATION

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

29 November 1999

SUMMARY

The main objective of this study was to investigate the potential production of a blended, organically based fertiliser for use on sugar cane in the KwaZulu-Natal Midlands. There has been a major increase in the application of unprocessed organic materials of various types within the region over the last three years. This has been ascribed largely to the soil conditioning properties of these materials and the benefits of their use which have been noted by farmers. However, it has emerged at the beginning of the study that very little literature or evidence of a concrete nature exists with regards to these benefits.

Due to a lack of existing literature with regards to the benefits of using manures as soil conditioners, the vast majority of the information collected was of a primary nature. Use was made of questionnaires, as well as personal and telephonic interviews for data collection. These methods of data collection resulted in information of a largely subjective and descriptive nature, traits which are evident in the presentation style of this information.

When considering the development of such a product, the following role-players were identified and included in the study: soil experts, sugar cane farmers, competitors within the organics industry, suppliers of raw materials (manure) and people involved in fertiliser processing operations. Information and opinions were obtained from these various sources and used to reach certain conclusions and to make recommendations.

While it was noted that no concrete definition exists for the term sustainable agriculture, it was determined that organic farming goes some way to promote sustainability. Thus, the use of organic material on soil is seen as beneficial to soil health and long term production - although only 43 percent of soil experts indicated the use of manures as a current promoter of sustainable production.

Contrary to this scepticism, it emerged that the use of organic material in the Natal Midlands regions is on the increase, with chicken litter, feedlot manure and filter cake the most popular organic materials applied. The limited availability of material, especially chicken litter, was identified as the most influential limiting factor.

Bearing this limitation in mind, a 30 dm^3 bagged, granulated product with a chicken litter base emerged as the most preferred by the potential consumers. It was explained by processors that while taking necessary structural and mechanical changes into account, producing such a product would be possible, but that production-wise a pelletted product would be preferred.

Sources of competition were identified at both input and output market levels, with the supply of raw materials as the major concern. It was further noted that in order to compete successfully, prices would have to be competitive, through correct formulation, and product benefits proven scientifically, especially with regard to soil conditioning characteristics.

OPSOMMING

Die hoofdoel van hierdie studie was om die moontlike produksie van 'n organiesgebaseerde kunsmismengsel vir die gebruik op suikerriet in die KwaZulu-Natal binneland te ondersoek. Daar is 'n toename in die gebruik van onverwerkte organiese materiaal op suikerriet in hierdie gebied oor die afgelope drie jaar waargeneem. Die verskynsel kan toegeskryf word aan die grondverbeteringseienskappe en ander voordele wat die gebruik van organiese materiaal vir die boere inhou. Dit het egter aan die begin van die studie reeds geblyk dat min literatuur of harde bewyse bestaan met betrekking tot hierdie verwagte voordele.

As gevolg van hierdie gebrek aan bewyse in die literatuur, is daar staat gemaak op primêre data. Vraelyste sowel as persoonlike en telefoniese onderhoude is vir die insameling van die data gebruik. Die metode van insameling het gelei tot inligting van 'n grootliks subjektiewe en beskrywende aard, soos ook weerspieël word in die aanbiedingstyl van die data.

Met betrekking tot die ontwikkeling van so 'n produk is die volgende rolspelers geïdentifiseer en in die studie ingesluit: grondkundiges, suikerrietboere, kompeteerders binne die organiese bedryf, verskaffers van grondstowwe en persone betrokke by die vervaardiging van kunsmis. Inligting en opinies is uit hierdie bronne verkry en is gebruik om sekere gevolgtrekkings en aanbevelings te maak.

Terwyl dit voorgekom het dat geen konkrete definisie vir die term "volhoubare landbou" bestaan nie, is daar gevind dat organiese landbou volhoubaarheid bevorder. Die gebruik van organiese materiaal op grond is dus as voordelig vir grondstruktuur en langtermyn produksie gesien, alhoewel net 43 persent van die grondkundiges aangetoon het dat die huidige gebruik van misstowwe volhoubare produksie bevorder.

In teenstelling met die skeptisisme, het dit geblyk dat die gebruik van organiese materiaal in die Natalse binneland aan die toeneem is, met hoendermis, kraalmis en filterkoek as die gewildste mistowwe. Die beperkte beskikbaarheid van mistowwe, veral hoendermis, is as die grootste beperkende faktor geïdentifiseer. Met hierdie

beperking in gedagte, het 'n verkorrelde, hoendermisgebaseerde produk wat in 30 dm^3 sakke verpak is, as die gewenste produk by potensiële verbruikers geblyk te wees. Kunsmisvervaardigers was van mening dat so 'n produk, met inagneming van strukturele en meganiese veranderinge, wel geproduseer kan word, maar dat 'n langwerpige, verpilde produk by produksie verkies sou word.

Bronne van mededinging is geïdentifiseer by beide die inset- en uitsetkant van die mark, met die aanbod van grondstowwe as 'n kernvraagstuk. Dit het verder aan die lig gekom dat om suksesvol te kompeteer, pryse mededingend moet wees. Dit kan slegs bereik word met die korrekte formulering van die mengsel en met wetenskaplik bewese voordele van die grondverbeteringseienskappe van die produk.

ACKNOWLEDGEMENTS

I would like to sincerely thank the following people and groups of people:

Dr J.P. Lombard, my study leader, for his guidance, assistance and support.

Agrifutura for their financial assistance.

Nitrochem Pty (Ltd) for their assistance, both financially and otherwise.

Soil analysts and consultants, competitors in the organics industry, raw material producers and especially farmers within the study region, all of whom supplied valuable information.

Mr Mike Wheeler, SASA Economist, for his assistance with the financial input-output analysis.

Mr Clinton Tweedale, Nitrochem Operations Manager, for his knowledgeable advice and support throughout.

Mr Geoff Maher, SASA Extension Officer, Midlands North, for his assistance with compiling a mailing list.

Mr William Gibson, Nitrochem, for sharing his knowledge concerning sugar cane production in the Midlands South region.

Mrs Taria Uys for her assistance with the typing, printing and other related aspects of thesis preparation.

My family, for their constant support, encouragement and patience.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIXES

CHAPTER 1
INTRODUCTION

1.1 Problem definition

As the world population increases, increased pressure is placed on the earth's natural resources. It seems to be emerging that the more primary the activity, the more the focus is on ways of becoming more sustainable. This perception stems mainly from the fact that primary activities are dealing first-hand with these dwindling natural resources. Agriculture, especially of a commercial nature, falls within this category and there is a major trend, especially in more developed countries, towards a more sustainable agricultural sector (Reeve, 1990).

Various alternative agricultures give different perceptions as to what is wrong and what is right with regard to sustainable production. Deciding which one is correct is open to endless discussion. What is known is that organic farming does help promote sustainability. It is here where this research has a role to play. The potential availability of around 72 000 tons of chicken litter close to Nitrochem's existing blender at Cato Ridge, KwaZulu-Natal (KZN), is a potential raw material source for a fertiliser blending operation. This has raised the question of the feasibility of using chicken litter and other organic manures as supplements to conventional chemical fertilisers on sugar cane.

The envisaged product to be developed and produced is one that will have an organic base with inorganic fertilisers blended in to make a more complete product both chemically and physically. This product will hopefully fill a niche market within sugar cane production. This niche has been created by many years of monoculture, which has had negative effects on soil condition in the KZN Midlands sugar cane growing region.

1.1.1 Background information as motivation for such a product

Due to the continuous monoculture style of sugar cane production in the KZN Midlands region, gradual soil degradation has occurred (Maher, 1999). This degradation has lead in turn to the increased application of inorganic fertilisers in an attempt to supplement soil nutrient levels and maintain yields - ideologies of the "green revolution". Unfortunately, a build up of nitrogen levels has occurred in these soils and this has lead to an acidity problem in most areas of the Midlands (Wittig, 1998).

In an attempt to combat this acidity, heavy applications of lime and gypsum were employed. While this did suppress the acidic nature of the soils, it proved costly and was not improving an integral part of soil health - its organic content. This aspect of soil health is of vital importance and especially so on sandier soils where fairly intensive agriculture is occurring with little or no replacement of organic material due to pre-harvest burning practices and inorganic fertiliser use (Wittig, 1998).

In previous years certain farmers were applying manures of various types to their lands, more as a means of waste disposal than anything else (Wittig, 1998). However, when the acidity problems in the area became noticeable through soil analysis and yield reductions, it was noted that the farmers who had previously applied manures were experiencing no such soil health problems (Wittig, 1998).

Thus was started the application of unprocessed organic matter to sugar cane by many KZN Midlands farmers on a large scale. Here was a potentially cheaper method of combating soil acidity, with the added benefits of improving soil organic content and nutrient levels simultaneously. It is important to remember at this point that the application of these organic materials was done as a supplementary measure to existing inorganic fertiliser application programmes. What did result, was a reduction in these inorganic fertiliser requirements (Wittig, 1998).

This raises the question as to whether a product could be produced which would have the characteristics of regular inorganic fertilisers combined with the soil conditioning properties of organic materials. This would lead to a single application resulting in a potential reduction in total application costs and perhaps a reduction in total fertilisation costs as well, while still achieving the desired results of high yields with healthier soils.

The opinions and inputs of many parties are needed when researching the development, production and distribution of a "new" product such as this. The following role-players were consulted during this study: soil scientists, analysts and experts were approached and questioned regarding present sugar cane production techniques in the Midlands and their opinions on the production possibilities of such a blended product. Potential raw material sources were investigated to ascertain present production levels and usage characteristics. Various possible sources of product competition were also investigated determining their product characteristics and raw material sources.

People involved in the processing of similar organic products were consulted together with existing blender management at Nitrochem, Natal. This gave some perspective on processing related factors. Finally, the target consumers were investigated. Data relating to present farming practices and the potential use of a blended product by the target market were collected.

All of these data are relevant and should be looked at closely when considering the development and production of a blended product, which will be new for both the processors of the product as well as its consumers. This is, however, just the tip of the iceberg, and more product related research (especially technically speaking) and specific marketing strategy development would have to be done. The information gained through this study is of importance though and provides a sound platform from which to begin.

1.1.2 Perceived product characteristics

The envisaged product should consist of a manure base with the addition of inorganic chemical fertiliser components to ensure a more balanced product in terms of nitrogen (N), phosphorous (P) and potassium (K) content. The decision regarding which product to use will depend on many factors including product availability, price, quality, physical and chemical characteristics, transport implications and consumer preferences.

The finished product should be in a form that will allow it to maintain its physical and chemical nature with the possibility of being altered in such a manner that a range of "different" products would be available for various application situations. This would most likely and easily be achieved through varying the amounts of inorganic materials added. It is important that the product is in a form which is convenient to handle and apply, and that the farmer is aware of exactly what he/she is applying and what the product will do for the crop. This means that a uniform, chemically standardised product is required. It is of vital importance that the benefits of using such a product be proven scientifically as there seems to be some uncertainty in this regard.

There are three major factors that will influence the product and its make-up. Firstly, raw material input considerations. Especially the cost, availability and transport implications of the manure base. Secondly, processing capabilities and limitations, and thirdly, consumer requirements and preferences. There are other important considerations, but these three are crucial in the feasibility and success of the product (Tweedale, 1998).

Organic farm wastes in their various forms have been used for literally centuries as soil conditioners and nutrient sources. Chemical fertilisers are almost seen as the basis of conventional agriculture, as we know it. What this study had as its main objective was a range of products which fall between these two extremes. In other words, a product that has many of the advantages of both extremes in one.

1.2 Research objectives

In an attempt to address the problem as defined, the formulation and investigation of sub-problems and objectives was necessary. This was done by considering factors which would have an influence on the main problem or study objective, i.e. the production of an organically based blended fertiliser in the KZN Midlands. These are as indicated below:

- A theoretical norm is established regarding sustainability as a term and a definition of sustainability is presented. A more practical outlook on sustainability is provided by soil scientists and experts.
- A parallel is drawn between the concepts of sustainable sugar cane production according to soil experts compared to that of farmers in the region. This is done by presenting the present farming techniques and practices employed by the farmers.
- The potential of using a blended organic product on sugar cane as primarily a soil conditioner in order to narrow the gap between what should be and what is, is investigated.
- Investigating the influencing factors relating to the development and production of such an organically based blended product.
- The presentation of important product characteristics to ensure customer satisfaction and possible improvements in sustainability of production.

These objectives were reached by carrying out an in-depth study into the present farming situation with regard to the sustainability or non-sustainability of especially sugar cane production as well as a look at present farming practices. This was followed by an investigation into the acquisition of the raw materials, the processing of the raw materials into a blended product and finally the distribution of the products to the end user and the consumption thereof.

1.3 Research procedures

The study began with a thorough literature study into the concepts of sustainability and organic farming. These concepts are largely interrelated which shows how complementary the two terms and practices really are. A common trend throughout is the absence of a concrete and definite definition for the concept of sustainability. In trying to find a suitable definition the only constant is the terminology's inconsistency.

Once an understanding was formed on the broad concepts of sustainability and non-sustainability and the various schools of thought found between these two extremes, interviews were carried out with various experts in the fields of soil science and soil analysis. An attempt was made to gain an objective picture of the relevant terms of sustainability and non-sustainability and what role organic farming has to play in this regard. The ultimate aim was to gain a study region based perspective which would be relevant and applicable to local environmental, social and economic conditions. This in-depth study into sustainability made up not only the practical basis for the research but also served as the theoretical grounding for the thesis.

Once the groundwork was completed the focus of the study moved to KZN. Primary data was obtained from the related parties in the fields of manure production, product processing and product distribution/consumption. The large majority of this data was obtained by making use of questionnaires and personal and telephonic interviews. The method of data collection was mainly dependent on budgetary considerations, time parameters and the types of data required as well as the number of people involved in the specific functions, namely production, processing or distribution.

The aim of these interviews was threefold: firstly to determine the present situation with regard to farming practices and the related sustainability of the sugar cane sector in the KZN Midlands. Secondly, to determine the possibility of establishing an "organic fertiliser" blending operation in KZN. And lastly, to try and determine factors which will influence the potential acquisition of such a product by the target consumer.

While much of the data was primary in nature, use was made of secondary or existing information. This is especially so in the section regarding the processing of the product. Much of the technical data was already available which enabled more time to be spent on the economics of the operation. Where data was not readily available or applicable, experts in the field of blending and processing were consulted.

With regard to other work and literature that has been prepared regarding the topic of organic material on sugar cane, it has emerged that very little data exists. Trials have been done at Cedara Agricultural College (Farina, 1998) and the Orange Free State University has a Centre for Sustainable Agriculture. The South African Sugar Association too have done some field work in this regard, but results seem inconclusive and largely pessimistic (Wood, 1981; Moberly and Stevenson, 1971).

1.4 Thesis structure

The structure of the thesis will be as follows. Chapter 2 will deal with sustainability. A relevant framework will be compiled, the various schools of thought regarding organic and inorganic farming practices will be investigated and certain relevant sustainability criteria will be laid down. The opinions of seven soil experts will also be included so as to gain a perspective regarding sustainability in sugar cane production in the study area.

Chapter 3 will introduce the area in which the study was conducted. Included will be a map of the region, a description of the geographic characteristics as well as the present farming practices and methods in sugar cane production in the study region. A cost structure for sugar cane production in the region will also be presented.

Chapter 4 deals with the acquisition of the raw material. Included here will be details on production areas, cost of acquisition, sources of competition and transport and storage implications. This information is based on the opinion of soil experts as to suitable materials for inclusion in such a product. These opinions are found at the beginning of that chapter.

Chapter 5 introduces possible sources of competition for the proposed product. The businesses, their products and their raw material acquisition characteristics will be presented.

Chapter 6 addresses the processing or blending of the product. This will include amongst other things, possible technological adaptations and associated costs, production costs, product descriptions and differentiation, transport implications and the costs of the final products.

Chapter 7 deals with the consumption of the final products. The target market and their needs and attitudes, transport implications, perceptions regarding possible advantages and disadvantages relating to the use of the products and potential sources of competition will fall under this section. Perceived product characteristics as seen by soil experts will also be included.

Finally, Chapter 8 will serve as a summary. This will include conclusions which have been reached and recommendations which could be made relating to the findings of the study.

CHAPTER 2

SUSTAINABILITY - A THEORETICAL FRAMEWORK

2.1 Introduction

The evidence of history makes it easy to describe agricultural practices that were not sustainable. It is a much more difficult matter to prescribe practices which are sustainable. As a result, definitions of sustainable agriculture have tended to define what it is not rather than what it is. This problem of negative definitions is added to by an increasing tendency for other terms both old (such as 'bio-dynamic' and 'organic') and new (such as 'ecological', 'biological', 're-generative', 'alternative' and 'low-input') to be used interchangeably with 'sustainable' (Reeve, 1990).

This chapter deals with the concepts of sustainability and alternative schools of thought surrounding sustainable production. From the above paragraph, it can be seen that the term sustainability has different meanings for different people in light of the constraints of the environment and the policy framework in which one is situated (Tollens, 1998). An attempt will be made in this chapter to conceptualise an applicable and relevant framework upon which to base the investigation into the sustainability or otherwise of sugar cane production in KZN (refer to Chapter 3). In order to make some sense of the terminology, some of the various schools of thought, dimensions and existing documentation relating to the sustainability of fertiliser usage will be discussed.

2.2 Factors influencing a definition of sustainable agriculture

Agricultural systems are sometimes defined with respect to one or more of the following: production possibilities (high or low potential, favourable or marginal), technological concentration (Green Revolution or complex and diverse), the readiness to adopt new externally induced or derived technologies (modern or traditional), the quality of available natural resources (resource-rich or resource-poor), and the use of external inputs (high or low) (Pretty, 1995).

Lockeretz (1988) pointed out that the inconsistency and confusion in terminology and definition may be due to a number of factors including:

- Fundamentally different concepts of agriculture are involved in the different terms but authors do not always choose the right term.
- The various terms more or less cover the same concept but new terms are coined to avoid negative images that might be associated with the older terms.
- The terms might be interchangeable in relation to particular practices, but not so in relation to fundamental concepts.

Lockeretz (1988) concludes that as sustainable agriculture is in its infancy, stability in terminology and definition will not be arrived at until greater intellectual rigour is applied, important conceptual questions are asked and answered, and fundamental principles developed and refined.

The terminology used when relating to sustainable agriculture in its many forms is often confusing and misleading. Sustainable development has implications different to those of sustainable agriculture and the various schools of thought have names and catch phrases which can be confusing (e.g. ecological agriculture, organic agriculture and biological agriculture). In the following sections we will investigate these concepts in an attempt to gain an understanding of the many spheres of sustainable agriculture.

2.3 Defining sustainable development

To facilitate an understanding of sustainable agriculture it is important to form a broad framework within which to work. The concept of sustainable development makes up a large part of this framework.

In the 1980s the objectives of development and environmental conservation were seen as contrasting and incompatible goals (Department of Environmental Affairs, 1992). It was accepted that a country could strive for either economic growth or environmental quality. This viewpoint was strongly contested however, and a "World Conservation Strategy" was drawn up. This strategy preached an integrated approach towards development and conservation. Development and conservation were viewed as equally important ingredients for human survival (Department of Environmental Affairs, 1992).

Sustainable development is defined as development which satisfies the present needs of a person or group of persons without endangering the ability of future generations to do the same. Following from this definition are certain criteria for sustainable development as laid out by the Department of Environmental Affairs (1992):

- The extension of planning horizons to the long-term.
- The need for social awareness between and within generations.
- Recognition of the value of both the natural and cultural environments.
- The concept of development is broadened to include and promote the economic, social and cultural dimensions thereof.
- The integration of the economy and the environment is stressed.

From the above it is easy to see why a concrete definition of sustainable development is so difficult to establish. Each one of the above criteria has different meanings for different people in different situations. However, it is important that some sort of understanding is formed to facilitate a study into the realms of sustainable agriculture.

To facilitate this understanding, sustainable development will be looked at as a collective group of dynamic problems relating to the economy, political, aesthetical, ethical and the scientific. These dimensions also represent the elements of welfare (Kleynhans, 1991). True development can then remain sustainable only if these elements are dealt with together in a dynamic and holistic manner, which according to Gharajedaghi (1985) are:

- The generation and division of economic welfare (economic dimension).
- The generation and division of power, authority and responsibility, as well as legitimacy (political dimension).
- The creation and spreading of beauty, as well as enjoyment and meaningfulness achieved through certain actions (aesthetical dimension).
- The creation and maintenance of peace, conflict solution and cultural respect (ethical dimension).

- The creation and spreading of information, knowledge and understanding (scientific dimension).

The dimensions outlook on sustainable development is further illustrated in World Resources 1992-93 (1992). This report on sustainable development identifies four critical, interacting dimensions, namely: economic dimensions, human dimensions, environmental dimensions and technological dimensions.

Moving toward sustainable development is demanding and will not be achieved without international co-operation, political will and improved policies. Policies will have to be adapted and enforced for all dimensions of sustainable development in order to facilitate a move in this direction. A policy of sustainable agriculture within the environmental dimension of sustainable development is of particular importance to this study. In the following section sustainable agriculture through sustainable development will be considered.

2.4 Sustainable agriculture through sustainable development

It is generally accepted that sustainable agriculture makes up at least a part of sustainable development. Although there is little consensus with regard to the definition of sustainable agriculture it will be seen how these terms do indeed share some common characteristics. Some of the problems with attempting to define sustainable agriculture have been touched upon previously, however an effort will be made to form a clearer picture of what this concept encompasses.

As sustainable agriculture has begun increasing in popularity over the last two decades especially, many authors have tried to plot its dimensions. Douglas (1985) identified three views of sustainability. The first, 'sustainability as food-sufficiency', exhibits characteristics much like those of what we know as conventional farming. This view sees increasing industrialisation, mechanisation, specialisation and chemical-intensiveness as the only means for sustaining an expanding and increasingly affluent world population. The second termed 'sustainability as stewardship', Douglas describes as a view that emphasises the maintenance of the integrity and quality of agriculture's non-renewable resource base, and of other natural systems upon which agriculture has an effect. 'Sustainability as community' describes a view that emphasises the cultural richness and social and economic well being in rural communities dependent upon agriculture.

A second approach has been proposed by Lowrance, Hendrix and Odum (1986), involving four hierarchical levels of sustainability:

- Agronomic sustainability - the ability of the field system to maintain acceptable levels of production over a long period of time.
- Microeconomic sustainability - the ability of the farm unit to maintain economic viability.
- Ecological sustainability - the ability of the catchment or land system to maintain the services that ecosystems provide (e.g. clean air and water).
- Macroeconomic sustainability - the ability of regional or national economies and institutional frameworks to continue to meet regional and national goals.

An important aspect of the above hierarchical structure is that sustainability at any level is affected by the state of the system at the level above. Also, sustainability at any level cannot be achieved without sustainability in the levels below.

These two views although different have definite connections. For example, the 'sustainability as stewardship' view of Douglas (1985) clearly overlaps with the ecological sustainability view of Lowrance et al. (1986). There is clearly more work needed in developing a detailed conceptual framework. Although relatively dated, the work of Douglas (1985) and Lowrance et al. (1986) is an acceptable initial reference into the dimensions of sustainability.

Although the above mentioned factors are necessary for a sustainable agriculture, they may not satisfy many of the more technical aspects thereof. This brings us back to the conceptual framework discussed under sustainable development, the economical, political, aesthetical, ethical and scientific dimensions of sustainability as discussed by Lyons (1993). In the following paragraphs we will touch on these aspects in an attempt to complete our understanding of the dimensions of sustainability.

- Economic considerations

The following considerations fall into this section: efficiency, stability and equality in the production, consumption, marketing and sharing of food, fibre, energy and wealth.

- Political considerations

These included considerations representing the degree to which agriculture succeeds in satisfying the communities needs with regard to power, legitimacy, authority, responsibility, influence, participation and ability.

- Aesthetic considerations

This is represented by the broad community's, agricultural employers' and farm workers' needs, within agriculture, for natural beauty, as well as their ability to carry out actions which will be meaningful and provide excitement and satisfaction.

- Ethical considerations

These considerations are represented by the challenge of appreciating the various value systems within agriculture, as well as the attempts of the community towards peace, integrity, good relations and companionship.

- Knowledge or scientific considerations

These considerations refer to the need for information, knowledge, insight, understanding and intelligence within agriculture. As mentioned in Section 1.3, there is little data available regarding the sustainability of sugar cane farming in South Africa and less on a blended organic product and its potential influence on this sustainability.

Leading from the above discussion and following this outlook on sustainability the concept of human welfare over the long term is seen as the central theme (Lyons, 1993). In other words, human behaviour or methods which inhibit the ability of agriculture to maintain human welfare, especially regarding the above-mentioned dimensions, over the long term are seen as non-sustainable. The above dimensions of sustainability also aid in placing the various, and often confusing, interpretations of sustainable agriculture in a logical framework in the form of a multi-dimensional concept. This allows a clearer picture to be formed of which considerations influence human welfare and thus which are sustainable and which not. This has obvious implications with regard to planning and organisation for all parties involved in agriculture.

Due to the multi-faceted, dynamic nature of the concept of sustainable agriculture, there exists a lack of a universal, consistent, objective norm for sustainable agriculture. Sustainability due to its inherent nature is extremely difficult to measure. There is constantly the danger that if quantifiable norms are used to measure sustainability, important non-quantifiable elements will be ignored. However the difficulty of including such concepts as understanding, welfare, happiness, beauty, empathy and self-satisfaction, which are of great significance to sustainability, can sometimes lead to their omission. For this reason, it is important that sustainability in its broadest sense is seen from the perspective of both quantifiable and non-quantifiable norms (Lyons, 1993).

The EUROSTAT (1997) report "Indicators of Sustainable Development" contains a long list of economic, social, environmental and institutional indicators of sustainable development, but does not specify at which level the indicators satisfy the criteria of sustainable development (Tollens, 1998).

Whether these ideals for sustainability are obtainable through various alternative agricultures is questionable. By way of an example, the work of Reeves (1990) is titled: Sustainable Agriculture: Ecological imperative or economic impossibility? This illustrates the uncertainty and scepticism which exists regarding alternative forms of agriculture. In the next section these various alternative schools of thought will be discussed.

2.5 Other schools of thought

It can be accepted that the use of the umbrella terms 'sustainable' and 'alternative' cover a wide range of agricultural practices, all of which seek to lessen environmental impact and ensure long-term viability. The 'sustainable' umbrella generally includes all ideologies, whereas the 'alternative' umbrella is generally seen as being restricted to those forms of agriculture with wholly or partially non-conventional ideologies.

The term 'alternative' suffers the disadvantage of being the opposite to 'conventional'. This has the effect of placing alternative agriculture in a bad light as seen by the general public. This is often an unfair and incorrect assessment, especially since the meaning of both terms is changing with time. Today's alternative practice may well be tomorrow's conventional practice.

2.5.1 Alternative agriculture

As mentioned this term is generally used as an umbrella concept for various forms of non-conventional agriculture. The National Research Council (1989) defined this umbrella term as: Any system of food or fibre production that systematically pursues the following goals:

- More thorough incorporation of natural processes such as nutrient cycles, nitrogen fixation and pest-predator relationships into the agricultural production process.
- Reduction in the use of off-farm inputs with the greatest potential to harm the environment of the health of farmers or consumers.
- Greater productive use of biological and genetic potential of plant and animal species.
- Improvement of the match between cropping patterns and the productive potential and physical limitations of agricultural lands to ensure long term sustainability of current production levels.
- Profitable and efficient production with emphasis on improved farm management and conservation of soil, water, energy and biological resources.

2.5.2 Low Input Sustainable Agriculture

Low Input Sustainable Agriculture or 'LISA' is characterised by the attempt to avoid the use of externally purchased farm inputs such as non-renewable or inorganic or synthetic inputs. The objectives are to use internal or farm produced resources such as rotation cropping to control weeds and pests, planting specific crops to provide soil nutrients and to preserve the soil, and using animal manure to enrich the soil (Ikerd, 1990).

Implementing LISA systems usually requires improved management and diversified knowledge which is normally achieved at a higher cost than would normally be the case. This means that the term 'low input' is not always a good indication of this ideology's objectives and meaning.

Note that American literature tends to be moving away from this terminology and using only the term 'sustainable agriculture' when referring to the traditional 'LISA'. Another term which is being used in an attempt to minimise any misunderstanding is 'LEISA', standing for Low External Input Sustainable Agriculture. This has arisen due to the fact that 'LISA' is not low in all inputs, but only those of an external nature.

Wagstaff (1987), in his review of lower external input agriculture systems, used the following definition:
"The terms 'conventional agriculture' or 'current practice' are used to refer to the reliance on high levels of use of chemical fertilisers, pesticides, fungicides and herbicides in crop production, and high levels of concentrate feeds in livestock production which predominate in most industrialised countries".

'Lower external input systems' are defined by Wagstaff (1987) in this review as farm production systems which use substantially lower levels of manufactured fertilisers, other agro-chemicals, fuels and purchased concentrate feed per hectare or per livestock unit than is typical of current production systems in industrialised countries.

2.5.3 Ecological agriculture

From a definition and description by Kiley-Worthington (1981), ecological agriculture is seen in terms of the maximisation of net returns per unit area on smaller, more diversified farms. It is here where this form of agriculture differs from the other schools of thought. Net returns are equivalent to gross returns minus inputs, bearing in mind that no more energy and nutrients should be removed as were applied. This has the effect of increasing employment and limiting capital investment. Another important characteristic is that farm produce should be processed and marketed on the farm itself and any profit must be a true profit, without any subsidies or state contributions. This term should not be confused with agroecology which is the scientific discipline relating to the ecology of agricultural systems (Reeve, 1990).

2.5.4 Biological agriculture

Biological agriculture differs from other alternative agricultures in that it takes the working of biological processes in natural ecosystems as its point of departure (Hodges, 1982). In other words, if natural processes and cycles are strengthened through the controlled use of inputs, soil fertility will be maintained and even improved. Pests and diseases will also be controlled. Because synthetic (chemical) inputs would negatively influence the working of the cycles, their use is prohibited in true biological agriculture. To ensure the continuation of the cycle, agricultural waste products should be re-incorporated into the system. Therefore, in order to be sustainable, diversified agriculture is seen as an important part of biological agriculture. The terms “biological-“ and “organic” agriculture are often seen as synonymous (Hodges, 1981). However, although very similar, they will be dealt with separately.

2.5.5 Regenerative agriculture

Rodale (1984) described regenerative agriculture in the following way:
“Nature - natural plant and animal systems - is regenerative when there is no agriculture. You can see natural regeneration in action when a farmer abandons a farm. When nature is allowed to take over land, the land improves, water is purified, and the air is cleaner. If nature can regenerate land and yield a fairly good surplus - which we have historically harvested - we, with all our brains, should be able to devise a new agricultural system that is similarly regenerative and will yield a somewhat larger return.”

Freudenberger (1986) states that:

"Regenerative agriculture attempts to maintain and improve the organic content of the soil, soil microbiological health, moisture capacity and biomass diversity. A regenerative agriculture cannot survive unless it is socially just."

Regenerative agriculture therefore supports the free workings of nature supported by the implementation of a mixture of annual and perennial plants and crops. In other words, monoculture especially is seen as damaging to the environment. It is believed that through following regenerative practices the need for soil workings will decrease, weed and pest control will become easier and water management will become more simple (Rodale, 1984).

2.5.6 Organic agriculture

Organic agriculture/farming (these terms are taken as synonymous) originated in the United Kingdom in the 1930s and 1940s from the ideas of Sir Albert Howard and Lady Eve Balfour (Howard, 1940 and Balfour, 1947), hence the name 'Howard-Balfour agriculture'. The International Federation of Organic Agricultural Movements (IFOAM) states the following objectives of organic agriculture (summarised by Vogtman, 1984):

- Organisation of the production of crops and livestock and management of farm resources so that they harmonise rather than conflict with natural systems.
- Development and use of appropriate technologies based upon an understanding of biological systems.
- Achievement and maintenance of soil fertility for optimum production by relying primarily on renewable resources.
- Diversification for optimum production.
- Pursuit of optimum nutritional value of staple foods.
- Use decentralised structures for processing, distributing and marketing of products.
- Strive for equitable relationships between those who work and live on the land.

- Create a system which is aesthetically pleasing for those working in this system and for those viewing it from the outside.
- Maintain and preserve wildlife and their habitats.

According to Lampkin (1990), "Organic farming has the potential to provide benefits in terms of environmental protection, conservation of non-renewable resources, improved food quality, reduction in output of surplus products and the reorientation of agriculture towards areas of market demand." In Nitrogen in Organic Wastes Applied to Soils (Hansen and Henriksen, 1989) we read: "Microbial turnover of the organic compounds in soil is often out of phase with the demands of the growing plants and is therefore difficult to manage."

Lampkin (1990) further defined organic farming as an approach to agriculture where the aim is, "to create integrated, humane, environmentally and economically sustainable agricultural production systems, which maximise reliance on farm-derived renewable resources and the management of ecological and biological processes and interactions, so as to provide acceptable levels of crop, livestock and human nutrition, protection from pests and diseases, and an appropriate return to the human and other resources employed".

As such, the objective of sustainability lies at the heart of organic agriculture and is one of the major factors determining the acceptability or otherwise of specific production practices.

The United States Department of Agriculture (USDA) carried out a study on organic farming, wherein the USDA (1980) described the basic principles of the organic ethic as:

- Nature is capital.
- Soil is the source of life.
- Feed the soil not the plant (important with regard to organic material use as dealt with in this thesis).
- Diversify production systems.

- Independence
- Anti-materialism

In summary, organic farmers seek to establish ecologically harmonious, resource efficient and nutritionally sound agricultural methods.

The term 'organic agriculture' has much in common, and is often confused with other forms of alternative agriculture, for example ecological, biological and bio-dynamic agricultures. Also, the fact that the produce produced using these other forms of alternative agriculture is often sold as purely 'organically grown produce'.

From the above it can be deduced that, basically, organic farming is separated from other forms of agriculture in that the use of inorganic fertilisers and chemical pest- and herbicides is not allowed and that 'life and purity' are seen as central themes. A study conducted by Kyriakopoulos and Van Dijk (1997) showed that consumers of organically grown products are willing to pay more for the products to receive these and other benefits such as environmental preservation, health attributes and quality. However, the production capabilities and benefits of such a system in a less affluent and food-secure country such as South Africa are questionable.

A main theme emerging from the above discussion is that of the use of renewable resources and on-farm harmony between and within enterprises. The use of organic wastes goes some way to promoting organic farming and thus sustainability. Obviously this practice does not define sustainable production, but it is a beginning at least.

2.6 Soil experts' opinions regarding sustainability

2.6.1 Introduction

Although an understanding of the theoretical aspects of sustainability and organic farming are important, it is just as vital to have a knowledge of the more practical aspects of these ideologies. The objective of this section is to present the opinions of seven soil scientists and consultants as obtained through personal, questionnaire (see

Appendix 1) based interviews. This is done in an attempt to transfer the overall view of sustainability as discussed above to one of a more locally applicable nature, especially with regard to sugar cane production in the KZN Midlands. The reason for including the opinions of these experts in the theoretical section of this thesis is due to the limited availability in the literature consulted of relevant theoretical/normative information.

The respondents were questioned on topics regarding sustainability and the present situation of sugar cane farming and its sustainability. The main objective was to bridge the gap between the philosophical and the practical. The information obtained was opinion based and thus subjective in nature.

2.6.2 Sustainability in commercial farming with special reference to sugar cane

The question was posed to the respondents as to whether sustainability is seen as important and feasible in commercial farming operations. All of the respondents said that sustainability was both important and feasible.

Reasons for these answers included:

- Without it the system will eventually become non-viable.
- Landowners are the guardians of the land and have an obligation to preserve it.
- Over the last 20 to 30 years sustainability has improved drastically and it has been done successfully in other parts of the world.

The respondents were then asked to give a definition of what a sustainable farming operation would incorporate in their opinions. The definitions had certain similarities and differences of opinion. The views expressed as well as the percentage of experts who shared that outlook are as follows:

- An operation which is economically viable and where profitability is sustained (71 percent).
- A system which minimises the effects of soil degradation while replenishing those resources which are being utilised (100 percent).

- A well-managed and properly co-ordinated agricultural operation (29 percent).
- A system with a long-term horizon (29 percent).

As can be seen in the above, the concept of soil conservation and improvement is seen as crucial by all the respondents, with sustained profitability being seen as the second most important aspect. Importantly, only one respondent mentioned specifically the replacement of organic matter into the soil.

The term, sustainability, was then applied to commercial farming, and the experts gave their impressions on sustainable agriculture. Opinions of the experts were sought regarding whether farmers see sustainable agriculture as important, and the reasons for these answers. Specifically if it is seen as important, what are they doing to improve the sustainability of their farming operations.

All of the respondents were of the opinion that commercial farmers see sustainability as important in their farming operations. It was their opinion that those individuals who do not see sustainability as important were not or would not be successful or progressive farmers. A fear of decreased production and profit and the change from the conventional being too costly and risky were offered as possible reasons for any negative outlook on sustainability.

With regard to what was being done by commercial farmers to improve the sustainability of their operations, the responses ranged from some doing nothing out of the ordinary and farming "sensibly", to others employing various methods to improve their soils for more sustainable production.

Four of the seven were of the opinion that efficient management and soil conservation practices were becoming more important. These practices include:

- Well planned and managed fertiliser and chemical applications.
- Higher inputs on higher potential soils and vice versa.
- Regular soil analysis.
- Lime application to combat nitrogen acidity.

Controlled use of external inputs was mentioned by two of the respondents. Both agreed that careful application, matching specific soil types is important in soil sustainability. Farina makes specific mention of increased control in nitrogen inputs.

Reduced or minimum tillage was mentioned by five of the seven respondents. One respondent went further to say that this is in specific reference to reducing production costs. Here the notion of economic sustainability versus physical sustainability is being touched on, which is in itself an interesting and relevant comment.

It is of especial importance to note that the use of manure as a soil nutrient source and soil conditioner was indicated by only three of the respondents as a current means of improving sustainability. It was indicated by two of the respondents that this practice was being employed especially by sugar cane farmers in the KZN Midlands, a valid point for the purposes of this study. Other measures mentioned for improving sustainability were:

- The use of sound conservation layouts.
- Greater use of lime.
- Crop rotation.
- The use of filter cake.

Reasons for farmers not consciously making an effort to improve the sustainability of their operations, even though the importance of sustainability is understood, are:

- A misunderstanding of the concept of sustainability and the perceived cost as possible reasons for this attitude.
- A fear of decreased production and profit and the perceived cost of changing from the conventional.
- A lack of an understanding of the concept by both farmers and advisors has lead to unintentional non-sustainability.

2.6.3 Sugar cane production and sustainability - the current situation

In this section soil analysts and experts were questioned regarding the current situation of sugar cane production and its sustainability, as well as how they perceive sustainability in sugar production can be achieved. Unfortunately three of the respondents felt that their knowledge of sugar cane production was inadequate to complete this section meaningfully and accurately.

Of the remaining respondents, all agreed that the soil conservation practices of sugar cane farmers in KZN were indeed moving towards sustainable production. In the opinion of the respondents, measures which could be implemented by these farmers to further improve sustainability are:

- 75 percent promoted the use of manure as a nutrient source.
- 25 percent stressed that balanced rather than low fertiliser inputs are important.
- 75 percent suggested minimum tillage.
- 100 percent said that leaving the sugar cane mulch (green versus burnt sugar cane harvesting) was of importance in promoting sustainability.
- 75 percent suggested the use of filter cake. It was noted that the distance of the farm from the sugar mill was a limiting factor in this regard.
- 25 percent suggested a more general approach in ensuring that correct/balanced conservation layouts are maintained.

Considering these opinions, the question was posed as to what would constitute an ideal sugar cane production practice in the KZN Midlands taking into account the sustainability of the industry, whether this ideal was realistically obtainable and how close the majority of producers are to this ideal at present.

"The successful cane grower is very much concerned with looking after his natural resources to achieve sustainability. Many decisions made by a grower are affected by soil type. These include effective systems of land preparation, such as minimum tillage to maintain the soil's physical properties, trash mulching to conserve moisture and planned conservation measures including strip cropping on steep land. His profitability will depend on how well he manages his soils and how well he knows their chemical and physical limitations" (Wood, 1998). Wood went on to say that the above ideal was obtainable and that the majority of producers within the study area are relatively close to this ideal at present.

"In much of the industry, there is a pressing need to reduce the levels of soil acidity. Greater lime use is a must. Better N management - the ultimate cause of the problem - will help, as will gypsum in some soils. In many others the only options available are deep ploughing to extend the effects of lime and heavy applications of manure. We are not yet sure about the mechanisms, but know that applications of three to six tons per hectare have a dramatic effect" (Farina, 1998). Farina feels that this ideal is obtainable, however, he feels that only a relatively small percentage are close to this ideal at present.

"The number one practice to promote is green cane harvesting, coupled with trash retention and minimum tillage and reasonably high fertiliser inputs (especially nitrogen and potassium). These alone will go some way to improve sustainability in sugar cane production" (Haynes, 1998). Haynes is also of the opinion that this ideal is obtainable, but that the majority of sugar cane farmers in the study area are not close to this ideal at all - mainly due to the fact that farmers are harvesting according to the mill requirements for burnt cane delivery.

2.7 Summary

In the first section of Chapter 2 the broad concept of sustainability was investigated. This began with a short introduction in which a brief history of sustainability was presented. Next an attempt was made to define the term 'sustainable agriculture'. This was approached by discussing and highlighting certain criteria necessary for sustainable development.

Then followed an overview of the dimensions of sustainable agriculture. The dimensions identified were as follows: economical, political, aesthetical, ethical and scientific dimensions. Each dimension was discussed briefly which provided a more understandable and orderly multi-disciplinary framework upon which to base a definition of sustainable agriculture.

Lastly, the various schools of thought regarding alternative forms of agriculture were investigated. These alternative systems all fall under the umbrella term of "sustainable". However, whether they are truly sustainable in their own context is a matter of much discussion. Certainly, according to the dimensions of sustainability, most of these systems have severe shortcomings. Although most address, directly or indirectly, the important aspects of profitability, conservation/preservation, social and environmental considerations, which are in themselves central to sustainability, this attention is not satisfactory or at all consistent between and within systems. Furthermore, addressing these points may be necessary for sustainability, but it is not sufficient.

Although most of these alternative systems preach a holistic inter-disciplinary approach none of them, individually or as a group, appear to present a complete conceptual framework for sustainable agriculture.

From this theoretical basis, experts were then questioned regarding their opinions around sustainability in general and the sustainability of sugar cane production in KZN. While there was agreement that soils are becoming degraded in the area, it became evident that the majority of producers are moving towards sustainable production and appreciate the importance of such an outlook. It was stated that a lack of understanding of sustainability by both producers and advisors had in some cases lead to unintentional non-sustainability. In their opinion, this situation is being remedied through general improvements in soil conservation, better N management, minimum tillage and green cane harvesting. The latter two measures seem to be in contrast to the solutions for problems associated with trash blanket effects on ratooning sugar cane. Importantly, only 43 percent of the respondents mentioned the application of organic material by farmers as a current promoter of sustainable production.

CHAPTER 3
A DESCRIPTION OF THE CURRENT SUGAR CANE PRODUCTION PRACTICES IN THE KWAZULU-NATAL MIDLANDS

3.1 Introduction

In order to gain a perspective of the study area and the topic and its implications it is important that a description of the current sugar cane production practices in the KZN Midlands growing region is supplied. Combined these areas supplied 14 percent of the total sugar cane crushed by mills in KZN during 1998, which indicates their relative importance within the industry (SASA, 1998a).

Included in this chapter will be a physiographic description of the area itself and an example of a typical production programme for sugar cane in these regions. This will include the presentation of some of the data gathered from current farmers in the study region. This data includes more specific information regarding fertilisation and soil conservation practices. Finally, a cost breakdown of a typical sugar cane production unit is presented.

The decision to present the information in the manner it is in this chapter is based on the nature of the data. The data is largely subjective and is collected using ordinal rank scale questionnaire type questions. After consulting various sources regarding the matter it became evident that the most suitable and understandable method of presentation would be using primarily graphs and tables. Multi-dimensional scaling is inappropriate due to the large number of product properties and characteristics (Lehman, 1989).

In Figure 3.1 a map of the study region is presented. This provides a spatial appreciation of the farming regions, raw material production areas and locality with regard to Cato Ridge, Pietermaritzburg and Durban, KZN.

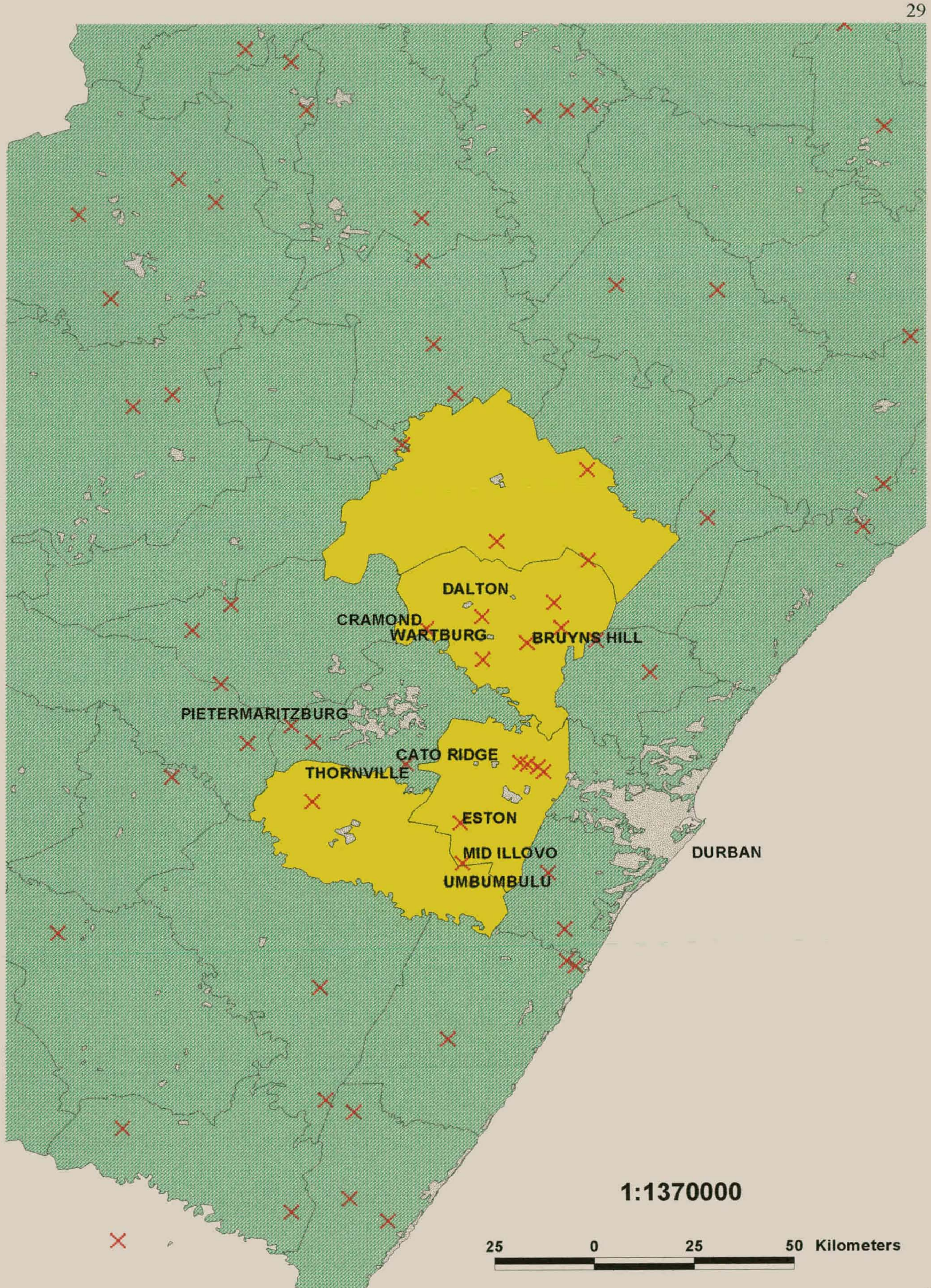

Figure 3.1: A map of Natal Midlands North and South

Source: GPS MAPPING. 1998. Farm Mapping Services, Howick.

3.2 A spatial and physiographic description of the study area

The area that falls into the study region is known as the KZN Midlands growing area. This region is further divided into Midlands North, Midlands Central and Midlands South. Generally, Midlands North and Central are dealt with together and fall under Midlands North.

Midlands North consists of the following main districts: Cramond, Bruyns Hill, Wartburg, Dalton, Bishopstowe with mills at Noodsberg and Dalton. It constitutes an area of approximately 52 000 hectares. Midlands South incorporates the districts of Umbumbulu, Beaumont, Thornville and Eston, which is also the location of the mill. The area covered is approximately 27 000 hectares (SASA, 1998b).

The reason for the study being carried out in these regions specifically is threefold. Firstly, it is in these regions that farmers are moving increasingly towards incorporating the use of organic material into their production. The reasons for this will be discussed later in this chapter. Secondly, these areas are ideally situated with regards to the proximity of the proposed blender site at Cato Ridge. Due to the nature of the product the transport implications are far reaching and of significant importance. Thirdly, sources of the raw materials are also situated in this greater region which again influences transport considerations of these raw materials as well as acquisition side characteristics.

3.2.1 Midlands North

The Midlands North region is situated at an average elevation of between 750 and 900 meters above sea level. The area enjoys an average yearly precipitation of 962 millimetres. The mean annual temperature is 17 degrees Celsius with a mean maximum of 32 and a minimum of 10 degrees C (SASA, 1998b).

The heat units over the main growing period (November to March) total 1 500 units which is relatively low with regards to sugar cane production. This shortage of heat units lengthens the growing period fairly substantially with the result that the crop has a two-year growth period from harvesting/planting till harvesting. The yields in the area average around 100 tons of stick cane per hectare harvested. The payment for the sugar cane delivered is based on the sucrose yields of the sugar cane. Ordinarily the sucrose yield is approximately 14 percent of the total yield. This figure does vary and is dependant on time of harvesting, time taken from off the farm to the mill and variations from season to season due to climatic differences, amongst other reasons (SASA, 1998b).

3.2.2 Midlands South

The Midlands South region is very similar to the Midlands North area. They are geographically close to one another in proximity and therefore also similar physiographically. In fact, from the centre of Midlands North to the centre of Midlands South is a straight-line distance of about 60 kilometres.

Midlands South is also at an elevation of between 750 and 900 metres above sea level. The average yearly precipitation is 862 millimetres, slightly less than Midlands North. It too is a summer rainfall region which means the growing period falls from November to March. During this time heat units total 1 500 units which once again is relatively low resulting in a two year growing period (SASA, 1998b).

Yields in the area average from about 100 tons per hectare of harvested cane, right up to 140 tons in exceptional years. Sucrose levels once again average 14 percent, but do vary. This is further proof of the similarity between the areas, which accounts for the uniformity in many aspects of sugar cane production.

Although these areas are very similar in nature, they will be dealt with separately in this study. The reasons for this decision include the differences in farmer psyches, the size and production capacity differences between the areas, with Midlands North supplying 2 021 090 tons of crushed sugar cane in 1996/97 and Midlands South supplying only 927 458 tons (SASA, 1998a) with per hectare yields as mentioned above, and the differences in current organic material usage practices.

3.2.3 An overview of production for the KZN Midlands - background information

3.2.3.1 Planting

Sugar cane is planted as seed cane roughly every ten years. This is due to the return of five ratoons on a two yearly growth cycle per planting. This equates to the farmer having to plant one tenth of his land per year if he maintains his management schedule. Land preparation occurs in May. This involves disking, ploughing or ripping for land preparation and to expose the remaining seed and in so doing kill any growth.

Planting occurs in September mainly with some being done in February/March. The latter is not commonly practised as the sugar cane is then emerging through the dry winter months. The planting rate is between 10 to 12 tons of seed cane per hectare, which takes approximately 14 man-days per hectare. The furrow is pulled mechanically and the seed is planted by hand. It takes approximately two years for the sugar cane to be ready for harvesting (Gibson, 1998).

3.2.3.2 Fertilising

A common characteristic of the KZN Midlands soils is their poor phosphorous (P) fixing capabilities. For this reason when planting one should aim for a maximum of 60 kg P in the furrow. In other words 600 kg when planting with 2:3:4 (30) inorganic fertiliser blend at a maximum application rate of 6 to 8 tons per hectare. Once the sugar cane emerges, top-dressing is carried out with a blend of between 1:0:1 and 2:0:3.

For ratoon sugar cane top dressing is obviously more important as the plant is not receiving fertiliser as it would through planting. Rates of nitrogen application should vary between 100 to 120 kg per hectare going right up to 160 kg on sandy soils (less than 15 percent clay). P varies between 30 to 40 kg per hectare with potassium at about 150 kg per hectare. Possible blends would be 3:1:4 on soils with more than 40 percent clay content, 4:1:6 on soils with a 30 percent clay content and up to 5:1:5 on sandy soils.

Organic material is becoming increasingly popular as both a soil conditioner and nutrient source especially in the Midlands North region. Chicken litter, battery manure and feedlot manure are the most popular materials applied at present (Gibson, 1998).

3.2.3.3 Harvesting and yields

Harvesting in the Midlands occurs between April and January. This is due to a number of reasons including the following (Gibson, 1998):

- The sugar mills open only over this time of the year to correspond with the ideal harvest time.
- It is the ideal time because it is relatively dry climatically which aids in transporting and harvesting.
- Sucrose levels of the sugar cane are at their highest. While the sugar cane is growing sucrose levels are diluted. However, during the dry months the sugar cane stops growing and begins building up and storing its sucrose reserves thus increasing the sucrose yields. In an attempt to realise maximum sucrose yields, some farmers induce an artificial ripening of the sugar cane by applying chemicals.

Almost all of the harvesting is done manually. Mechanical harvesters are available on the market, however these machines are extremely expensive and are at present largely unsuited to South African coastal conditions. The main reasons for this are (Gibson, 1998):

- The undulating and steep nature of most of the land upon which the crop is grown.
- The economic position of the country and consequently its people including farmers.
- Most importantly the sugar mills cannot handle the sugar cane in the form in which the harvesters deliver the product (the harvester cuts the cane sticks into relatively short lengths).

The yields per hectare in both areas are usually very similar due once again to the closeness of the regions both in locality and climate. Yields can range from as little as 80 tons of sugar cane per hectare in a bad year right up to 140 tons per hectare harvested in a good year. The largest single influence on yield is climatic variations and more specifically rainfall. The Midlands growing regions are heavily reliant on rainfall as at least 90 percent of all sugar cane production in the areas is dry-land (Gibson, 1998).

3.2.3.4. Varieties

As with most crops various varieties are developed which have different characteristics and are more suited to certain regions than others. Sugar cane is no exception and ongoing research into varietal improvement is carried out at the Experimental Station at the South African Sugar Association near Mt. Edgecombe in KZN.

By far the most grown variety in the Natal Midlands is variety N12. This is due to the plant's tolerance to acidity which is a problem in the inland soils. N12 makes up at least 75 percent of the total, with three other varieties making up the difference. N16 and N21on dry land plantings and N14 being under irrigation.

Other important differences between varieties include: drought resistance, water tolerance, slight differences in sucrose levels and canopy formation characteristics, which can be important where weeds are a problem and resistance to disease and parasites (Gibson, 1998).

3.3 KwaZulu-Natal Midlands North current sugar cane farming practices

3.3.1 Midlands North breakdown

From the Midlands North region there were a total of twenty respondents from the thirty mail questionnaires (see Appendix 4) sent. This is a 66,7 percent return rate which is very good indeed. Combined, the twenty respondents farm an area of 7 377,0 hectares, with an average farm size of 368,85 hectares. The smallest farm included in the data is 150,0 hectares, while the biggest is 965,0 hectares.

Per area, there were five respondents from Bishopstowe and Wartburg, eight from Dalton and one each from New Hanover and Hilton. Although more respondents would have been ideal, the spread is satisfactory. The fact that only one respondent came from the areas of Hilton and New Hanover is due to the fact that these areas are on the outskirts of the sugar cane producing region. The majority of sugar cane in the Midlands North region is grown in and around the Dalton and Wartburg regions (Maher, 1999), this is a possible reason for the higher numbers of questionnaires received from these areas.

Respondents were chosen on a random basis with the help of the Midlands North SASA Extension Officer (Maher, 1999). As can be deduced, a fair representative sample of farmers and farms was the objective and ultimately this was indeed achieved.

3.3.2 Current farming practices

The first part of the questionnaire mailed to the respondents dealt with on farm practices, which have an effect on soil conservation, fertilising practices and subsequently sustainability.

Regarding the use of manures/organic material on sugar cane, 75 percent of the respondents use some form of organic fertiliser on their sugar cane compared to the 25 percent who do not. Reasons for the use of the materials will be discussed later in this chapter, however, reasons for not using organics included:

- Logistical/transport considerations.
- Absence of a cost affective means of application.
- Unavailability.
- High levels of organic N pushing Eldana to unacceptable levels.
- Soil organic content already satisfactory.

The respondents were then questioned as to whether they burn their sugar cane before harvesting. All the respondents burn for the following reasons:

- Transport cost effectivity.
- Sugar mills will not accept unburnt sugar cane (burning decreases the fibre content going through the mill).
- Ease of harvesting (increased labour productivity).
- Trash blanket keeps soil too cool in winter months, which negatively effects ratooning.

It is important to note here, that according to (Haynes, 1998), a soil scientist at the University of Pietermaritzburg, green cane harvesting rather than burning is the number one practice to promote to improve the sustainability within sugar cane production. However, if one looks at the number and validity of the reasons for burning sugar cane prior to harvesting, green cane harvesting seems highly unlikely due to both economical and physical aspects.

The respondents were then asked whether they considered their farming practices to be working towards long term sustainability. In response, 90 percent said that their farming practices were sustainable, while the remaining 10 percent did not respond. Reasons for this opinion of sustainability varied widely and were of particular value when keeping in mind the theory of sustainability and the opinions of the soil analysts and experts discussed in Chapter 2. These reasons included:

- Increased yields per hectare.
- Annual yield comparisons make it evident.
- Improved ratoon cycles.
- Visible improvement in cane crop.
- Use of combination of organic and inorganic fertilisers.
- Sound soil conservation practices.
- Reduction of soil acidity.
- Use of organic material.
- Crop rotation practices.

From the questionnaires, an increase in seasonal yields seems to be the most important aspect relating to sustainable production. Few of the respondents added a time horizon, which does question the validity of this viewpoint. However, the above aspects do highlight the different focal points between farmers, soil scientists and textbook theory. Farmers are understandably more concerned with yields and physical evidence of "sustainability" than with the theory thereof.

3.3.3 Current fertilising practices

In this section data is generated regarding fertilising materials, their costs and the reasons for their use. This has a more objective bearing on the soil conservation implications and the economics thereof for the farmer.

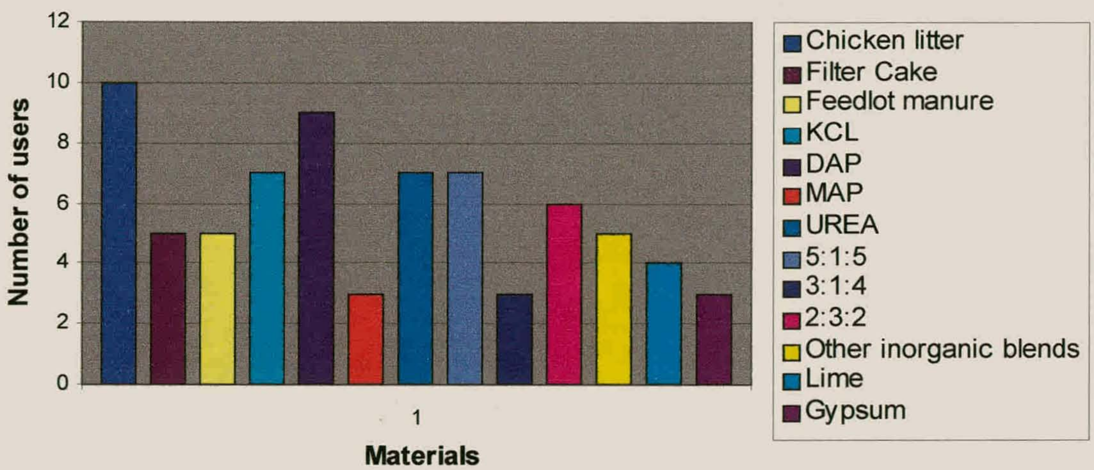

Figure 3.2: Number of users per fertilising product for Midlands North

As can be deduced from Figure 3.2, amongst the organic materials chicken litter is by far the most used fertilising medium. DAP (di-ammoniated phosphate) is the most commonly used inorganic fertiliser followed by KCL (potassium chloride).

Figure 3.2 shows purely the number of farmers using each product, without taking amounts or cost into account. If this is converted to an average expenditure per farm where the products are used, then the products rank as indicated in Table 3.1.

Table 3.1: Material usage based on average farm expenditure per product per year for Midlands North

Material	Number of users	Average farm input per year (R)	Average cost per ton incl. Transport (R)
1. Chicken litter	10	200 112,50	117,53
2. 5:1:5	7	51 666,67	1 295,03
3. KCL	7	38 800,00	1 153,28
4. Feedlot manure	5	38 750,00	61,08
5. Urea	7	35 000,00	1 062,81
6. DAP	9	15 142,86	1 705,64
7. Filter cake	5	10 000,00	10,38

From Table 3.1, it can be seen that chicken litter is once again at the top of the list with regards to farm input per year for those farmers using the product. This can be ascribed to the product's sudden popularity and the large quantities that are being applied. DAP has fallen down the list and this can be ascribed mainly to the high price of the product. This means that although there are a number of farmers using the product it is being used rather sparingly due to its higher nutrient content. Feedlot manure and, more so, filter cake are cheaper products with the bulk of their cost being made up by transport (100 percent in the case of filter cake). The fact that these products are being used by farmers close to their sources, minimises transportation costs, which has a depressing effect on the average total expenditure per farm. However, the high application rates of these products have an opposite effect on cost per hectare (see Table 3.3).

As calculated from Table 3.1 the total farm average for all the farms and all products was R209 212,50 only R9 100,00 more than the farm average for chicken litter alone. This goes some way to illustrate the emphasis and importance placed upon the use of litter to those farmers who are using it on their sugar cane. It is important to keep in mind the application rates of the materials when making these comparisons.

An important aspect of product usage revolves around factors relating to the decision to apply one product and not an alternative product. In other words, what makes one product have an advantage over another, similar or dissimilar product, in the opinion of the farmer. The respondents were asked to rank certain criteria which influenced this usage decision, from most important (1) up to least important (5), in their opinions. The results are illustrated in Figure 3.3.

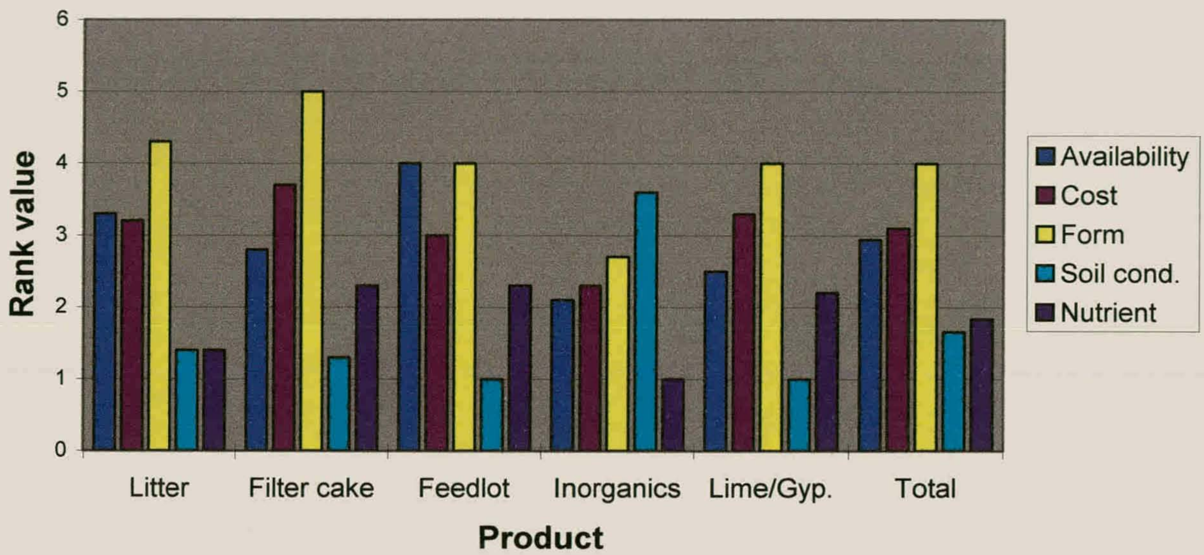

Figure 3.3: Average ranking of decision criteria per product for Midlands North

From Figure 3.3 above, it can be deduced that for chicken litter, the soil conditioning properties and the nutrient value of the product are seen as the most advantageous aspects of using the product. The cost of the chicken litter is seen as the third most important, closely followed by the availability of the product which has been stated as a problem area in chicken litter acquisition. The form of the product is seen as its least advantageous aspect.

The advantages of using filter cake rank as follows: soil conditioning properties, nutrient value, product availability, cost and finally the form of the product where it was ranked last by all the respondents using filter cake. Feedlot manure also had soil conditioning properties as its biggest advantage, followed by nutrient value, cost and lastly form and availability.

The inorganic fertilisers ranked rather differently, as one would expect. Nutrient value was by far the most advantageous aspect of using inorganics, followed by their availability, cost and form, which were closely ranked. The product's poor reputation as a soil conditioner makes this aspect its least advantageous characteristic. Lime and gypsum again scored highly as a soil conditioner - due largely to their use as combat measures against soil acidification.

From all this it can be deduced that the organic products rank highly in their ability as soil conditioners, an important advantage in the Midlands with the soil acidity problems. This trend is made evident in the "Total" column, where an average ranking is taken from the criteria of all the products, thus showing a positional ranking relative to the other products. However, the form of these products is seen as problematic, especially filter cake. Lime and gypsum too followed this trend, which is expected due to their soil conditioning natures. An interesting observation is the high regard the respondents have for these organic products as plant nutrient sources. The inorganic fertilisers ranked poorly as soil conditioners, which is to be expected, with the products' nutrient value as its biggest advantage.

The storage and use characteristics of the various products are of relevance, especially when considering possible social and environmental implications. The respondents were questioned regarding the storage of these products, the subsequent usage thereof and any resulting social or environmental implications.

Table 3.2: Storage characteristics of fertilising products for Midlands North

	Heaped in field	Heaped at central site	In shed, bagged	Average storage time (days)
Litter	40%	60%		100
Filter cake	100%			24
Feedlot	100%			42
Inorganics			100%	135
Lime			100%	50
Gypsum		100%		15

From Table 3.2 above, the various storage methods of the different products and what proportion of the products are stored as such is determinable. Although these methods are of importance and vary with especially the value and form of the product, it is the average number of days stored which is of real relevance. The trend which seems to emerge is that the higher the value of the product, the longer the average storage time. This goes from filter cake at 24 days, right up to inorganic fertilisers at 135 days. This can be ascribed to taxation influences and price fluctuations, with the goal as minimisation. The form of the product is important, meaning that a bagged product will keep for much longer than one left loose in an outside heap.

3.3.4 Organic material application characteristics

Application characteristics were narrowed to those using organic material. Out of the 15 qualifying respondents, 100 percent applied the material themselves, with two also making use of contractors for application. The manure is spread using three methods: mechanical spreader, dumped and graded and hand broadcast.

The application characteristics per material and the related costs are presented in Table 3.3. Looking ahead to this table, there is a calculated difference of some R1 284,40 per hectare between the two application methods for filter cake (mechanical spreader versus grading). It is important to consider the effectiveness of both methods when justifying this increased cost. The inaccuracies of grading the material onto the land could counter-balance the increased cost of mechanical application. Conversely, the argument is whether the added expenditure is justified when applying such large volumes of a cheap material. With double the number of farmers spreading the material mechanically, compared to dumping and grading, it would appear that the added cost is validated.

From the calculations in Table 3.3, it is evident that chicken litter is far and away the most cost effective of the three organic materials with regard to application costs per hectare. This is in contrast to expectation when looking at the cost of the materials, chicken litter being the most expensive.

Table 3.3: Application characteristics per material and associated costs for Midlands North

	Chicken litter	Filter cake	Feedlot manure
Application method and cost (R per ton)			
• Mechanical spreader			
Overall average	R24,50	R18,50	R21,25
Contractor	R30,00	R20,00	R25,00
• Dumped and graded			
Own application	N/A	R5,50	N/A
Application rates (tons per ha)			
• Planting	10,3 tons	98,8 tons	65 tons
• Ratoon	7,9 tons	N/A	22,5 tons
Material cost (R per ton)	R117,53	R10,38	R61,08
Total application cost (R per hectare)			
• Mechanical spreader			
Planting – Overall average	R1 462,91	R2 853,34	R5 351,45
- Contractor	R1 519,56	R3 002,58	R5 595,20
Ratoon – Overall average	R1 122,04	N/A	R1 852,43
- Contractor	R1 165,49	N/A	R1 936,80
• Dumped and graded			
Planting - Own application	N/A	R1 568,94	N/A

Reasons for the turnaround in application costs described on Page 49 include:

- Levels of N, P and K per ton.
- The form of the products.
- Application rates per hectare.
- Deceptively high transportation costs.

These factors are all inter-linked and have a bearing on one another. For example, the levels of N, P and K affect application rates and the form of the product affects transportation costs.

Due to the raw nature of organic products, there are bound to be environmental and social implications regarding the storage and use of such products. For Midlands North, of those using organic materials, these implications are listed below.

Percentage of users with storage related implications and implication description:

- Social - 46,7 percent
  - flies and smell
- Environmental - 33,3 percent
  - flies and runoff

Percentage of users with use related implications and implication description:

- Social - 53,3 percent
  - flies and smell
- Environmental - 40,0 percent
  - flies, runoff and water pollution

It is important to note that not much can be done regarding the minimising of these implications. The smell decreases after rain and flies are sometimes sprayed with chemical pesticides, which is done at an average cost of R1 050,00 per farm per year. Other non-cost measures include incorporating the material into the soil and applying the material as soon as possible to minimise storage time.

3.4 KwaZulu-Natal Midlands South current sugar cane farming practices

3.4.1 Midlands South breakdown

There were a total of 14 respondents from a total of 25 mail questionnaires (see Appendix 4). This is a return of 56 percent, which is good. It would have been preferable to have more respondents, for obvious reasons. The respondents farm a total area covering 4 168,5 hectares, with the average farm size being 297,75 hectares. The smallest farm measured 150,0 hectares, with the biggest at 722,0 hectares. The respondents were chosen on a random basis with the help of the previous SASA extension officer. The objective was to obtain a representative sample, which was achieved (Gibson, 1998).

3.4.2 Current farming practices

The respondents were questioned regarding their current production practices. It is evident from the data that 64 percent of the respondents use a form of organic material, as opposed to the 36 percent who do not. Reasons for not using organic material include:

- Limited availability of material.
- Inconvenience of use.
- Transport implications.
- Bulkiness of the product causing storage and application difficulties.
- Lack of conclusive research into product advantages and disadvantages.
- Additional costs associated with product use.

Further, 100 percent of the respondents burn their sugar cane prior to harvesting. Reasons for this are:

- High transport costs for unburnt cane.
- Trash blanket keeps soil too cool in winter months, which negatively effects ratooning.
- Ease of harvesting, resulting in increased labour productivity.
- Green material increases fibre content and decreases sucrose percentages.

Following from this, farmers were asked whether they would consider their production systems as sustainable in their opinions. Of the respondents, 11 said yes, one was undecided and one said no. The reasons supplied for the sustainability of these systems were:

- Decreased production costs per hectare.
- Increased yields per hectare.
- Improved soil structure through soil conservation.
- Use of new fertilising and production technology.
- Annual yields maintained over time.
- Effective fertiliser application.
- Use of organic material.

As for Midlands North, yield increase was seen as the most important factor, followed by sound soil conservation practices for the perceived sustainability of the production units. These outlooks vary largely with the more traditional/theoretical definitions of sustainability as described in Chapter 2.

3.4.3 Current fertilising practices

Data relating to the current fertilising products used, their costs and reasons for use are presented in this section.

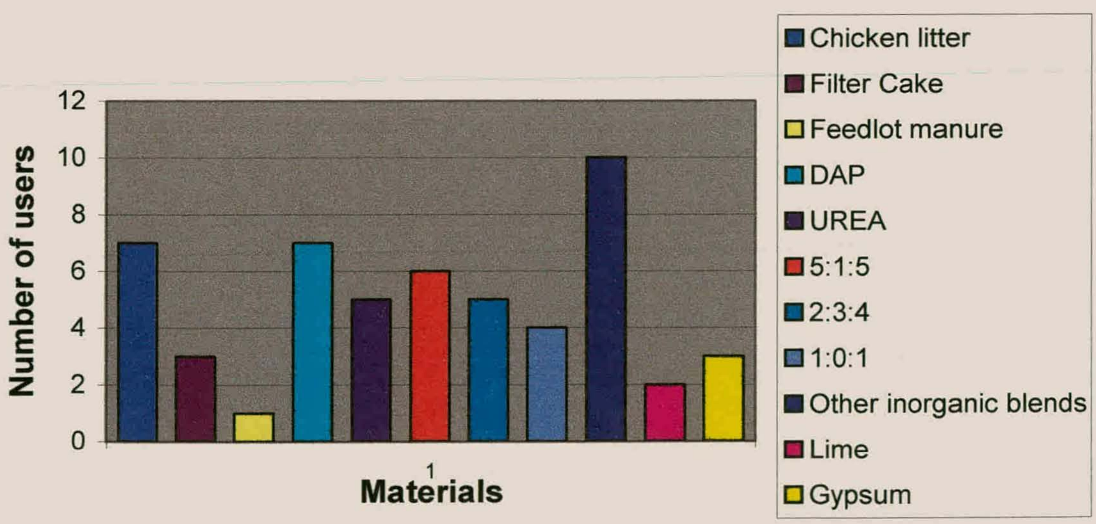

Figure 3.4: Number of users per fertilising product for Midlands South

Disregarding "Other blends" one can see in Figure 3.4 that chicken litter is once again the most widely used organic material. DAP is the most commonly used inorganic fertiliser, closely followed by 5:1:5.

When basing the usage popularity on the average expenditure per year per fertilising material per farm where the specific product is used the order is as in Table 3.4 below. From Table 3.4 it can be seen that 5:1:5 and urea are the most spent upon fertilisers. This is in sharp contrast to the situation in the Midlands North region where chicken litter is by far the biggest money-spinner (see Table 3.1). Chicken litter in the South is only third on the list. This can be ascribed to the small amounts of the material being used due to its scarcity and its lower price than in Midlands North.

Table 3.4: Material usage based on average farm expenditure per product per year for Midlands South

Material	Number of users	Average farm input per year (R)	Average cost per ton incl. Transport (R)
1. 5:1:5	6	77 300,00	1 325,00
2. Urea	5	45 000,00	930,00
3. Chicken litter	7	39 300,00	57,00
4. DAP	6	34 000,00	1 466,67
5. 2:3:4	5	15 000,00	1 480,00
6. Filter cake	3	10 000,00	13,00

Further from Table 3.4, it can be seen that filter cake is again deceptively low down on the list. This is due to the fact that it is used by only a few farmers close to the sugar mill where it is freely available. Transport considerations and high application costs offset the apparent cheapness of the product.

The decision to use one product rather than another is based on the opinion of the farmer regarding various product characteristics. The respondents were presented with five criteria and asked to rank them from most important (1) to least important (5), in terms of the product's ability to satisfy the specific characteristic. The rankings for each characteristic per product were added and an average ranking for that characteristic was obtained. The results are illustrated in Figure 3.5.

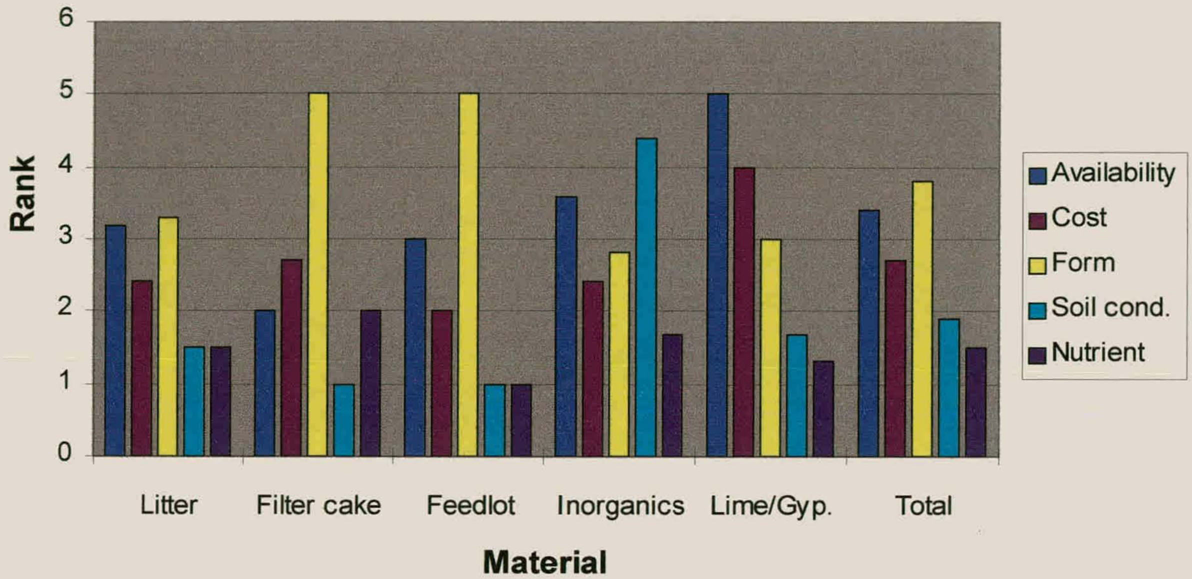

Figure 3.5: Average ranking of decision criteria per product for Midlands South

The results shown in Figure 3.5 are basically as can be expected. For the organic materials, soil conditioning is an important product advantage, whilst the form of the product is seen as least advantageous. The availability of the manures is also seen as a product limitation. For the inorganic products the soil conditioning properties of the product are seen as least advantageous. From Figure 3.5 it is evident that the farmers see chicken litter as the more balanced product in all aspects.

The possible social and environmental implications relating to the use and storage of the various products is of great importance. This is especially so when dealing with raw materials such as manures. The storage methods and time duration are indicated in Table 3.5.

Table 3.5: Storage characteristics of fertilising products for Midlands South

	Heaped in field	Heaped at central site	In shed, bagged	Average storage time (days)
Litter	83,3%	16,7%		120
Filter cake	100%			105
Feedlot	100%			7
Inorganics			100%	45
Lime			100%	42
Gypsum		50%	50%	51

From Table 3.5, it is noticeable that unlike in the Midlands North region it is chicken litter and filter cake that are stored for longer periods than the inorganic fertilisers. This can be ascribed to the scarcity of chicken litter, which means that when it is available, a large amount is purchased and stored for later use. Filter cake, too, could be along similar lines. Due to the high transportation costs, a large amount is procured at once and then stored for later application.

3.4.4 Organic material application characteristics

Application characteristics were narrowed to those of organic materials only. Of the nine qualifying respondents, 100 percent applied the material themselves, with none making use of contractors for application. The manure is spread using mechanical spreaders, broadcast by hand, and dumped and graded.

The application characteristics per material and the related costs are as indicated in Table 3.6. below.

Table 3.6: Application characteristics per material and associated costs for Midlands South

	Chicken Litter	Filter cake	Feedlot manure
Application method and cost (R per ton)			
• Mechanical spreader	R19,00	N/A	N/A
• Dumped and graded	N/A	R20,00	N/A
• Broadcast by hand	N/A	R12,00	R12,00
Application rates (tons per ha)			
• Planting	8,2 tons	107,5 tons	10,0 tons
• Ratoon	6,2 tons	N/A	N/A
Material cost (R per ton)	R57,00	R13,00	R52,00
Total application cost (R per hectare)			
• Mechanical spreader			
Planting	R623,20	N/A	N/A
Ratoon	R471,20	N/A	N/A
• Dumped and graded			
Planting	N/A	R3 547,50	N/A
• Broadcast by hand			
Planting	N/A	R2 687,50	R640,00

From Table 3.6 above, one can observe large differences in application costs between chicken litter and feedlot manure versus that of filter cake. This is as a direct result of the incredibly high application rates of 107,5 tons per hectare. The gap is further widened by low material costs for chicken litter and low feedlot manure application rates, when comparing these to Midlands North.

As mentioned earlier, the use of raw organic materials is bound to have certain social and environmental implications relating to their storage and use. These implication characteristics are presented as follows:

Percentage of users with storage related implications and implication description:

- Social - 21,4 percent
  - flies and smell
- Environmental - 0 percent

Percentage of users with use related implications and implication description:

- Social - 28,6 percent
  - flies and smell
- Environmental - 7,1 percent
  - flies and water pollution

In an effort to control these implications, the materials are stockpiled in an effort to minimise run-off and exposed surface area. The manure is also stored away from human habitation.

3.5 Input and output projections for a typical Natal Midlands production system

The following cost analysis is a projected average of the 1998/99 costs for sugar cane production in the Natal Midlands. It is projected from historical data. The South African Cane Growers Association (SACGA) collects this information through annual cost data questionnaires to all sugar cane growers. The degree of representation of this data amongst the growers is therefore totally dependent on the number of respondents. Thus far this has been seen as satisfactory (Wheeler, 1998).

As far as possible, the returned figures are actual cost figures for sugar cane only. There is some unavoidable overlapping where mixed enterprise farming is practised. The returned figures are then audited to ensure authenticity and are then used for the compilation of industry indices and for making industry related decisions.

The financial information below is compiled by the South African Sugar Association economist (Wheeler, 1998), from the annual audited figures collected by the SACGA. It is important for predictions and planning that expected costs and returns be calculated for the current season - figures which are obviously not available the following year. These figures are compiled by taking the previous five years actual, audited costs, calculating inflation indices for each cost centre and inflating the previous years figures to those projected for the current season. This is done for all cost and return items, excluding levies. This is due to the non-economic and ever changing nature of the levy structure within sugar cane. This figure is obtained yearly through policy projections.

Costs given as "General" and "Other" under variable maintenance and labour costs are various miscellaneous costs as defined by the respondents. It is the opinion of the people concerned that it is not within their rights to classify these costs without accurate knowledge of their nature.

The margin which is presented below in Table 3.7 is equal to the Net Farm Profit (excluding taxation, personal drawings, capital expenditure and loan repayments). These figures were omitted due to their personal and subjective nature which results in large variations between growers (Wheeler, 1998).

Table 3.7: Projected costs and returns for sugar cane production for Natal Midlands 1998/99

PHYSICAL INFORMATION			
Total dry-land area		1	Ha
Harvest area		0,5	Ha
Replant area		0,1	Ha
Ratoon area		0,4	Ha
Total sugar cane estimate		43,48	tons
Sucrose %		13,5	%
Total sucrose		5,87	tons
A Pool quota		5,87	tons
A Pool sucrose		5,87	tons
A Pool price		920	R
GROSS INCOME		**5 870**	R
		RAND / Ha	
VARIABLE COSTS		**3 414**	
Consumables		25	
Seed		29	
Chemicals		206	
Fertiliser		601	
Transport		469	
Fuel and Lube		278	
Mechanical maintenance		554	
- Tractors	241		
- Implements	68		
- General	116		
- Motor vehicles	115		
- Irrigation equipment	14		
Crop insurance		20	
Levies		8	
Labour costs		1 181	
- Wages	834		

(Table 3.7 continued)			
- Rations	285		
- Other labour costs	62		
Other		43	
FIXED COSTS		**473**	
Salaries		8	
Fixture maintenance		93	
Electricity		78	
Water/Rates		3	
Administration		126	
Short term insurance		119	
Licences		12	
Lease		34	
Rent		0	
Contract work/plant hire		0	
TOTAL COSTS		**3 887**	
MARGIN ABOVE SPECIFIED COSTS		**1 983**	

Note: Average 1998/99 projected costs for sugar cane production projected from historical data (1995/96)

Source: Wheeler, M. 1998. Personal interview. SASA Economist, Hilton.

3.6 Summary

In this chapter, the study area was described in terms of its location and physiographic description. Next, an attempt was made to enlighten the reader regarding a very broad production plan for sugar cane production in the area. This was followed by a more detailed production plan of a sample of production units, especially regarding current soil conservation practices, fertilising practices and organic material usage characteristics. A projected annual production cost budget was also presented. This was aimed at highlighting the cost and return structure for an average sugar cane production unit in the KZN Midlands.

It is important that such a chapter is included as a basis for understanding and visualising the study area. It is important to appreciate both the physical and the climatic conditions of the region. Also, forming a spatial image of the area's location is important with regards to blender sites and distribution implications.

It was deduced that most farmers feel that they are presently farming, or are moving towards farming sustainably. The use of organic material is becoming more popular with limited availability of material, especially chicken litter, emerging as an area of concern for potential users. It would also appear that application costs are high for the bulkier products and this offsets their apparent low cost. This application cost is an important consideration.

CHAPTER 4

DESCRIPTION OF ACQUISITION CHARACTERISTICS OF RAW MATERIALS

4.1 Introduction

The present production sources of manure are investigated in this chapter. Data relating to the type, amounts, present usage practices, distribution characteristics, storage and production aspects of the raw materials was collected. This was done in KZN by means of personal and telephonic questionnaire based interviews (see Appendix 3). The data obtained was largely of a descriptive nature and will thus be presented as such.

The decision regarding which raw material producers to include was based on the opinion of the soil analysts and consultants interviewed (see Appendix 1). These opinions will be presented at the beginning of this chapter. They were questioned regarding to the most suitable raw material for inclusion in such a product. The results of these interviews allowed proportionately more focus (time and number of interviews) on producers of chicken litter, feedlot manure and battery manure relative to producers of pig and cow slurry manure.

It is of importance to obtain information relating to the supply of these raw materials and their present usage when considering producing an organically based product and entering the organic market. It is of obvious importance to have a knowledge of and an understanding of the current situation regarding the sources and supply of raw materials.

4.2 Soil experts' opinions regarding raw material use for inclusion in a blended product

The first step when considering raw material acquisition is to ascertain what manure would be best suited for use in the production of such a product. This was achieved by asking the respondents to rank the materials from most suitable (1) to least suitable (7). Three of the respondents did not list the manures in an order of suitability. Hughes (1998) and Farina (1998) stated that the decision would rest on the nutrients required, the volumes of material available and the ease of acquisition and collection. The remaining four read as follows (in order of suitability and reasons for this opinion):

Table 4.1: Suitability of manures for use in a blended product

Material	Johnston	Wood	Norvall	Baxter	Average ranking	Rank order
Chicken litter	1	1	2	1	1,25	1
Battery manure	2	2	1	2	1,4	2
Feedlot manure	5	3	3	2	3,25	3
Pig manure	4	4	N/A	N/A	4,0	4
Slurry manure	6	5	N/A	N/A	5,5	6
Sheep/goat manure	3	6	N/A	N/A	4,5	5
Filter cake	N/A	7	N/A	N/A	7	7

Note: Materials ranked from most suitable (1) to least suitable (7)

Source: Baxter, N. 1998. Personal interview. Nitrochem, Howick.

Johnston, M.A. 1998. Mail questionnaire. University of Natal, Pietermaritzburg.

Norvall, F. 1998. Personal interview. Stockowners, Howick.

Wood, R.A. 1998. Personal interview. SASA, Mt Edgecombe.

The decisions in Table 4.1 above were based on:

- N, P and K content of the manures.
- Nutrient content, balance and concentration, moisture content and product availability.

From Table 4.1 it can be deduced from the average ranking figures, that chicken litter is seen as the most suited raw material for use in producing a blended product. It is important to note that it is not the actual figure which is important, but rather the resulting rank order of each material relative to the others. Physically and chemically chicken litter has advantages over the other raw materials. A factor which counts against chicken litter is its relative scarcity and high demand which is conveyed through the high cost of the product. Battery manure and feedlot cow manure are the next best materials according to these findings. Detracting features of these products are the higher moisture content and the bulkiness, which have logistical implications. It is the opinion of these experts that the other materials (slurry cow manure, pig manure and sheep/goat manure) are of very little practical use in producing a blended organic fertiliser due to these product's limited availability, high moisture contents and form of the products.

4.3 A description of manure production areas and producer inclusion criteria

Due to the nature (bulkiness and moistness) of the raw materials the area of investigation was limited to within roughly eighty kilometres of the proposed blender site at Cato Ridge. This limit on distance from the blender is however not as restrictive as one would think. A large amount of chicken, feedlot and other manure production occurs within this area. This can be ascribed largely to the favourable climatic conditions (relatively warm and dry), the proximity to the larger centres of Durban and Pietermaritzburg and the abattoir at Cato Ridge.

Rainbow Chickens, National Chicks and Golden Lay Farms have their offices in the Cato Ridge/Camperdown area. Argyle Poultry is mainly situated in the Albert Falls/Cramond region. The feedlots of Crafcor, Triple A and Stockowners are also in the Albert Falls area. It is evident from Figure 3.1 that these sources of the raw materials are situated close to the sugar cane growing regions of North and South Midlands as well. This will become more important in the discussion concerning the consumers of the products presently and of the planned blended product.

4.4 A description of the products and their producers

4.4.1 Chicken litter

Chicken litter is the name given to the product obtained by running chickens, normally broilers, on sawdust. The chicken droppings are absorbed by the "litter", making the product generally dry and powdery in character with minimal loss of nutrients through fermentation. Below is the average nutrient content of 30 samples as tested at SASA's Experiment Station at Mt Edgecombe (SASA, 1997):

Nitrogen	3,3 %	Calcium	3,0 %
Phosphorus	1,6 %	Magnesium	0,7 %
Potassium	1,8 %	Moisture content	20,0 %

Actual rand values of N, P and K are difficult to supply as they are reliant on N availability, amounts of citric soluble P and on the nature of the soils upon which the manures are applied (SASA, 1997).

Of the four poultry producers interviewed, all four produce a litter of either broiler or breeder origin. The difference between these is that breeder litter consists of a thicker sawdust layer and is kept in the house for longer before removal. Rainbow Chickens are by far the largest producers in Natal producing roughly 84 000 tons of litter per year (Perrett, 1998). Argyle Poultry Farms produce 10 800 tons per year on a six week broiler cycle (Atwell, 1998). Golden Lay Farms produce 6 600 tons of pullet rearing litter per year (Marais, 1998) and National Chick Ltd produce 6 500 tons of breeder litter per year (Pembridge, 1998).

The sum of these give a total of 107 900 tons of chicken litter produced by the four largest poultry producers in this region. Of this amount, roughly ten percent is moist with a high moisture content (exceeding 35 percent) (Marais, 1998), with the rest being dry and therefore highly suitable for transporting, processing and application for various uses.

4.4.2 Layer battery manure

Layer battery manure is a very different product to chicken litter. The outstanding characteristic of battery manure is the high moisture content. The difference in moisture content is due to the way in which the birds are housed. As layers, the birds are kept in wire cages on concrete floors to facilitate easier egg collection. The concrete does not absorb any moisture from the droppings, thus they maintain their high moisture content. The high moisture content often makes the product lumpy and difficult to handle which has implications when it comes to transportation and application. Further, left undisturbed it can undergo anaerobic fermentation, leading to a loss of nitrogen as ammonia. These implications make it less suited for use as a soil conditioner or nutrient source than chicken litter.

Below is the average nutrient content on a dry matter basis of 25 samples as tested at SASA's Experiment Station at Mt Edgecombe (SASA, 1997):

Nitrogen	2,5 %	Calcium	6,0 %
Phosphorus	1,5 %	Magnesium	0,9 %
Potassium	1,6 %	Moisture content	40,0 %

Of the four major chicken producers interviewed, Golden Lay Farms was the only concern which produced layer battery manure. Roughly 21 614 tons of battery manure is produced per year from 474 000 birds. The physical moisture characteristics of the total manure when ready for disposal is as follows: 40 percent dry, 50 percent raw/wet and 10 percent slurry (Marais, 1998).

4.4.3 Feedlot manure

There are three large-scale feedlot businesses in the study area. These are Triple A Beef, Crafcor's Riversdale Feedlot and Stockowners' Wondervale Farm. Combined these feedlots produce 48 900 tons of manure per year. All three of these producers are in the Cramond district, again, close to the Midlands North sugar cane growing region (see Figure 3.1). An analysis of feedlot manure was unavailable.

4.4.4 Slurry cow manure

Due to the highly unsuitable nature of this product for processing and transporting, only one dairy farmer was interviewed. It was the general opinion of the experts interviewed that slurry dairy manure was the least suitable for inclusion in a blended product, or for use on lands any distance from the source.

Dairydale Farm is situated near Baynesfield on the Richmond road in the Midlands South sugar cane growing region. The decision to use this dairy was based on the fact that it is well managed and of an average size for the region, milking 300 cows twice daily.

The manure is collected in slurry dams where it comes from the milking parlour. The parlour is cleaned with water after every milking, thus adding to the moisture content of the manure. The solid matter in the slurry settles in the dams and once the dams become full, the slurry is disposed of (Braithwaite, 1998).

4.4.5 Pig manure

Pig manure, like dairy manure, is very high in moisture. This makes it largely unsuitable for processing and for transporting any distances. The experts interviewed shared this opinion. For these reasons only one piggery was approached.

Baynesfield Piggery was chosen due to its situation near Richmond in the Midlands South sugar cane region, the high level of management and due to the fact that it is one of the biggest piggeries in KZN.

Actual production levels of manure were unknown, but the piggery houses around 10 000 pigs on average. This number does vary due to births and the selling of weaners and baconers. These fluctuations generally occur on a monthly basis and numbers move from around 9 800 up to 10 300 head at any given time (Wyllie, 1998).

4.5 Manure usage characteristics of raw material producers

4.5.1 Chicken litter

1. Rainbow Chickens

Rainbow Chickens sells 100 percent of its 84 000 tons (210 000 m^3) of litter produced per year. The chicken litter is sold at a price of R27,00 per m^3 to H&K Enterprises at Wartburg. This litter is then distributed by H&K Enterprises to various farmers in the Midlands North sugar cane region (see Chapter 5).

The litter is gathered on site using a skidsteer and a pay-loader, and then placed into bulk bins in Umlaas Road, from where it is transported by road to H&K Enterprises in this bulk/loose form. The collection and transport responsibility is that of Rainbow

Chickens'. Transportation costs are around R15,00 per m^3, which constitutes about 50 percent of the total price of the product to the consumer. The moisture content of the litter is roughly 25 percent when ready for disposal.

As far as the social and environmental aspects of litter production are concerned, Rainbow Chickens feel that there are no negative implications. Their policy is to remove the litter as soon as it is ready for sale, thus negating any possible fly, smell, pollution or dust problems (Perrett, 1998).

2. National Chick Ltd

National Chick Ltd sells 80 percent of its 6 500 tons of chicken litter produced per year, while keeping 20 percent for application to sugar cane on its affiliated farm, Gambier Holdings. The majority of litter sold goes to Igwababa Manufacturers and to Gromor for processing. Some is also sold to various vegetable farmers in the area. The litter is sold at a price of R55,00 per ton, which includes delivery.

The manure is removed from the chicken houses and loaded into bulk transport containers, which are then also used for transporting the litter. National Chick Ltd is responsible for the collection and transportation, by road, to the buyer. The cost of this transportation is R5,00 per ton per kilometre. This works out to an average of approximately 40 percent of the total price of the product to the consumer.

National Chick Ltd feel that the storage of the litter once removed from the chicken houses does have environmental implications. These implications assume the form of smell, runoff, soil/water pollution and flies. Their policy to attempt to limit these implications revolves around selling and moving the litter as quickly as possible. This practice does have a labour cost of around R12,00 per ton for removing the litter from the chicken houses, but this cost is not directly allocable to eradicating these problems, it is rather allocated to removal and is covered in the price of the product (Pembridge, 1998).

3. Golden Lay Farms

Golden Lay Farms produce 6 600 tons of pullet rearing litter per year. The production of this manure is fairly consistent with a 5 percent fluctuation on a monthly basis due to different feeding patterns and stocking rates. 100 percent of this litter is sold to sugar cane farmers in the Mid-Illovo area of Midlands South. The litter is sold at a price of R18,00 per ton in the chicken houses as a loose product sold in bulk and at R25,00 per ton if bagged.

The litter is collected using manure scrapers and then loaded with the use of augers. The collection and transportation is the responsibility of the buyers. Transportation is done by road.

According to Golden Lay Farms, the production of the manure has social implications, while the storage of the manure has social and environmental implications. These implications assume the form of smell, flies and runoff. The only practice employed to minimise these problems is to use the manure as soon as possible after removal from the production units. There is no cost allocable to this practice (Marais, 1998).

4. Argyle Poultry Farms

The chicken litter produced by Argyle Poultry Farms is different to that of the other producers in that Argyle produce a breeder litter. Here the litter is in the house for a six-week period resulting in a slightly composted end product. Other than these slight differences the products are much the same.

Argyle Poultry Farms sells 90 percent of its 10 800 tons of litter, while keeping 10 percent for its own use. Of the 90 percent which is sold, 95 percent goes to the Helleman Brothers in Wartburg for application to sugar cane, and 5 percent to Stockowners as a part of their feedlot ration. The 10 percent which is kept for their own use is also mixed into a ration for feedlotting purposes in an affiliated feedlot. The litter which is disposed of externally is sold at a price of R45,00 per ton as a bulk product.

Production levels fluctuate by about 25 percent between summer and winter. This is due to the fact that in winter, the initial wood shaving thickness is roughly 25 percent thicker than in summer to assist insulation. Every six weeks the litter is manually bagged and removed from the chicken houses. This collection is the responsibility of Argyle Poultry Farms and the litter is stored in bulk heaps away from the production facilities. The buyer is responsible for the transportation of the litter, which is done by road.

Argyle Poultry feel that the production or storage of this litter has neither environmental nor social implications. There is a certain amount of ammonia emitted, and the existence of some disease threats to the chickens, but disinfecting, washing and spraying for flies occurs every six weeks, which helps keep these problems in check. This has a cost of roughly R2 800,00 per six-week cycle. These measures do not have any negative effects on the quality of the litter as it is done only once the litter has been removed (Atwell, 1998).

4.5.2 Layer battery manure

Golden Lay Farms

Golden Lay Farms sell 100 percent of the battery manure produced. The manure is sold to sugar cane farmers in the Mid-Illovo area in Midlands South. The price of the manure to the farmers in the chicken houses is dependent on the form of the product. Wet/raw manure, sold in bulk is R12,00 per ton and when bagged is sold at R20,00 per ton. Dry and in bulk is sold at R18,00 per ton and bagged at R25,00 per ton. The slurry manure is sold at R5,00 per ton.

These variations in price can be ascribed to the differences in moisture content and thus the concentration of the nutrients or nutrient value per ton. Obviously, the higher the moisture content, the lower the concentration of nutrients and therefore the lower the nutrient and soil conditioning value of the product.

The collection and transport responsibility is that of the buyer. The layer battery manure, due to the nature of the product, is collected using a pay-loader and wheelbarrows. This is labour intensive and time consuming. The manure is transported by road in lorries to the farms.

Due to the high moisture content of the manure, there are social implications relating to the production and storage of the product and environmental implications with the storage of the product. Production results in smell problems, which have social consequences. The storage of the product before application results in smell, runoff and flies, which are both social and environmental implications.

The only measure employed by Golden Lay Farms towards solving this problem is to ensure that once the manure is ready for sale/use, that it is collected and removed from the premises as soon as possible. There are no directly allocable costs in doing this (Marais, 1998).

4.5.3 Feedlot manure

1. Triple A Beef

Triple A Beef run on average 9 000 cattle which each produce about nine kilograms of manure per day. This gives a total of 30 000 tons of manure produced per year. Depending on climatic factors, the vast majority of this manure is relatively dry. The moisture content averages around 30 to 40 percent depending on various climatic and other factors. There is roughly a 50 percent fluctuation in production levels of beef on a seasonal (summer to winter) basis. This is due to differences in stocking rates resulting from climatic variations. Cattle numbers drop from 11 000 in winter down to about 6 000 in summer. However, the manure is removed more frequently in summer, which means that levels of manure ready for sale do not fluctuate by as much as that of the beef itself.

Triple A Beef presently sell 100 percent of the manure produced. Manure is applied to the farms own hay lands on a three yearly basis (see paragraph below). The manure is sold to sugar cane growers in the Midlands North region. It is sold in loose in bulk at a price of R3,00 per ton. The collection responsibility is that of Triple A Beef. It is done by using graders to make a stockpile in the pens, loading it onto trailers with a pay-loader and dumping it onto a storage heap away from the feedlot. The R3,00 per ton covers the costs of this removal. The transport responsibility from the stockpile to the farms is that of the buyer. The transportation is done by road.

Triple A Beef apply some manure to their veldt on a three yearly basis. This is done for both the nutrient and conditioning benefits of the manure. It is applied relatively dry (as it comes out of the feedlot). It is done in winter by dumping it on the lands and spreading it with a grader blade. Due to the rough method of application, the rates of application are unknown - an estimate was made at about 10 tons per hectare.

In the opinion of English (1998), the advantages of applying manure are as follows:

- High levels of calcium.
- Cheap and readily available.
- Clear of weed seeds.
- Effective method of waste disposal.

Disadvantages of application (relating more to the physical application of the manure):

- Bulkiness of the product.
- Application costs.

According to Triple A Beef the production and storage of feedlot manure has no environmental implications, but these practices do have social problems. These problems assume the form of smell and flies. In an effort to minimise the fly problem, insecticide is sprayed, fly bait is set out and all cattle are dipped upon arrival at the feedlot. This practice is carried out in summer only and costs R2 500,00 per week. The smell problem is unavoidable (English, 1998).

2. Stockowners Feedlot - Wondervale Farm

The Stockowners Feedlot is much smaller than that of Triple A Beef, producing only 2 400 tons of manure per year. Like Triple A, this production does fluctuate on a seasonal basis between winter and summer. This is due to higher stocking rates in winter due to climatic and economic factors. The actual fluctuation was undisclosed.

Stockowners Feedlot does not sell any of its manure in an unprocessed form. This was tried in the past but was unsuccessful due to logistic and economic problems (again actual details were not disclosed). Instead the manure is used on the farm, being applied to pastures and hay lands and is a main ingredient in Stocklush (see below). The manure is applied as slurry through irrigation to the pastures and manually to the hay lands. This is done whenever there is manure which needs disposing of and is done throughout the year.

The main use however, is in producing an organic product called Stocklush by Just Nature Organics. This business is affiliated to Stockowners and Abacor and is on Wondervale Farm property and is reliant on the feedlot for the bulk of its organic ingredients. See Chapter 5 for more information on Just Nature.

The collection responsibility of the manure from the feedlot units is that of Stockowners. The manure is then taken directly to Just Nature Organics for processing. The collection and transportation to Just Nature's processing site is done with the use of a pay-loader.

The advantages obtained from using the manure on the farm are as a soil conditioner, soil nutrient source and as an effective method of waste disposal. Disadvantages of application include the bulkiness of the product and the volumes involved.

Unfortunately information regarding the environmental and social implications resulting from the production and storage of the manure was undisclosed (Wilson, 1998a).

3. Crafcor - Riversdale Feedlot

Crafcor produces around 16 500 tons of kraal manure per year. The production levels of the actual manure do fluctuate on a seasonal basis by about 25 percent. The fluctuations occur due to the differences in cattle numbers between winter (6 500 head) and summer (5 000 head). The basis for these differences is due to drought conditions and the lower price for beef in winter as producers look to decrease the number of cattle on the farms.

Crafcor disposes of all its manure on an off-farm basis. A contract manure spreader, Ian van Rooyen (see Chapter 5), takes the manure free of charge. The "payment" is the removal of the manure from the production units. If there is a surplus of manure Crafcor apply it to their pastures and veld. This is relatively infrequent and is done purely on an availability basis rather than as a routine practice.

With regard to the collection and transporting of the manure the responsibility is entirely that of the "buyer". Crafcor heap the manure in the feedlot with bulldozers and the buyer loads the manure onto lorries with a pay-loader and transports it to the application sites by road.

Crafcor feels that there are benefits through using the manure on their lands. These are as a soil nutrient source and as an effective method of waste disposal. The manure is applied by dumping it in the land and spreading it with a grader blade. As already mentioned, the manure is applied whenever available, but preferably in winter.

Crafcor feels that the production of the manure has social implications, which assume the form of smell and flies. Environmentally, the production of manure can result in runoff and pollution. Due to the fact that the manure is removed as soon as it is ready for disposal, storage is of little significance. However, with heavy rains some runoff is inevitable. The only means employed to try to minimise these problems is to remove the manure as often as possible and as soon as it is heaped for storage (Koning, 1998).

4.5.4 Slurry cow manure

Dairydale Farm

Slurry manure makes up 100 percent of the manure produced on the farm. Actual production levels were unknown as this is dependent on many factors, both managerial and climatic. Production levels of manure do fluctuate on a seasonal basis however, and this is due to the nature of the feed supplied, the condition of the pastures and the climate. This production tends to be higher in summer, when more food and moisture are available.

Dairydale does not sell any of the slurry produced. An interest was expressed in selling, but no known market exists. All of the slurry is discarded on the farm. The slurry is applied to pastures through the irrigation system. The primary benefit of employing this practice is mainly as an effective method of waste disposal, the benefits to the soil are seen as secondary. The slurry is applied whenever the slurry dams become full and is thus done throughout the year, but more in summer than in winter.

As already mentioned the benefit of applying the slurry is as an effective and cheap method of waste disposal. Disadvantages in application include the slurry blocking the irrigation sprinkler nozzles and the offensive nature of the grass to grazing cattle once sprayed with slurry.

The production and storage of the slurry manure has social implications. These assume the form of smell and flies. Dairydale employs no methods to attempt to minimise these problems. Spraying and baiting for flies is carried out in the parlour, but this is for health reasons and has no effect on the manure (Braithwaite, 1998).

4.5.5 Pig manure

Baynesfield Piggery

The pigs are housed in covered pig houses. These piggery units have slatted floors through which the waste falls into a channel which is flushed once per week with water. The manure and bedding, which may have fallen through, are swept along to a separating area where the separating of solids from solution is done by means of a static screen. The slurry goes into a slurry dam where some sedimentation takes place and the solids are removed and composted.

Baynesfield uses all of the manure produced on the farm. They would consider selling it, however there is no known existing outlet. The manure is applied in various forms to sugar cane, maize and avocado-pear orchards. The slurry is irrigated onto sugar cane throughout the year as the slurry becomes available. The composted solids are spread onto the maize lands with a manure spreader during land preparation, and are also applied by hand off a tractor drawn trailer to the avocado orchards in spring.

The benefits of using the manure are as a soil conditioner, soil nutrient source and as an effective method of waste disposal. However, the availability of the manure was the main reason for it being used originally. The bulkiness, the cost of spreading the solids and the on farm transportation costs are seen as the main disadvantages of using the manure, especially with regards to the composted solids. These disadvantages are however more application and logistically based.

Baynesfield feel that neither the production nor the storage of the manure has social or environmental implications. The reasons for this opinion are that the manure is stored under floor and the channels flushed weekly. The slurry goes straight to the slurry dam and the solids are composted which negates any smell or fly problems. Once ready for use the manure is applied to the various crops as soon as possible (Wyllie, 1998).

4.6 Summary

Within the study area, it has emerged that 107 900 tons of chicken litter, 21 614 tons of battery chicken manure and 48 900 tons of feedlot cattle manure are produced per year. Of these, only 105 520 tons of chicken litter, all the battery manure and 46 500 tons of feedlot manure are sold (see Chapter 5 for sources of raw material competition). According to the opinion of soil experts and consultants interviewed, these are the three most suitable products for use as soil conditioners and soil nutrient sources. Additionally, these are the only products found in large enough volumes and in a relatively acceptable form for use in processing the proposed blended product or for large-scale use in agriculture.

The manures which are kept for own use by the producers are used in various ways, such as for soil conditioners, plant nutrition sources, production of compost products and animal nutrition. It is the opinion of those interviewed that the use of these manures is beneficial, especially as soil conditioners and are thus applied for reasons other than as purely a means of waste disposal.

As can be deduced from the above discussion, however, the production and consumption of organic material in KZN is nearing an equilibrium status at present prices. Securing manure, especially chicken litter is not as easy as it might seem, with all producers selling all the manure that they themselves do not use. Due also to the relatively poor state of livestock farming at present, it is unlikely that there will be any increasing trend in the numbers of livestock in these production units. This in turn means little or no increase in the amounts of manure of various kinds produced.

Thus, there is a potential problem regarding the acquisition of sustainable amounts of suitable organic material. This apparent shortage of organic material will become more prevalent in the chapters to follow.

CHAPTER 5

POTENTIAL SOURCES OF PRODUCT COMPETITION

5.1 Introduction

Current and potential sources of competition for a proposed blended organic fertiliser within KZN were identified and interviewed using personal, questionnaire based interviewing techniques (see Appendix 2 for an example of the questionnaire). It is important to note that competitors in this context are defined as those individuals or organisations who would be in direct competition for raw materials from an input perspective and those producing similar products which would be competing in the market place from an output/final product perspective.

Within KZN, the following competitors were identified: Just Nature Organics, Gromor National Plant Foods, Kynoch Soil Services (Gromed Organics), Igwababa Manufacturers, Ian van Rooyen and H&K Enterprises. It was decided to exclude individual farmers procuring manures for their own use from this section as they will be included in Chapter 7. It is, however, important to acknowledge the influence that concerns such as H&K Enterprises and Helleman Brothers have on the organics milieu and thus H&K Enterprises have been included.

It is important to have a knowledge and understanding of the current sources of competition in the field of organic manures and products. The influence of these companies, businesses and individuals on the development and growth of a proposed organic product is of obvious and vital importance. It is important to know who the role players are and to appreciate their contribution to the organics milieu.

5.2 The competitors, their products, businesses and raw material acquisition characteristics

5.2.1 Just Nature Organics

1. Introduction

Just Nature Organics is situated in the Cramond area near Albert Falls roughly 40 kilometres from Pietermaritzburg. Just Nature is affiliated to Stockowners and is in fact situated on the same farm as the Wondervale Farm Feedlot. The business was also run in a 50-50 partnership with Abakor (Cato Ridge) from whom paunch contents was obtained. The importance of the paunch contents was as a cheap, readily available and natural source of enzymes and nutrients aiding the composting process. This alliance has since been broken, downsizing is to occur and production has stopped for the interim. The co-founder and manager, Michelle Wilson, is also due to leave which will further influence the business.

2. The product and business

Just Nature Oganics produce a composted kraal manure based product range, tailored for different application uses and users. The generic name for the range is Stocklush. The products produced and their contents are listed in order of amounts sold (Wilson, 1998b):

- Compost: kraal manure, hay, sawdust and paunch contents.
- Potting media: kraal manure, hay, sawdust, composted bark and coarse sand.
- Kraal manure: kraal manure, hay and sawdust.
- Lawn dressing: kraal manure, hay, sawdust and fine sand.
- Mulch: lumps of compost allowing for slower release.
- Planting mix: compost with sand added - especially good for clay soils.
- Growing media (seedling mix): paunch contents, sawdust and vermiculite for added water retention. No manure is used due to possible ammonium toxicity.

The target market consists of the following outlets in order of importance (Wilson, 1998b):

- Via nurseries to the public - bulk and packaged.
- Private landscapers - largely in bulk.
- Direct to the public - minimum of 100 bags or six m^3.
- Retailers - Makro and Pick 'n Pay Hypermarket, packaged.
- Hotels and resorts - bulk for landscaping and gardens.
- Vegetable producers - bulk, but expensive for large-scale use.

The consumption of the products is very seasonally based with autumn and spring being the busy periods. However, it is the quality and the price of the product compared to that of competitors which most influence the demand for the product. Other demand curve shifters include the economic position of the target market (products are seen as luxury items) and product awareness which can be improved through specials and promotions. The volumes sold over the busy spring period are approximately 20 m^3 bulk product and 1 500 bags (30 dm^3 bags) per week.

The target market for the product range is located in KZN, with the extremities of this market being the areas of Vryheid and Richards Bay in the north, Ramsgate and Margate in the south and Kokstad in the east. These parameters were implemented due to transport constraints. Diesel, labour and maintenance is expensive and the logistics are difficult to keep organised and running smoothly. The transportation is done by Just Nature themselves using a single 8-ton lorry. The lorry's capacity is 6 to 10 m^3 of product be it bulk or bagged. During the busiest season hired transport in the form of Haulgoods Transport is sometimes used.

The product is either transported in bulk by volume (m^3) or bagged in 15, 30 or 50 dm^3. Transportation costs are done on a fixed basis per destination. For example:

To Pietermaritzburg - R0,50c per bag or R15,00 per m^3 in bulk.

To Durban - R1,00 per bag or R30,00 per m^3 in bulk.

To Vryheid - R1,50 per bag of R45,00 per m^3 in bulk.

The price of the compost products (most basic), on farm excluding VAT are as follows (Wilson, 1998b):

Bagged - R3,65 per 30 dm^3

R5,54 per 50 dm^3

Bulk - unsifted R69,30 per m^3

sifted R86,65 per m^3

This is an undelivered price. The transport costs given above would obviously have to be added to obtain a cost of acquisition including transport.

Production occurs on a year round basis. The levels of production are influenced mainly by the consumer requirement fluctuations, which are very seasonal, as well as climatic factors. Climatic factors are of relevance for both consumers, such as first rains and temperature which influence the application of the products, and for the producers of the products. Rainfall makes handling the product more difficult, too much or too little heat and/or moisture can negatively influence the composting processes. These and other related factors are important.

3. Raw material acquisition

The main two ingredients found in the products are kraal manure and paunch contents. These make up the basis of the compost which in turn makes up a large portion of the other products. Due to the nature of the product (tends to be seen as a luxury item and thus competes for free disposable income) profit margins tend to be relatively small (actual percentages were not given). For this reason input costs are of vital importance and need careful monitoring. The kraal manure comes directly from the feedlot. This is very convenient as it is cheap, readily available and near in proximity which makes for huge savings in transport. Stocklush pay Stockowners R5,00 per ton for the manure. This is to cover the removal of the manure which is the responsibility of Stockowners and is done with the use of a pay-loader.

The other main ingredient, paunch contents, is obtained from Abakor's abattoir at Cato Ridge, situated 60 kilometres from the farm. The paunch of the slaughtered livestock is collected by Abakor and placed in a large storage bin from where it is collected by Just Nature. The paunch is free, with the only cost being that of transportation from Cato Ridge back to Cramond.

Other products used are sawdust which is obtained from a sawmill near Wartburg 18 kilometres away. Again, the product is free, with transportation being the only cost for Just Nature. Composted bark is bought from Gromed Organics at a cost of R108,75 per m^3. Sand is bought from Sandop in Pietermaritzburg at R58,00 per m^3. Due to the weight of this sand the transportation is expensive although it is only being transported 25 kilometres. Hay is cut on the farm and the cost to Just Nature is only to cover the making thereof. The opportunity costs for the farm related to this hay making seem to have been overlooked.

Reasons for using these products are due to the soil nutrient and soil conditioning properties of the products - satisfying the plants macro and micro nutrient requirements, the organic nature of the products - putting nature back into nature and the relatively low costs and high availability of the products, which helps to keep production costs down.

The production techniques of the products ensure that there are no environmental implications in the production or storage of the products. The materials are stored under tarpaulins, mixing is done on a concrete mixing slab and the windrows are on concrete. Social problems could arise from the smell of especially the paunch contents. However, once composted the smell disappears (Wilson, 1998b).

5.2.2 Gromor National Plant Foods

1. Introduction

Gromor, as it is commonly known as, is situated in Cato Ridge on the Harrison Station Road roughly 25 kilometres from Pietermaritzburg and 30 kilometres from Durban and is owned by Ralph Hagen. The company produces compost and potting media as its main products. Previously a large component of the business was chicken litter orientated. However, the loss of the tender with Rainbow Chickens for their litter has had important negative repercussions for Gromor.

2. The product and business

Gromor's business is made up of 70 percent compost and 30 percent potting media. The compost is manure based (chicken litter, kraal and horse) and also contains paunch contents, filter cake, pen sweepings and spent mushroom compost. The potting media is pine bark based. The target markets for these products are retail outlets (middleman), nurseries and in bulk quantities to municipalities, home gardeners and seedling nurseries. None is sold directly to agriculture. According to sales figures the current target markets are remaining constant in size, as are quantities demanded per customer for all products. Factors which influence the demand for the products include (Hagen, 1998):

- Seasonal variations in demand.
- The economic position of the target market.
- A well known brand name and product.

Geographically the target market is situated in Natal, with 90 percent of sales deliveries going to the greater Durban and Pietermaritzburg areas. The target market extremities are Port Edward in the south, Richards Bay in the north-east and Newcastle in the north. Transportation to these regions is done by road with five percent being own transport and 95 percent hired transport. The cost of this transportation for the Durban and Pietermaritzburg regions is worked into the price of the product and works out at around R1,00 per bag. For destinations further afield the cost is between R3,00 and R6,00 per bag.

The product can either be purchased in bulk per m^3 or bagged in packages of mainly 30 dm^3 but also 66, 15 and 5 dm^3 volumes. The split of amounts sold between bulk and bagged is roughly 50-50, with 12 000 m^3 of bulk and of bagged compost and 18 000 m^3 of potting media produced per year. The production cost of bulk, screened compost is around R45,00 per m^3 with an expected margin of 10 to 20 percent. The potting media has a production cost of R65,00 per m^3. This higher cost is due to the addition of urea and fertiliser and the fact that the necessary raw materials come from further afield. Factors which influence production costs and quantities include:

- The availability of inputs (especially chicken litter).
- Climatic factors, especially moisture.

Gromor see Just Nature Organics, All Grow, Karibu and Gromed Organics as the main competitors in the industry (Hagen, 1998).

3. Raw material acquisition

As mentioned above, the raw materials used in producing the products are (Hagen, 1998):

- Chicken litter (approximately 30 percent into blends).
- Layer battery manure (approximately 10 percent).
- Feedlot (kraal) cow manure (approximately 10 percent).
- Horse manure (approximately 10 percent).
- Paunch contents and pen sweepings (approximately 10 percent).

The balance is made up of pine bark compost and spent mushroom compost.

The primary reasons for the inclusion of these products specifically are:

- Form of the products (especially chicken litter).
- Cost of products (except chicken litter).
- Availability of products (except chicken litter).
- Good compost base - carbon/nitrogen balance must be correct for effective composting (chicken litter is important here).

According to Hagen (1998), the soil nutrient value and conditioning properties of the products are secondary considerations when selecting suitable products.

Below in Tables 5.1 and 5.2 the raw material input acquisition and transportation characteristics are presented. As can be seen from Table 5.1 many of the materials are freely available, with the only cost for Gromor being that of transportation. However, due the nature and form of some of these products this transportation cost can become deceptively high per ton.

Table 5.1: Raw material acquisition characteristics for Gromor

Product	Source	Cost*	Form
Chicken litter	Small, local producers	R25 to R35,00 per dm^3	Dry, bulk
Chicken litter	National Chick Ltd	R25 to R35,00 per dm^3	Dry, bulk
Battery manure	Small, local producers	Free	Raw/wet, bulk
Feedlot manure	Affiliated feedlot (Eston)	R10 to R15,00 per dm^3	Dry, bulk
Horse manure	Stables in area	Free	Dry, with bedding
Paunch contents	Cato Ridge Abattoir	Free	Wet
Pen sweepings	Cato Ridge Abattoir	Free	Dry, with bedding

Source: Hagen, R. 1998. Gromor National Plant Foods, Cato Ridge.

* Transportation excluded

Table 5.2: Raw material transport characteristics for Gromor

Product	Source	Responsibility
Chicken litter and battery manure	Small local producers (20%) National Chick Ltd (80%)	Own- hired transport Seller
Feedlot manure	Affiliated feedlot (Eston)	Own- hired transport
Horse manure	Stables in area	Own- hired transport
Paunch contents	Cato Ridge Abattoir	Own- hired transport
Pen sweepings	Cato Ridge Abattoir	Own- hired transport

Source: Hagen, R. 1998. Gromor National Plant Foods, Cato Ridge.

The average distance travelled from the source of the raw material to the factory is around 40 kilometres. The cost of transporting the products this distance ranges between R10,00 and R15,00 per dm^3. According to Hagen (1998), the maximum distance which can be travelled to collect the raw materials and still remain economically viable is 90 kilometres for broiler litter and 40 kilometres for the others.

Once the products arrive at the production site, they are mixed and placed into compost windrows as soon as possible to eliminate storage and possible losses.

Consequently, there are no social or environmental implications relating to the storage of the products. The production of the products does however have such implications. These assume the form of runoff, smell and water and/or soil pollution. Measures implemented to minimise these problems include keeping the stacks aerobic which helps reduce the smell and any runoff goes onto pastures which stops it from getting into surface or ground water (Hagen, 1998).

5.2.3 Kynoch Soil Services - Gromed Organics

1. Introduction

Kynoch Soil Services, or Gromed as it is commonly referred to as, is situated in the Cramond district roughly 30 kilometres outside Pietermaritzburg. The business falls under the auspices of Kynoch and thus has the advantage of the backing of a large company. The manager of Gromed is Roddy Howard, information was obtained from him in a personal, questionnaire based interview.

2. The product and business

The product produced is a pine bark based compost range, tailored for various applications. The largest outlet by far is to seedling nurseries with 95 percent of the product being consumed there. The remaining five percent goes directly to agriculture in the form of vegetable seedlings (4,5 percent of the total), sugar cane seedlings (0,25 percent) and ornamental plants (0,25 percent) (Howard, 1998).

According to Gromed the target markets are remaining constant both in size and in number. Factors which do, however, influence the demand within these target markets include:

- Seasonal variations in demand (high in spring).
- Economic position of the target market.

Geographically, the target market is situated throughout South Africa, with exports being done to The Gulf and Taiwan.

Once the product is ready for distribution it must be transported to the customer. This is done locally by means of hired road transport of which 20 percent is loose, bulk product and 80 percent packaged in 66 dm^3 bags. The cost of this transport is R40,00 per m^3. The exported product is transported by ship. The cost of this transport was unavailable.

The final costs of production differ quite largely between the various products. This is due to the different degrees of product processing required. For example, "Log Deck", the most basic product, costs around R40,00 per m^3 to produce. "Seedling Mix" on the other hand, as the product requiring the most processing, costs around R80,00 per m^3.

Production levels vary between 7 and 10 m^3 of product per hour. Production occurs five days per week, eight hours per day under normal circumstances. Factors which influence this production include:

- Consumer requirement fluctuations.
- Climatic factors (especially rain).

Gromed feel that the main competitors in their industry are Gromor, Bark Enterprises in Gauteng and Nu Cellar in the Cape (Howard, 1998).

3. Raw material acquisition

Two sources of pine bark are used: Mandini Sawmills in Zululand and Clan Sawmills in KZN. The two bark types are mixed, urea added for nitrogen and lime added for pH regulation, before being placed into windrows for composting. Other than the bark, which falls outside this topic, the only organic material used is Kynogan 6:1:6 and 3:1:5. This product is composted chicken litter which has been enriched with inorganic soil nutrients and is produced and obtained from Kynoch Somerset West. It is added to a very small portion of products for its soil nutrient value.

The Kynogan is transported the 1 500 kilometres by road in a PX container. The cost of this transportation is that of Gromed's. The container takes 35 tons of Kynogan packaged in 50 dm^3 bags and costs R6 500,00 per trip. Rail transport was considered but worked out too costly for a product of this nature.

Once on site, the bags are stored in the container and used as required. This storage does have social implications in the form of smell. Stricter storage regulation enforcement would help to minimise this problem (Howard, 1998).

5.2.4 Igwababa Manufacturers

1. Introduction

Igwababa Manufacturers is located on the Harrison Flats road near Cato Ridge roughly halfway between Durban and Pietermaritzburg. The company is owned by Hugh van Rooyen who has secured the rights to use the trading name of the Australian company Neutrog. Igwababa's trading name is Neutrog Africa.

The company is relatively new and is at present experiencing a period of growth and development, both internally and externally. Starting the company required a large capital investment. This demanding cash injection was however necessary and has been seen as successful.

2. The product and business

Neutrog Africa supply a 100 percent organic fertiliser in the form of pelletted chicken litter. Of the total production, 20 percent goes directly to local agriculture and the remaining 80 percent is exported. The local agricultural market is made up of vegetables countrywide, sugar cane in KZN, orchards in Mpumalanga, timber seedlings by Mondi and Sappi and tea in Nongoma. With regard to export, the main target markets at present are: The Middle East, Singapore, Taiwan, Thailand and Malaysia. Due to the relative infancy of the business, the target market is increasing both in size/numbers of consumers and in amounts of product per consumer (Van Rooyen, 1998a). Factors which influence this demand include:

- Seasonal variations in demand
- Economic position of the target market.

Transportation locally is done by means of hired road transport. This is done at a cost of R65,00 per ton for the KZN region. Exportation is done by ship at the following costs (Van Rooyen, 1998a):

- Taiwan US$380,00 per 18,5 ton container.
- Singapore US$550.00 per 18,5 ton container.
- Middle East US$850.00 to $1 030,00 per 18,5 ton container.

The product is all packaged in bags of sizes 20, 25, 30 and 40 kg. The final production cost is R425,00 per ton. This figure includes annuities on capital investments, fixed costs, monthly overheads, packaging and raw material costs. The exact extent and makeup of these costs was withheld. The selling price of these products at the time of interview was R500,00 locally and R570,00 fob at Durban for export.

The product is produced at an average hourly rate of 1,8 to 2 tons. This production is influenced by factors such as the availability of inputs (raw materials) and the time and cost associated with repairs and maintenance.

The main sources of competition according to Van Rooyen (1998a) come not from competing companies (there is one other chicken litter pelleters in South Africa), but from consumers of the raw material, chicken litter. Interestingly, a large and increasing portion of these litter consumers are potential users of Neutrog's product - sugar cane farmers.

3. Raw material acquisition

The raw material used in producing the product is breeder chicken litter. The reasons for the use of this product are (Van Rooyen, 1998a):

- The soil nutrient value of the product.
- The soil conditioning properties of the product.
- The availability of the product.
- Due to the fact that the litter is in the hen houses for approximately 60 weeks, it becomes partially composted which softens the fibre.

The breeder litter is obtained from National Chick Ltd at a cost of R80,00 per ton. The form of this product when bought is dry. National Chick is responsible for both the collection and transportation of the product to Igwababa Manufacturers. The litter is transported by road over distances varying from 15 to 60 kilometres. The cost of the collection and subsequent transportation is included in the final cost of the product. Once the product arrives on site, it is sifted and then stored indoors on concrete prior to use. For this reason there are no environmental or social implications relating to the storage or production of the products (Van Rooyen, 1998a).

5.2.5 Ian Van Rooyen Contracting

1. Introduction

Ian van Rooyen has recently, with the growth in popularity of applying manure to sugar cane especially, started a contract based spreading service in the Midlands North sugar cane region of KZN. The main areas in which the services of Mr Van Rooyen are employed are Wartburg, Table Mountain and Albert Falls.

2. The product and business

As mentioned, Van Rooyen (1998b) supplies a manure spreading service to farmers in the Midlands North region. 95 percent of this business is on sugar cane, with the remaining five percent on vegetables and maize. The majority of material spread is feedlot manure (90 to 95 percent), with the rest being made up of chicken litter, horse manure, pig manure and filter cake.

Due to the infancy of the business, the target market is increasing. The potential size of this market is however limited by capacity implications. At present only one spreader and one 8,5-ton lorry are available. Other factors which influence the target market size and demand are the quality of the service and seasonal variations in demand (mainly from April to December).

Spreading capacity at present is 200 tons per day. Factors which influence this application level include (Van Rooyen, 1998b):

- Availability of inputs (in winter less manure available).
- Climatic factors, especially rain.
- Machinery maintenance.

According to Van Rooyen (1998b), the main competitors in this industry are farmers who are spreading the manure themselves. This is being done largely by sugar cane farmers applying their own chicken litter.

3. Raw material acquisition

As mentioned, the raw materials applied are kraal (feedlot) manure, broiler litter, pig manure, horse manure and filter cake. The reasons for the use and application of these products include (Van Rooyen, 1998b):

- Concentration of the product.
- Availability of the product.
- Organic content of the product.
- Customer preferences.

Feedlot manure aside, the organic materials are obtained from small producers in the area, where the materials are available. The feedlot manure is acquired from Triple A Beef and Crafcor Feedlots, both situated in the Cramond district.

The feedlot manure is stockpiled by the feedlotters using pay-loaders. It is then the responsibility of Van Rooyen to load and transport this manure to the various application sites. This transportation is done by means of an 8,5-ton lorry for longer trips and directly with the muck spreader and tractor for short distances. The form of this manure is relatively dry (moisture content of around 40 percent), this does, however, depend largely on the weather. The cost of this manure from the feedlots was not divulged (see Chapter 4 for these costs).

The cost of this transportation varies between R20,00 and R32,00 per ton depending on the distance transported. The furthest Van Rooyen is prepared to transport the materials is 30 kilometres. Beyond this distance becomes too costly. The average distance travelled is approximately 20 kilometres.

Once on site, the material is placed in piles ready for application. The size of these piles depends on the size of the land and the application rate. Due to this storage technique there are social implications which assume the form of flies and smell. Measures employed to try and minimise these implications are to attempt to spread the material as quickly as possible and to store the material away from human habitation (Van Rooyen, 1998b).

5.2.6 H&K Enterprises

1. Introduction

H&K Enterprises was established by two brothers, Heinz and Kurt Wittig, after the large scale use of chicken litter became popular in the Midlands North sugar cane growing region. They are both successful farmers in the area themselves and run H&K Enterprises as an additional business.

The business was started when Heinz Wittig and others decided to tender for the chicken litter contract from Rainbow Chickens. This was done to ensure a certain supply of litter in the future and to effectively eliminate the middle-man. The tender was successful and the Wittig brothers became the co-ordinators of the project and in so doing set up H&K Enterprises (Wittig, 1998).

2. The product and business

H&K Enterprises supplies essentially a distribution service rather than a product as such. They supply the transport and other technical services in order to get the chicken litter from its source in Umlaas Road directly to the appropriate farms in the Midlands North region. There are at present 70 growers who are serviced by H&K Enterprises.

For this service, a transport charge of R47,35 per ton is charged over and above the cost of the raw material. This transport cost, however, along with transport includes administration costs, regular product sampling, loading and off-loading costs and weighing charges. Thus, the farmer is receiving the correct amount of litter, chemically analysed (every load) and delivered to his farm (Wittig, 1998).

3. Raw material acquisition

As mentioned, H&K Enterprises obtained the contract to purchase all the chicken litter produced in KZN by Rainbow Chickens. This is a total of roughly 210 000 m^3 of chicken litter per year. The raw material is purchased at a cost of R71,00 per ton with an average moisture content of 25 percent. The litter is stockpiled by Rainbow Chickens at a site in Umlaas Road, near Cato Ridge and is collected and transported an average of 75 kilometres to farmers in the Midlands North region. It can be deduced that such a set-up would have a large influence on the availability of chicken litter in KZN (Wittig, 1998).

5.3 Summary

Deductions that can be made from the above information include:

- Certain raw materials, especially chicken litter, are in large demand and are thus difficult to obtain and their usage is based largely on their availability. The successful tender of H&K Enterprises for Rainbow Chickens' litter is of especial relevance.
- Margins are small and consumption depends largely on the economic position of the target market. The seller is competing for the consumer's free disposable income, especially in non-agricultural circumstances.
- Transportation is expensive and problematic. 60 percent of the respondents mentioned limitations on transport distances for both the collection of raw materials and the distribution of the final product to consumers. These limitations can be ascribed to the form (bulky) and nature (inexpensive) of the product.

- Just Nature Organics is undergoing a split from Abakor which will result in downsizing and decreased production and sales. This will have a definite effect on the remainder of the industry.
- Three of the five businesses have large organisations backing them. Just Nature Organics - Stockowners, Gromed Organics - Kynoch, and Igwababa Manufacturers - Neutrog.

CHAPTER 6

THE PROCESSING AND DISTRIBUTION OF A BLENDED FERTILISER

6.1 Introduction

The processing and distribution implications of an organically based, blended fertiliser will be discussed in this chapter. This will involve an investigation into the existing blender production characteristics of Nitrochem's blender in Cato Ridge and what potential changes will be necessary to facilitate producing such a product. This will be followed by a section regarding two companies who are producing a similar product. This will give some indication of their production set-up and how these compare to that of Nitrochem's blender. Raw material considerations will then be discussed and lastly, perceived blending and distribution implications.

6.2 An overview of the Nitrochem blender at Cato Ridge

Nitrochem Fertiliser Ltd is a Natal based fertiliser distribution company. It is a service-orientated business which supplies farmers with their fertiliser requirements throughout KZN. The company is affiliated to the Omnia Group and is one which is highly progressive in its management and customer orientated approach.

Nitrochem buy in the raw materials and blend their own inorganic fertiliser mixes at their blender in Cato Ridge. The blender is situated close to the N3 national highway, near the Cato Ridge railway siding, roughly midway between Pietermaritzburg and Durban. This site would appear to have all the necessary ingredients to be well suited for the production of an organically based, blended fertiliser. Obviously, the existing blender is a major advantage, Cato Ridge is central to both the Midlands North and Midlands South sugar cane producing regions and it is centrally located with regard to the various sources of raw material production. Distribution infrastructures are also effective and conveniently close at hand.

6.2.1 Current blender production characteristics

At present Nitrochem blend only inorganic raw materials to produce a range of blends for various customer requirements. The raw materials used in the blender include MAP (mono-ammoniated phosphate), DAP (di-ammoniated phosphate), KCL (potassium chloride), urea, LAN and lime. Current production levels are running at approximately 28 tons per hour, depending on time of year, breakdowns, labour implications and climatic influences (Tweedale, 1998).

Blending costs which are categorised as a fixed and a variable cost component are as follows (Tweedale, 1998):

- Fixed costs - R41,03 per ton
- Variable costs - R18,96 per ton
- This gives a total blending cost of R59,99 per ton, which obviously does not include raw material inputs. The purchasing cost of these raw materials was undisclosed. However, the transportation cost of the products to the blender by road and, where applicable, by rail are as indicated in Table 6.1.

Table 6.1: Raw material transport methods and costs per ton for Nitrochem 1998

Product	Road R	Rail R
MAP	72,00	42,40
DAP	72,00	42,40
KCL/Potash	32,00	32,00
Urea	95,00	102,86
LAN	95,00	98,90
Lime	100,00	N/A

Source: Tweedale, C.J. 1998. Operations Manager - Nitrochem Fertilisers, Howick.

The decision regarding which method of transportation to use depends upon more than just the cost and includes factors such as (Tweedale, 1998):

- The location of the source of the product.
- Required speed of delivery.
- Loss due to spillage and theft.
- The form of the product.
- Product handling implications.

As already mentioned, the transportation infrastructure is conveniently close at hand and relatively sound. This bodes well for the transportation of raw organic products to the blender and the distribution of the finished product.

6.2.2 Perceived technical limitations and possible changes

Due to the fact that Nitrochem blend only inorganic fertilisers at present, the addition of an organic product range would have important technical and managerial implications. When asked whether the current blender could house an organic fertiliser blending operation it was stated that it could not, especially if chemical fertiliser blending is continued. The main problem areas in this regard, in order of severity according to Tweedale (1998), are:

- General space shortage.
- Storage implications.
- Production capacity limitations.
- Insufficient product handling facilities.
- Internal product competition.
- Segregation of materials in the finished product.
- A large dust component.
- Smell.

Solutions for the first four problems above would require physical, structural and planning changes such as building additional work-space and storage areas and the acquisition of machinery. The solution to the problem regarding internal product competition lies in effective operations and marketing management. The last three problems would have to be solved through careful planning of product form, product packaging and raw material input type. Pelleting for example would limit segregation of materials in the finished product.

Incorporating an organic fertiliser blending operation will also have negative influences on the present production of inorganic fertiliser. These influences would assume the form of (Tweedale, 1998):

- Production capacity limitations at peak production times.
- Setting up the blender from chemical fertiliser to organic would be time consuming.
- Raw material storage space would be limiting and in competition with that for inorganic raw materials.

These problems would have to be solved through effective management and production policy development.

6.2.3 Raw material considerations

Tweedale (1998) stated that dry broiler litter or layer manure would be best suited for use as the organic base of the blended product. The reasons for this were based upon the favourable form of the product and the concentration of the beneficial elements within the manures.

The form of the product is especially relevant when considering the moisture content of the product. Some inorganic raw materials which would be used in the blending of an organic fertiliser are moisture intolerant such as urea and LAN. These materials react and break down when moist, changing their nature. Others, such as MAP, DAP, KCL and lime are more stable and tolerate moisture to a certain degree.

Form is also important when considering the ease with which the product is blended. Feedlot manure, for example, often has a high soil content which makes blending more difficult. Manures with too high a moisture level (greater than 30 percent moisture) are also very difficult to work with. In this regard, broiler litter and to a lesser extent battery manure (moisture content would be problematic) would, in Tweedale's opinion, be best suited for inclusion in a blended product, when considering ease of blending.

6.2.4 Blending and distribution characteristics of a blended product

With a suitably dry and relatively uniform base product it would be possible and feasible to add various inorganic raw materials to produce a range of blends suitable for use in various situations. Soil analysts and consultants (see Chapter 7) share this view. In the opinion of Tweedale (1998) there would be certain restrictions on the blends possible in terms of N, P and K addition, however, the possibilities are virtually infinite.

Feasible blends which could be produced, with regard to use in sugar cane production especially, include 5:1:5, 4:1:6, 1:0:2, 2:0:3, 4:3:4, 3:1:4 and 6:1:6. It would seem that the blends produced would depend only on farmer needs and this would be related to soil and plant requirements.

The form and packaging characteristics of the finished product would depend largely on customer preference. Tweedale (1998) stated that the product would have to be pelleted or granulated to avoid segregation of materials, with pelletisation as the more likely option. He also envisaged three basic levels of processing: low, medium and high.

- Low - bulk distribution of pelleted product.
- Medium – mini-bulk (500 kg or 1 ton) of pelleted product.
- High – 50 kg bags of pelleted product.

Again, the product processing level would depend on customer preference, and there would be no ideal level. Costs associated with the various processing levels would obviously be a consideration. However, this added cost would be offset by other factors such as convenience of handling and application.

Further, the costs of adding an organic fertiliser component to the current set-up would involve an increase in mainly capital costs. The building of additional working space and storage facilities as well as the acquisition of a pelleting machine would be the largest expenditures. Day to day running costs per ton produced would remain much the same due to the stable nature of such an operation.

Distributions wise, the products would be transported using the existing transport methods of road and rail. Tweedale (1998) suggested that a probable basis for this transportation decision would be that products with a low level of processing are transported only by road, while those with medium and high levels of processing are transported by both road and rail. This is related to product value addition and the higher cost of rail transport.

While this data above is mostly speculative in nature, it is important to consider what the influences of an additional blending operation would be on the current production situation. Nitrochem have not yet done any kind of feasibility study on these influences, but if such an undertaking was considered a detailed study would be of vital importance.

6.3 Description of other organic product blending operations

In this section a brief look will be taken at two operations currently producing organic fertilisers. Both are relatively young, and will supply an insight into the set up and initial influencing factors of starting such an operation.

6.3.1 Igwababa Manufacturers

Igwababa Manufacturers was included in Chapter 5 as a possible competitor in the organic fertiliser industry. The product produced is a pelleted, chicken litter based fertiliser under the trade name of Neutrog Fertilisers in Australia. The operation is situated in Cato Ridge and supplies consumers throughout Southern Africa and abroad.

According to the owner (Hugh van Rooyen, 1998a), the capital investment in Igwababa Manufacturers is fractionally over R1 million. This investment has costs in the form of depreciation and interest which were undisclosed as specific amounts. They were however included as monthly overheads which include salaries, maintenance, depreciation, interest and insurance totalling R45 000,00. Running costs which include electricity, steam, dyes, pelleter paddles and packaging total around R70,00 per ton. This figure does not include the raw material costs which total

R80,00 per ton. The breeder chicken litter is purchased from National Chick Ltd in KZN.

For more information regarding Igwababa Manufacturers' product, business and raw material acquisition characteristics see Section 5.2.4.

6.3.2 Bionamix Terramax

1. Introduction

The Bionamix Terramax company is a newly formed blending operation. The blender is located in Potchefstroom, and is positioned there relative to raw material sources and major markets due mainly to transport considerations. The operation was recently set up and consists of work space of 500 m^2 and storage area of 1 000 m^2. Machinery acquired includes: crusher, blender, pelletiser, cooler, conveyors and a bagging unit resulting in a total capital outlay of R2,5 million (Diedericks, 1999).

2. The product and business

The product produced is a range of blended, organically based fertilisers which combine the ease of using inorganic fertilisers, with the advantages of organics. This is seen as a comparative advantage of the product over conventional fertilisers. The product is granulated and has a broiler chicken litter base. The following blends and their prices (R per ton) are available (Diedericks, 1999):

3:2:1(20) - R1 290,00
5:1:1(19) - R1 042,00
3:1:5(23) - R1 081,00
3:1:1(22) - R1 266,00
6:1:6(22) - R1 076,00

The use and application of these blends depends on soil analyses and soil-crop combinations, as well as the growth stage of the crop. The product is packaged in woven poly-propelene bags with weights of 500, 50 or 25 kilograms. The average cost of this packaging is R40,00 per ton. The blender production capacity is limited by the pelletting process which runs at 2,5 tons per hour. This is not going to be changed as the quality of the pellets is seen as very important (Diedericks, 1999).

The market entry strategy is based on quality products at competitive prices, backed by a "scientific-organic approach" (Diedericks, 1999). The main target markets are situated in the Western Cape, Lowveld and Orange River irrigation areas. The transportation of the product to these regions is done by road and is the responsibility of the marketing agents.

Diedericks (1999) was then asked why the product would sell when it is possible for the farmer to obtain his own organic material and inorganic fertiliser and apply them him-/herself. Reasons why this wouldn't endanger the blended product include:

- The need for extra handling and application equipment for bulk manure too costly.
- Mixing of products is difficult and could result in inaccurate application rates and product segregation.
- Manure would be purchased in bulk and dumped on the land, this is wasteful and proves difficult to handle.
- Rain makes application of bulk manure difficult and can result in run-off and waste.
- Separate applications of manure and inorganics would prove costly due to the double application.

3. Raw material acquisition

The broiler litter is obtained from various sources in the region. The cost of this material was undisclosed, but is based on market related prices. Broiler litter is the material of choice over other organic materials due to its availability in the area, the requirements of the market, its consistency in chemical and physical parameters and for security in supply.

The litter has a moisture content of 18 percent when purchased, which falls within the 20 percent moisture limit beyond which blending becomes impossible. It is analysed monthly and has an average analysis of 4:2:1(7). Deviation from this average was undisclosed. The litter is transported by road to the blender at an average cost of R20,00 per ton over an average distance of 60 kilometres. Inorganic, granulated raw materials used for blending purposes are obtained from various fertiliser companies. These include with cost per ton (Diedericks, 1999):

LAN - R790,00	KNO3 - R3 410,00
Urea - R1 250,00	MAP - R2 233,00
KCL - R1 365,00	

6.4 Summary

In this chapter, an investigation was made into Nitrochem's existing blender in Cato Ridge. It was felt that unless additional work and storage space was created, (discounting additional machinery needs) an organic product blending operation could not be accommodated. These changes, together with the acquisition of production related machinery, would necessitate large capital outlays - as can be seen from Igwababa and Bionamix's set up costs.

It would seem that the range of possible blends is almost unlimited and this would depend more on raw material aspects, especially moisture content, consumer requirements and soil-crop combinations. Packaging too is consumer needs orientated. It would appear that blended product prices can be held relative to market prices for other fertilisers, which is important when considering consumer psyche when making the product use decision.

CHAPTER 7

PERCEIVED PRODUCT CHARACTERISTICS OF A BLENDED ORGANIC FERTILISER

7.1 Introduction

In this chapter, data regarding potential, foreseen and required product characteristics for a blended organically based fertiliser will be presented. This information has been gathered through questionnaires (see Appendix 1) from seven soil experts and a sample of farmers within the study area who make up the potential market for the product (see Appendix 4).

From a soil expert viewpoint, the information addresses production and use possibilities, potential product advantages and disadvantages and product effectiveness. Information was gathered from the farmers regarding the potential use of such a product, what factors would influence the decision as to whether to use the product or not, product characteristic preferences and reasons for potential added expenditure when purchasing such a product relative to conventional (inorganic) fertilisers. As mentioned in Chapter 3, the two areas of Midlands North and South will be handled separately due mainly to the differences in potential consumer psyche.

The decision to present the information in the manner it is in this chapter is based on the nature of the data. The data is largely subjective and is collected using ordinal rank scale questionnaire type questions. After consulting various sources regarding the matter it became evident that the most suitable and understandable method of presentation would be using primarily graphs and tables. Multi-dimensional scaling is inappropriate due to the large number of product properties and characteristics (Lehman, 1989). It was also decided to exclude urban municipalities as potential outlets for the product due to their non-agricultural nature. Nurseries were approached, but none expressed an interest in the product due to the potential toxicity of the product, which would be detrimental to the seedlings and other plants. For this reason they too were excluded.

7.2 The opinions of soil experts regarding the production of a blended product

7.2.1 Production implications and subsequent usage by farmers

The respondents were questioned regarding certain aspects around the possible production and use of a product which is organic (manure) based and blended with chemical components of conventional fertilisers to provide a more complete and balanced product. The questions revolved around the feasibility of producing such a product, most suited manures for inclusion, advantages and disadvantages of applying such a product as well as the effectiveness of applying such a product.

With regards to the existence of a potential market for the product, 71 percent of the respondents said a market could be established against the 29 percent who said no market would exist. The reasons for the negative responses stemmed from a perceived fear of high costs and limited effectiveness. Wood (1998) felt that a market was available, but would be of a more specialised, intensive nature.

Further, only 28 percent of the respondents stated that the use of an organic (blended) fertiliser would promote sustainable production in sugar cane. 44 percent said they were unsure of such a product's effect and 28 percent said it would have no positive effect on sustainability. The scepticism rises from a foreseen problem regarding the quantities of organic material needed to have an influence on soil structure and health and, therefore sustainability. The question is whether enough organic material can be applied in a cost effective manner through the blended product. As can be seen from the above results this seems unlikely in the respondents' opinions.

Regarding the possibility of producing such a product, 72 percent said it would be possible, with some of these being slightly unsure, and 28 percent said it would not be possible. It is important to note that 57 percent said that producing such a product would be feasible, against only 14 percent who said it would not. Important considerations when considering these two points include:

- The need for clear proof that there are, indeed, advantages in using such a product.

- Such products are being successfully produced in other parts of the world especially for more specialised markets.

- The quantities of organic material required to have significant effects are large (10 to 25 tons per hectare). It would be more cost effective for the farmer to buy this organic material directly from the source.

- The costs associated with the transport and general handling of large quantities of a bulky product would endanger the cost effectiveness of its use.

7.2.2 Potential product advantages, disadvantages and effectiveness of use

The respondent's opinions regarding important advantages of using such a product as a soil conditioner and as a nutrient source were then analysed. The respondents were again asked to rank the potential advantages from most important (1) to the least important (5). In some cases some of the respondents did not give their opinions and where they did not all characteristics were ranked.

It would appear from Table 7.1 below that an increased soil organic content and improved soil condition (structure) are considered important advantages of using a blended organic fertiliser. Slow nitrogen release is an important point in the context of the Natal Midlands. This is due to the fact that poor N management is seen as one of the reasons for the poor condition of the soils in the Midlands regions.

Table 7.1: Advantages of using a blended product as a soil conditioner

	Norvall	Baxter	Farina	Johnston	Hughes	Wood
Organic content	2			2	2	1
Soil conditioning	3			1	1	2
Nutrient supply	4			4	3	
Nutrient balance	5			3	4	
Water Holding	1					
Water infiltration		1				
Slow nitrogen release			1			3

Note: Ranked from most important advantage (1) to least important advantage (5).

Sources: Baxter, N. 1998. Personal interview. Nitrochem, Howick.

Farina, M. 1998. Telephonic interview. Independent soil consultant, Howick.

Hughes, J. 1998. Personal interview. University of Natal, Pietermaritzburg.

Johnston, M.A. 1998. Mail questionnaire. University of Natal, Pietermaritzburg.

Norvall, F. 1998. Personal interview. Stockowners, Howick.

Wood, R.A. 1998. Personal interview. SASA, Mt Edgecombe.

Looking further ahead to Table 7.2, deductions emerging from this table include the view that an improved nutrient supply is seen as the most important advantage of using an organically based product. An improved balance with regard to nutrient supply is also seen as important as presented in Table 7.2.

Table 7.2: Advantages of using a blended product as a soil nutrient source

	Baxter	Farina	Johnston	Hughes	Wood
Organic content			4	3	2
Soil conditioner			3	4	4
Nutrient supply	2		2	2	1
Nutrient balance	3		1	1	
Water holding					
Water infiltration	1				
Slow N release		1			3

Note: Ranked from most important advantage (1) to least important advantage (4).

Sources: Baxter, N. 1998. Personal interview. Nitrochem, Howick.

Farina, M. 1998. Telephonic interview. Independent soil consultant, Howick.

Hughes, J. 1998. Personal interview. University of Natal, Pietermaritzburg.

Johnston M.A. 1998. Mail questionnaire. University of Natal, Pietermaritzburg.

Wood, R.A. 1998. Personal interview. SASA, Mt Edgecombe.

Haynes (1998) did not list his opinion stating rather that these depend largely on the nutrient content of the various manures and the rate of application. Baxter (1998) explained that manure contains certain trace elements not found in most chemical fertilisers and that manure has an important neutralising effect on soil acidity. Wood (1998) concluded by saying that such products, if used in sufficient quantity, enrich soils by adding organic matter, humus and micro-organisms. They help to make soil nutrients more available to crops and improve overall structure and health.

It was then important to ascertain what would be the most important disadvantages of using such a product as a soil conditioner and as a nutrient source. The results are indicated in Tables 7.3 and 7.4.

Table 7.3: Disadvantages of using a blended product as a soil conditioner

	Norvall	Baxter	Farina	Johnston	Hughes	Wood
Application difficulties	3	1	2	3	3	4
Nutrient imbalance			4	4	2	3
Volumes required	1		1	2	1	5
Bulkiness						1
On land loss			3		4	
Logistical costs				1		2
Pollution	2					

Note: Characteristics ranked from most disadvantageous (1) to least disadvantageous (5).

Sources: Baxter, N. 1998. Personal interview. Nitrochem, Howick.

Farina, M. 1998. Telephonic interview. Independent soil consultant, Howick.

Hughes, J. 1998. Personal interview. University of Natal, Pietermaritzburg.

Johnston, M.A. 1998. Mail questionnaire. University of Natal, Pietermaritzburg.

Norvall, F. 1998. Personal interview. Stockowners, Howick.

Wood, R.A. 1998. Personal interview. SASA, Mt Edgecombe.

It would appear from Table 7.3 that with three out of six respondents ranking it as the most important disadvantage of using such a product as a soil conditioner, the volumes of such a product required could prove problematic. This in turn would influence application difficulties, the bulkiness of the product and logistical costs (transport, handling and application). Baxter (1998) stated that with the correct handling equipment, the volumes required would not pose too much of a problem.

Table 7.4: Disadvantages of using a blended product as a soil nutrient source

	Baxter	Farina	Johnston	Hughes	Wood	Haynes
Application difficulties	2	2	3	3	3	
Nutrient imbalance	1	1	4	2	1	
Volumes required		4	2	1	2	1
On- land loss		3		4		
Logistical costs			1		4	

Note: Characteristics ranked from most disadvantageous (1) to least disadvantageous (4).

Sources: Baxter, N. 1998. Personal interview. Nitrochem, Howick.

Farina, M. 1998. Telephonic interview. Independent soil consultant, Howick.

Haynes, R.J. 1998. Mail questionnaire. University of Natal, Pietermaritzburg.

Hughes, J. 1998. Personal interview. University of Natal, Pietermaritzburg.

Johnston, M.A. 1998. Mail questionnaire. University of Natal, Pietermaritzburg.

Wood, R.A. 1998. Personal interview. SASA, Mt Edgecombe.

In the opinion of the majority of respondents in Table 7.4, two outstanding disadvantages of using such a product as a soil nutrient source are a probable nutrient supply imbalance and once again the volumes of the product which would be required. Baxter (1998) stated that some trace elements found in the manure may be excessive and detrimental, such as copper in pig manure. Wood (1998) concluded by stating that the main disadvantages of most organic manures are their bulk, high costs of handling, transporting and application coupled with an imbalance in nutrient supply.

It is of vital significance to determine whether the soil conditioning effect of manures on soil is important and significant in the opinion of the soil experts as presented in Table 7.5. This information will give much needed assurance when considering the development of a blended product.

Table 7.5: Opinions of soil experts regarding the effect of manure on soil condition

	Yes	No	Undecided
Important	86%	14%	0%
Significant	72%	14%	14%

The largest variable influencing the opinions in Table 7.5 was that of differing climatic and soil conditions. The positive effects of using manures is more important and significant under some conditions. Farina (1998) was of the opinion that the soil conditioning effects of the product would be minimal. This is due to the fact that the importance and significance of the conditioning effect is quantity dependant. It was the opinion of Farina that the quantities used in a blended fertiliser would be too little to be significant.

Lastly, it is always important that such a product be applicable to different crops and users under varying conditions. The experts were asked in what other spheres they foresee a possible demand for such a product. The results and percentage of responses per use are as indicated in Table 7.6.

Table 7.6: Alternative potential markets for a blended product

	Percentage
Vegetables	86
Nurseries own use	71
Municipalities	14
Domestic households	43
All crops and pastures	14

From Table 7.6 it can be seen that vegetables, nurseries and domestic consumers as sources of possible demand have one common trait - their intensive nature. This allows for the product to be used in a more specialised environment under stricter management practices. This, in turn, allows for a higher price to be attached to the product. As mentioned the nurseries approached expressed no interest in using such a product due to possible toxicity.

7.2.3 Overall opinion of experts regarding the production and use of a blended product

Through all the above findings it can be deduced that while these experts agree that the sustainability of sugar cane production needs to be improved, there seems to be some scepticism surrounding the use of organic material and more importantly the use of a blended product to obtain this goal.

To illustrate this, Farina (1998) stated, "One will pick up the fact that I am somewhat sceptical about the value of manure in small quantities. A few years ago chicken litter from a layer operation was compared with inorganic fertiliser here at Cedara. No differences in soil characteristics were detectable at equivalent nutrient levels".

Wood (1998) went further to state, "While in theory such a product may have great potential, in practice it would not be able to compete with inorganic fertilisers which can supply the nutrients required for sugar cane far more cost effectively. However, such products do have a niche in more intensive agriculture on a relatively small scale. Also, the costs of production of pelletted organic products are considerable in terms of the processing plant required".

Hughes (1998) stated, "It is possible, but the product will be in competition with already established products. Volumes of manures required and their maturity will also prove problematic".

Johnston (1998) referred to a lack of existing proof when he stated that, "I'm sure that there is a place for such a product, but it will need to be demonstrated in field experiments that it is superior".

Norvall (1998) touched on the transport economics of the problem when he concluded by saying, "If the product can be produced in a sufficiently concentrated form to make transport economically feasible, then such a product can do well".

7.3 Farmer based expectations and requirements of a blended fertiliser for Midlands North

7.3.1 The existence of a potential market

A big consideration when planning for a new product is whether there is a potential market for the product. The respondents were given basic information regarding the type of product and its main characteristics. They were then questioned on various aspects of their potential use of the blended product.

Firstly, the respondents were asked whether they would use such a product. The answer was a unanimous yes. The respondents were then asked whether they were aware of any similar products. Only one farmer knew of such a product.

These findings bode well for the development and introduction of a blended organic fertiliser. It seems that a potential market does indeed exist, with very little or no known competition. Next, it is important to identify criteria that the potential consumers of such a product would consider when looking to purchase such a product.

7.3.2 Factors influencing the farmers' product use decision

For the product to be purchased and used, it should have characteristics that make it appealing to the consumer. The respondents were asked to rank various product characteristics from most important (1) up to least important (6). Some of the respondents included additional decision criteria which increased this number to eight in some cases.

The findings relating to product characteristic considerations for potential consumers of a blended product do have a weakness. Many of the respondents ranked some or all of the characteristics as one (1), or most important. This may be accurate, in that all these aspects are of equal and vital importance, however, this sloughs the data to the left (graphically speaking).

In table form, the results showing the rank importance and percentage of respondents allocating the rank position per criteria are as indicated below in Table 7.7. When comparing the criteria vertically, for price specifically it can be seen in Table 7.7 that 90 percent of the respondents rating price ranked this as important when considering the purchase and use of such a product. When looking at quality, a U-trend can be seen. For 29,4 percent of the respondents quality was the most important product characteristic while the same percentage saw it as the least important aspect.

The relatively even spread of ranking position percentages for the volumes of the product required, gives the impression that it was not seen as a distinctly crucial decision aspect. On the other hand, the bulkiness of the product was of relatively large concern to the consumer. This deduction is made due to the fact that 57,8 percent of the respondents ranked bulkiness as an important consideration when deciding to use a product or not.

A possible explanation for this view on product bulkiness is an opinion amongst those currently using organic materials with a bulky nature and those who are not using organics, but who have reservations regarding product form, who would be concerned regarding the product's bulkiness. Those who are currently using products with less bulk and/or who are equipped to handle the product will find bulkiness less important a consideration.

Due to the nature of soils in the Midlands region, it is understandable why the soil conditioning properties of the product were of such importance to the consumer. With 83,3 percent of the respondents ranking this as an important consideration, this point is vindicated. With regards to the 16,7 percent who ranked soil conditioning at sixth most important, one can only assume that either these soils are already high in organic content, are in less need of conditioning or that the respondent had reservations regarding the soil conditioning value of organic material.

Table 7.7: Ranking of farmer based purchase and use decision criteria for a blended product for Midlands North showing criteria comparisons vertically

	Decision factor						
Rank order	Price (%)	Quality (%)	Volumes required (%)	Bulkiness (%)	Soil conditioning (%)	Nutrient source (%)	Water retention (%)
1	55,0	29,4	20,0	31,6	50,0	36,8	26,7
2	15,0	17,7	20,0	15,8	22,2	21,1	13,3
3	20,0	5,8	15,0	10,4	11,1	5,3	26,7
4	5,0	17,7	15,0	5,3	0,0	5,3	6,6
5	5,0	29,4	15,0	0,0	0,0	10,4	0,0
6			15,0	15,8	16,7	5,3	6,7
7				15,8		15,8	13,3
8				5,3			6,7
Total %	100	100	100	100	100	100	100
Respondents per factor	20	17	20	19	18	19	15

From Table 7.7 it can be seen that product nutrient value was again seen as important with 57,9 percent of respondents ranking highly as a decision criterion. The 15,8 percent who ranked it as only seventh most important, either saw the product's nutrient value as being of secondary importance or envisage using other products for nutrient purposes. Water retention was also deemed an important product characteristic by potential users. A total of 66,7 percent of respondents ranked water retention as important when looking at such a product. Once again, there were those who felt it was not of vital importance.

Other characteristics with less than five responses were: nutrient solubility, proof of use benefits, additional equipment requirements and hygiene considerations. These were excluded from Table 7.7.

In order to compare these findings horizontally, the percentage of respondents from the total number of respondents ranking each characteristic as most important is presented below in Table 7.8.

Table 7.8: Horizontal comparison of characteristics ranked as most important (1) for Midlands North

Characteristic	Number of respondents ranking as most important	Percentage of total characteristics ranked as 1 (%)
Price	11	23,9
Quality	5	10,9
Volumes required	4	8,7
Bulkiness	6	13,0
Soil conditioning	9	19,6
Nutrient source	7	15,2
Water retention	4	8,7
Total	46	100

From Table 7.8 it can be seen that price was ranked as most important more times than any other criteria which was also ranked by the respondents as most important.

This was followed by soil conditioning properties and then nutrient source. These results are consistent with those in Table 7.7.

An additional presentation method is to calculate an average of the rankings from all the respondents per characteristic. It is important to remember that it is not the figure that is of importance, but rather the order of the characteristics - going from most important to least important on an average basis. Characteristics with less than five responses are omitted.

Table 7.9 gives the average rank value and this value is used to give a rank order per product characteristic. It would seem that financial considerations are a priority followed by the soil conditioning properties of the product. The fact that the lowest ranking aspect, bulkiness, is ranked at an average of 3,6 illustrates the left bias which the data exhibited.

Table 7.9: Rank order position per average of each product characteristic for Midlands North

Rank Order	Product characteristic	Average rank value
1	Price	1,9
2	Soil conditioning properties	2,3
3	Quality	3,0
4	Nutrient value	3,1
5	Volumes required	3,5
5	Water retention properties	3,5
6	Bulkiness	3,6

Note: Characteristics ranked from most important (1) to least important (6)

7.3.3 Consumer based product preferences

The farmer respondents were then questioned regarding their preferences with regard to product type, form and packaging characteristics. The results per organic material type were as indicated in Table 7.10 (percentage indicates number of farmer respondents indicating that specific preference):

Table 7.10: Preferred product type, form and packaging characteristics for Midlands North

	Respondents %
Chicken litter, pelletted, bagged (30 dm^3)	14,71
Chicken litter, granulated, bagged (30 dm^3)	20,59
Chicken litter, granulated, bulk	5,88
Chicken litter, loose, bulk	17,65
Battery manure, pelletted, bagged (30 dm^3)	5,88
Battery manure, granulated, bagged (30 dm^3)	5,88
Feedlot manure, pelletted, bagged (30 dm^3)	8,82
Feedlot manure, granulated, bagged (30 dm^3)	14,71
Feedlot manure, loose, mini-bulk (500 kg)	2,94
Filter cake, granulated, bagged	2,94
TOTAL	100

From Table 7.10 above, the following product preferences can be deduced-

Material type:

- Chicken litter - 58,83%
- Feedlot manure - 26,47%
- Battery manure - 11,76%
- Filter cake - 2,94%

Product form:

- Granulated - 50,00%
- Pelletted - 29,41%
- Loose - 20,59%

Product packaging:

- Bagged - 73,53%
- Bulk - 23,53%
- Mini-bulk - 2,94%

From this summary, it is evident that the most popular product description relating to material, form and packaging, would be one that is chicken litter based, granulated and bagged in 30 dm^3 packaging. This would be an important aspect of the product to consider during product development. These specific product characteristics correlate relatively closely with blender requirements and capabilities. Foreseeable problems include the high level of value addition for a product with a fairly low cost reputation and the limited availability of large enough volumes of accessible chicken litter - physically and economically.

7.3.4 Increased expenditure criteria for a blended product

The farmer respondents were then posed with three situations where the blended product, with its organic base, has firstly higher levels of Nitrogen, Phosphorous and Potassium (N, P and K) per unit weight, secondly the same levels and lastly lower levels of N, P and K. The question was then posed to them as to whether they would pay more for the blended product than for inorganic fertilisers under the various situations.

The results read as follows:

- Higher N, P and K - 90 % would pay more
- Same N, P and K - 50 % would pay more
- Less N, P and K - 10 % would pay more

These results speak largely for themselves, obviously the respondents who are willing to pay more for an organically based product with lower amounts of N, P and K per unit weight, value its other properties highly. It was surprising that more than 50 percent of the respondents were not willing to pay more for a blended product with the same N, P and K levels.

From these findings, the next step was to ascertain why the farmer respondents would be willing to pay more for a blended product than for conventional fertilisers. The objective was to determine criteria which could influence the spending patterns of the respondents for such a product. Again, the farmer respondents were asked to rank their choices from most important (1) to least important (6). A number of farmer respondents did not rank all the criteria.

In Table 7.11 below it can be seen that improved soil conditioning and a more balanced nutrient supply are ranked as the most important reason for added expenditure being validated for a blended product. To further analyse this data presented in Table 7.11 in an attempt to rank these criteria in an order of importance, the three basic statistical measures of average, mean and mode will be used. Although these measures are very simplistic in their design, they are well suited for use in this type of data set. These results are presented in Table 7.12.

Table 7.11: Increased expenditure criteria and frequency of rankings per position for Midlands North

Criteria	Ranking order and frequency					
	1	2	3	4	5	6
Improved soil conditioning	11	1	1			
More balanced nutrient supply	10	3	1	2		
Reduced supplementary fertilising	5	4	1	2	2	
Improved water retention	3	1	1	2	1	1
Nutrient value	1	3	2		2	1
Trace element supply		2			1	
Slower Nitrogen release				1		

Table 7.12: Increased expenditure criteria analysis for Midlands North

Criteria	Average	Mean	Mode
1. Improved soil conditioning	1,2	1	1
2. More balanced nutrient supply	1,7	1	1
3. Reduced supplementary fertilising	2,4	2	1/2
4. Improved water retention	3,0	3	1
5. Nutrient value	3,2	3	2
6. Trace element supply	3,5	*	*
7. Slower Nitrogen release	4,0	*	*

* Too few responses to warrant inclusion.

From the results in Table 7.12, these criteria can be placed into an order of importance. The average is the most accurate due the fact that, as once before, a number of the respondents did not rank their criteria numerically and only indicated which of the criteria were of importance. This has lead to an imbalance in the data. The statistical average smoothes these inaccuracies. This sloughing is evident in the mode, where a criterion with an average of 3,0 has a mode of one.

It is important to remember that it is the order of the criteria and not the figure that is important. Calculating the average for the data set should be seen as the means to this end, and not the end itself. Bearing this in mind the order of importance for criteria influencing the spending patterns of the respondents for the blended product versus conventional fertilisers is as above in Table 7.12.

Lastly, the farmer respondents were questioned regarding potential alternate application possibilities of the blended product on their farms. This was done to assess the potential of introducing the product for application to other crops and enterprises. The results read as follows:

- Orchards - 3
- Vegetables - 4
- Maize - 5
- Pastures - 8
- Cut flowers - 2

It is important that any product has more than one application or usage possibility. However, the product will only be used where its use is economically justified. For this reason, there is some scepticism regarding the application of such a product in lower return enterprises such as pastures. Having said this, it is encouraging to see that farmers are willing to use such a product on various crop types.

7.4 Farmer based expectations and requirements from a blended fertiliser for Midlands South

7.4.1 The existence of a potential market

The farmer respondents were questioned regarding their potential use of an organically based blended fertiliser. Firstly, they were asked whether they would consider using such a product. 100 percent of the respondents said they would. With regards to any knowledge of a similar product on the market, 35,7 percent said that they were aware of a rival product.

From these figures it can be seen that a potential market does exist, with relatively little competition. This bodes well for the development of a new product. The next step was to identify criteria that the potential consumers of such a product would consider when looking to purchase the product.

7.4.2 Factors influencing the farmers' product use decision

For a product to be purchased and used, it must be able to satisfy the need for certain product properties important to the consumer. The farmer respondents were asked to rank various product characteristics from most important (1) up to least important (7).

The results are presented in Table 7.13, where the rank order is shown down the left of the table, decision factors along the top, giving the percentage of farmer respondents ranking each factor in that specific position. Additionally, the total number of respondents which ranked each factor is also presented.

Table 7.13: Ranking of farmer based purchase and use decision criteria for a blended product for Midlands South showing criteria comparisons vertically

	Decision factors						
Rank order	Price (%)	Quality (%)	Volumes required (%)	Bulkiness (%)	Soil conditioning (%)	Nutrient source (%)	Water retention (%)
1	91,7	9,1	10,0	8,3	33,3	7,7	
2	8,3	27,3	30,0	16,7	8,3	61,5	18,2
3		9,1	20,0	8,3	33,3	15,4	9,0
4		27,3	10,0	8,3	8,3		27,3
5		27,2	20,0	16,7		7,7	18,2
6			10,0	25,0	16,8	7,7	
7				16,7			27,3
Total %	100	100	100	100	100	100	100
Respondents per factor	12	11	10	12	12	13	11

From Table 7.13 it can be seen that when compared vertically per criteria, price is ranked as the most important factor by the respondents when considering purchasing the product. 91,7 percent of the respondents who ranked price, ranked it as a number 1 priority. Note that 61,5 percent of the respondents voted nutrient source as the second most important consideration when ranking this factor specifically. The fact that 74,9 percent of farmers responding for soil conditioning placed it within their top three most important considerations, shows the emphasis placed upon this characteristic. This can be ascribed to the degradation of soils in the area.

It is further evident from the data that the quality of the product, its bulkiness and its water retention properties are not seen as crucial when making the use decision. This can be deduced from the fact that for all three of these factors over 50 percent of respondents placed them within the three least important use decision criteria. Another factor which was mentioned by one respondent was the effect of the product on the percentage sucrose of the sugar cane.

In order to compare these findings horizontally, the percentage of farmer respondents from the total number of respondents ranking each characteristic as most important is presented below in Table 7.14.

Table 7.14: Horizontal comparison of characteristics ranked as most important (1) for Midlands South

Characteristic	Number of farmer respondents ranking as most important	Percentage of total characteristics ranked as 1 (%)
Price	11	57,8
Quality	1	5,3
Volumes required	1	5,3
Bulkiness	1	5,3
Soil conditioning	4	21,0
Nutrient source	1	5,3
Water retention	0	0,0
Total	19	100

In Table 7.14 it can be seen that price was ranked as most important more times than any other criteria which was also ranked by the farmer respondents as most important. This was followed by soil conditioning properties. The remaining characteristics were possibly not seen as important factors when considering the purchase and use of such a product. These results are consistent with those in Table 7.13. The above deductions are further confirmed when an average ranking is calculated for each characteristic. It is important to remember that it is not the figure which is of importance, but rather the resulting order of the criteria as presented below in Table 7.15.

Table 7.15: Rank order position per average of each product characteristic for Midlands South

Rank Order	Product characteristic	Average rank value
1	Price	1,1
2	Nutrient value	2,6
3	Soil conditioning properties	2,8
4	Volumes required	3,3
5	Quality	3,4
6	Bulkiness	4,5
6	Water retention properties	4,5

Note: Characteristics ranked from most important (1) to least important (6)

7.4.3 Consumer based product preferences

The farmer respondents were then questioned regarding their preferences with regard to manure base, product form and packaging characteristics. The results per organic material type are as indicated below in Table 7.16.

Table 7.16: Preferred product type, form and packaging characteristics for Midlands South

	Respondents (%)
Chicken litter, pelletted, bagged (30 dm^3)	14,3
Chicken litter, granulated, bagged (30 dm^3)	23,7
Chicken litter, granulated, mini-bulk (500 kg)	28,5
Chicken litter, granulated, bulk	4,8
Battery manure, pelletted, bagged (30 dm^3)	4,8
Battery manure, loose, bulk	4,8
Feedlot manure, granulated, bagged (30 dm^3)	9,5
Feedlot manure, pelletted, bulk	4,8
Filter cake, granulated, bagged	4,8
TOTAL	100

From Table 7.16, the following product preferences can be deduced-

Material type:

- Chicken litter - 71,3%
- Feedlot manure - 14,3%
- Battery manure - 9,6%
- Filter cake - 4,8%

Product form:

- Granulated - 71,3%
- Pelletted - 23,9%
- Loose - 4,8%

Product packaging:

- Bagged - 57,1%
- Mini-bulk - 28,5%
- Bulk - 14,4%

From this summary, it is evident that a chicken litter based product, which is granulated and bagged in 30 dm^3 packaging is the most popular product description. This is similar to Midlands North and falls within the boundaries of blender capabilities. High levels of value addition and raw material availability are potential limitations of this product type.

7.4.4 Increased expenditure criteria for a blended product

The farmer respondents were asked whether they would pay more for a blended product with higher, equal and lower levels of N, P and K. The results were as follows:

- Higher N, P and K - 85,7 % would pay more
- Same N, P and K - 50,0 % would pay more
- Less N, P and K - 7,1 % would pay more

The results are largely self-explanatory in that those willing to pay more for a product with an organic base but, with lower levels of N, P and K, value the product's other properties highly. As for Midlands North, it is surprising that more than 50 percent of the respondents would not be prepared to pay more for a blended product with the same levels of N, P and K.

The next step was to ascertain why the farmer respondents would be willing to pay more for a blended product, over inorganic fertilisers. This would give some idea as to the competitive advantage of the blended product over inorganic fertilisers in the opinion of the target market. Respondents ranked the choices from most important (1) to least important (5). Note that not all the respondents ranked all the criteria.

Table 7.17: Increased expenditure criteria and frequency of rankings per position for Midlands South

Criteria	Ranking order and frequency				
	1	2	3	4	5
Improved soil conditioning	8	1	2		1
More balanced nutrient supply	4	4	1	1	1
Reduced supplementary fertilising requirements	1	2	4	3	1
Improved water retention	1	3	3	2	2
Nutrient value	3	3	2	2	2

In attempt to determine an order of importance for these criteria in Table 7.17, the three basic statistical measures of average, mean and mode will be used. Although these measures are simplistic in their design, they are well suited to data of an ordinal nature. The results are presented in Table 7.18 below.

Table 7.18: Increased expenditure criteria analysis for Midlands South

Criteria	Average	Mean	Mode
1. Improved soil conditioning	1,8	1	1
2. More balanced nutrient supply	2,2	2	1/2
3. Nutrient value	2,8	2,5	1/2
4. Improved water retention	3,1	3	2/3
5. Reduced additional fertilising	3,1	3	3

Compared to that for Midlands North (see Table 7.12), the data presented in Table 7.18 is far more meaningful and statistically correct. There is far less sloughing of the data, which indicates that the ranking was done as requested. The average is used to determine the order of criteria importance regarding why the farmer respondents would pay more for a blended product than for inorganic fertilisers. From this it can be deduced that when promoting the product, its soil conditioning properties and the resulting reduction in additional fertilising requirements should be emphasised, for example.

Lastly, the respondents were asked whether they would considering using it on other crops on their farms. This was done to assess the potential of introducing the product for alternate application uses. The results read as follows:

- Orchards - 1
- Vegetables - 5
- Maize - 6
- Pastures - 8
- Forestry - 3

It is important for product sustainability that it has more than one application or usage possibility. However, the product will only be used by farmers where its use is economically justified. For this reason there is some scepticism regarding the application of such a product in lower return enterprises such as pastures.

7.5 Summary

The potential of the KZN Midlands sugar cane growing region as a potential consumer of a blended, organically based fertiliser was investigated in this chapter. This involved an investigation into the opinions of soil analysts and consultants regarding the possibility and feasibility of producing such a product as well as perceived product characteristics. This was then followed by the opinions of the farmers from the Midlands North and South regions, as potential consumers of the product, regarding product preferences and use characteristics.

The soil experts conveyed a sense of scepticism regarding the effectiveness of such a product. This was due mainly to the large volumes of manure which they foresee for effective soil conditioning and nutrient supply. These large volumes of product would mean high acquisition, transportation and application costs, jeopardising the product's feasibility. It is their opinion that producing such a product would indeed be possible, but question the feasibility of production, especially when potential costs are compared to those of inorganic fertilisers. Importantly, the need for clear proof of the benefits of using such a product was mentioned as vital for its success.

The farmers on the other hand seemed extremely interested in the use of such a blended product. Criteria used to justify the added expenditure of purchasing such a product, emerge as very important in justifying the production of a blended product. It was deduced that a granulated product with an organic base of chicken litter and packaged in 30 dm^3 bags, would be the most popular product description preferred in both regions. The price of the product is of vital importance to the potential consumer, as is the product's soil conditioning properties. These and other aspects within this chapter, are all important factors relating to product development, processing, promotion and distribution. Importantly, an in-depth marketing plan falls outside the scope of this thesis. However, the data presented in this chapter goes some way to providing a building block for this purpose.

CHAPTER 8
CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

Chapter 2 presented a theoretical framework for sustainability. From this it was concluded that while there are many interpretations of sustainability, there exists no concrete and all-encompassing definition of the term. There are also many schools of thought and different agricultures which preach aspects of sustainability. These are often very different and sometimes even contradictory in nature.

This was further highlighted by the comments and opinions of soil scientists and consultants. They too had varying ideas and thoughts surrounding sustainability as a term and the sustainability of sugar cane production in the KZN Midlands. It emerged that due to the uncertainty and misunderstanding surrounding the term sustainability amongst farmers and advisors, unintentional non-sustainability had occurred. This should be addressed through reduced tillage, manure application, green cane harvesting and trash mulching - all of which result in improved soil conservation practices.

Chapter 3 gave a description of the study area. It is important to have a knowledge of the spatial and physiographical nature of the region. Included was a broad example of a sugar cane production system for the region, a more detailed investigation of current farming practices in the study region, especially with regard to fertilising, and a cost breakdown of a typical sugar cane production system for a season. This chapter supplied region based background information to the reader.

Chapter 4 involved an investigation into the various sources of organic material, their location and production characteristics. As was to be expected, chicken litter emerged the most expensive and sought after product. Of the 107 900 tons produced annually, 84 000 tons is secured contractually by H&K Enterprises alone. Battery manure is in less demand due mainly to the form of the product, but it is produced in smaller quantities (21 614 tons). Feedlot manure is in plentiful supply (48 900 tons) and is basically given away free at the source as a means of waste disposal. This negligible cost together with the product's acceptability as an organic fertilising material ensures that there is a demand for the product. Deceptively high costs associated with transportation and application of the more bulky organic products makes their application less feasible. Slurry cow manure and pig manure appear to have no market within the study region.

The decision as to which type of manure to investigate was based on the opinion of soil experts with regard to which products would be best suited for use in a blended, organically based fertiliser. These opinions are presented at the start of Chapter 4.

Chapter 5 presented the various sources of competition within the organics milieu. The importance of this is to have a knowledge of potential sources of product competition. A background of each business was presented, its product discussed and its raw material acquisition characteristics explored. It is important to note that from this it was deduced that only Igwababa Manufacturers would be direct competitors in the market place. The other businesses would be competing on an input resource level. H&K Enterprises, as a relative new-comer, is having a large influence on chicken litter availability in KZN.

In Chapter 6, the processing and distribution implications of a blended organic fertiliser were presented. This included an overview of the current Nitrochem blender as well as an investigation into two existing organic product blenders. From this it was concluded that for an organic blending operation to be accommodated at the present site, additional storage and work space would be required as well as certain mechanical advancements. This would require large capital outlays. However, according to Nitrochem, mechanical and structural changes withstanding, it would be possible to produce an organically based, blended product with a range of inorganic components for different application situations.

Finally, Chapter 7 presented the target market characteristics and perceived product characteristics of a blended product. Soil analysts and consultants were questioned regarding their opinions surrounding the production of a blended product. From this it emerged that there was scepticism regarding the meaningful effect of organic material on soil sustainability and the production, application and sustaining effect on soils of a blended, organically based product in the region. The volumes of product required, cost effectiveness of use and lack of scientific evidence were cited as main areas of concern. This was in contrast to the opinions of the farmers interviewed.

These farmers were then consulted and the respondents then gave their opinions regarding the potential use of a blended product. It was found that many farmers are, or would like to be, using organic material in their fertilising programs. Chicken litter is the most commonly used material followed by filter cake. All the respondents expressed an interest in using a blended organic product, with the price of the product, its soil conditioning properties, its value as a nutrient source and a potential decrease in supplementary fertilising resulting from its use as the most important factors influencing the decision to use the product or not. With regards to product description, both regions expressed a preference for a granulated product, with a chicken litter base, packaged in 30 dm^3 bags.

8.2 Recommendations

1. Firstly, and most importantly, there needs to be scientifically based work done on the effects of organic material on soil condition, especially with regard to its acidity reducing properties, and as a plant nutrient source. Scientific evidence is severely lacking in this field and is vitally important when developing and promoting such a product.

2. A reliable source of raw material is required. Judging from the results presented in Chapter 7, chicken litter should be the material of choice. Chicken litter also appeared to be the best suited in terms of its form, chemical composition and concentration (see Chapter 2 and 7). From Chapters 4 and 5 it can be seen that securing a reliable chicken litter source could prove problematic. There is a large demand for the product and securing such a contract could prove costly. It is important that the source can satisfy the demand for the raw material throughout the year and that it is located such that transportation costs would not make the

operation unfeasible. To ensure the success of the operation, a sound market for the product must be established.

3. Changes will need to be made to accommodate an organic blending operation at the present site in Cato Ridge. Increased storage and work space and additional machinery would be required. It is recommended that the product be available pelletted and granulated to fully satisfy customer needs. Obviously, machinery costs would dictate whether this would be possible. These changes will involve large capital outlays which will further increase the cost of production, especially initially.

4. No product can be successful without a sound market. As the product is a relatively new concept for many farmers, promotion will be of utmost importance. From Chapter 7 it can be seen that there are certain properties which the potential consumers see as important when making the product use decision. Promoting these characteristics of the product such as its soil conditioning properties, its value as a plant nutrient source and its supplementary nature with regards to regular fertilising, will heighten consumer awareness and gain a market share. It is important though that these benefits have the backing of scientific evidence. It is also important to look at other possible markets for the product. These would include: flowers, market gardeners, vegetables and other intensive, high return crops.

5. A sound price policy for the product is vital. In Chapter 7, potential consumers placed price as the most important factor influencing the product use decision. For this reason, it is important that the price be competitive with market place prices of other organic and inorganic products. Raw material and transport costs will make up the largest proportion of the total cost of production, which re-iterates the importance of a reliable and economically feasible source of chicken litter. This could result in very low profit margins and high levels of competitiveness between producers, which is the current situation in the fertiliser industry anyway.

6. Lastly, due to the limited availability of chicken litter, it would be worth investigating the use of other organic materials as base products. It is

recommended that feedlot manure and even filter cake be considered due mainly to their plentiful supply and their acceptability as organic fertilising materials. This would involve a close look at their chemical analysis, concentration, product form, soil conditioning properties and transport and processing implications.

recommended that feedlot manure and even filter cake be considered due mainly to their plentiful supply and their acceptability as organic fertilising materials. This would involve a close look at their chemical analysis, concentration, product form, soil conditioning properties and transport and processing implications.

REFERENCES

ATWELL, G. 1998. Personal interview. Production Manager, Argyle Poultry Farms, Cramond.

BALFOUR, E.B. 1947. The Living Soil: Evidence of the importance to human health of soil vitality, with special reference to post-war planning. Faber, London.

BAXTER, N. 1998. Personal interview. Nitrochem Fertilisers, Howick.

BRAITHWAITE, B. 1998. Personal interview. Dairydale Farm, Baynesfield.

DEPARTMENT OF ENVIRONMENTAL AFFAIRS. 1992. Building the foundation for sustainable development in South Africa. Report to UNCED, Rio de Janeiro. Department of Environmental Affairs. Pretoria.

DIEDERICKS, B. 1999. Personal interview. Director Bionamix Terramax, Somerset West.

DOUGLAS, G.K. 1985. 'When is agriculture "sustainable"?' In: Edens, T.C., Fridgen, C. and Battenfield, S.L. (eds). Sustainable agriculture and integrated farming systems. Michigan State University Press, East Lansing.

ENGLISH, P. 1998. Personal interview. Triple A Beef, Cramond.

EUROSTAT. 1997. Indicators of Sustainable Development - A pilot study following the united Nations Commission on Sustainable Development. Office for Official Publications of the European Communities, Luxembourg.

FARINA, M. 1998. Telephonic interview. Independent soil consultant, Howick.

FREUDENBERGER, C.D. 1986. 'Value and ethical dimensions of alternative agricultural approaches: in quest of a regenerative and just agriculture'. In: Dahlberg, K.A. (ed). New directions for agriculture and agricultural research. Rowman and Allanheld. New Jersey.

GHARAJEDAGHI, J. 1985. Toward a systems theory of organization. Intersystems, Pennsylvania.

GIBSON, W. 1998. Personal interview. Nitrochem agronomist and previous SASA Extension Officer- Natal Midlands. Eston KwaZulu-Natal.

GPS Mapping. 1998. Farm mapping services, Howick.

HAGEN, R. 1998. Personal interview. Gromor National Plant Foods, Cato Ridge.

HANSEN, J.A. & HENRIKSEN, K. 1989. Nitrogen in Organic Wastes Applied to Soils. Academic Press, London.

HAYNES, Prof. R.J. 1998. Mail questionnaire. School of Applied Environmental Sciences, University of Natal, Pietermaritzburg.

HOWARD, A. 1940. An agricultural testament. Oxford University Press. London.

HOWARD, R. 1998. Personal interview. Production manager, Kynoch Soil Services, Cramond.

HODGES, R.D. 1981. 'An agriculture for the future'. In: Stonehouse, B. (ed). Biological Husbandry: a scientific approach to organic farming. Butterworths, London.

HODGES, R.D. 1982. Agriculture and horticulture, the need for a more biological approach. Biological Agriculture and Horticulture. Vol. 1, No. 1.

HUGHES, J. 1998. Personal interview. Department of Agronomy, University of Natal, Pietermaritzburg.

IKERD, J.E. 1990. Agriculture's search for sustainability and profitability. Journal of Soil and Water Conservation, Vol. 45, No.1.

JOHNSTON, M.A. 1998. Mail questionnaire. Department of Agronomy, University of Natal, Pietermaritzburg.

KILEY-WORTHINGTON, M. 1981. Ecological agriculture. What it is and how it works. Agriculture and Environment, Vol. 6.

KLEYNHANS,T.E.1991. Toepassing van stelselsdenke op ontwikkelingsteorie. Ongepubliseerde proefskrif, Universiteit van Stellenbosch. Stellenbosch.

KONING, B. 1998. Telephonic interview. Crafcor Feedlots, Cramond.

KYRIAKOPOULOS, K. and VAN DIJK, G. 1997. Post-purchase intentions for organic foodstuff. Journal of International Food and Agribusiness Marketing, Vol. 9, No. 3.

LAMPKIN, N.H. 1990. In: LAMPKIN, N.H. & PADEL, S. 1994. The Economics of Organic Farming: an International Perspective. CAB International, London.

LEHMAN, D.R. 1989. Market Research and Analysis. Irwin, Illinois.

LOCKERETZ, W. 1988. 'Open Questions in Sustainable Agriculture'. American Journal of Alternative Agriculture Vol. 3, No. 4.

LOWRANCE, R., HENDRIX, P.F. and ODUM, E.P. 1986. 'An heirarchical approach to sustainable agriculture'. American Journal of Alternative Agriculture, Vol. 1, No. 4.

LYONS, F.T. 1993. A Study of Sustainable Agriculture in the Standerton District. University of Stellenbosch, Stellenbosch.

MAHER, G. 1999. Personal interview. SASA Extension Officer - Midlands North, Bruyns Hill.

MARAIS, D. 1998. Personal interview. Golden Lay Farms, Camperdown.

MOBERLY, P.K. and STEVENSON, D.W.A. 1971. "An evaluation of poultry manure as a sugar cane fertiliser". Paper delivered at the South African Sugar Technologists' Association's forty-fifth annual congress. Durban.

NATIONAL RESEARCH COUNCIL. 1989. Alternative Agriculture. Report of the Committee on the role of alternative farming methods in modern production against agriculture. National Academy Press, Washington DC.

NORVAL, F. 1998. Personal interview. Stockowners, Howick.

PEMBRIDGE, J.A.S. 1998. Personal interview. Director - National Chick Ltd, Umlaas Road.

PERRETT, K. 1998. Personal interview. Rainbow Chickens, Pietermaritzburg.

PRETTY, J.N. 1995. Regenerating Agriculture: Policies and Practice for Sustainability and Self-Reliance. Earthscan Publications, London.

REEVE, I. 1990. Sustainable Agriculture: Ecological imperative or economic impossibility? University of New England, Australia.

RODALE, R. 1984. Alternative Agriculture. Journal of Soil and Water Conservation. Vol. 39, No.5.

SASA. 1997. Experiment Station Information Sheet 7 – Nutrition. Mt Edgecombe.

SASA. 1998a. Industry Directory. Durban.

SASA. 1998b. The South African Sugar Journal. Vol. 82, No. 6.

TOLLENS, E. 1998. Concept and Measurement of Sustainability in Agriculture. Paper presented at the 4th African Farm Management Congress, Stellenbosch.

TWEEDALE, C.J. 1998. Personal interview. Operations Manager - Nitrochem Fertilisers, Howick.

TYLER, R.W. 1996. Winning the Organics Game. ASHS Press, Alexandria.

USDA. 1980. Report and recommendations on organic farming. USDA, Washington.

VAN ROOYEN, H. 1998a. Personal interview. Igwababa Manufacturers, Cato Ridge.

VAN ROOYEN, I. 1998b. Telephonic interview. Manure Application Contractor, Wartburg.

VOGTMAN, H. 1984. Organic farming practices and research in Europe. In: Bezdicek, D.F. and Power, J.F. (eds). Organic Farming: Current technology and its role in a sustainable agriculture. ASA Spec. Publications. Holland.

WAGSTAFF, H. 1987. 'Husbandry methods and farm systems in industrialised countries which use lower levels of external inputs: a review'. Agriculture, Ecosystems and Environment. Vol. 19.

WHEELER, M. 1998. Personal interview. SASA Economist, Hilton.

WILSON, I. 1998a. Telephonic interview. Stockowners Feedlot, Cramond.

WILSON, M. 1998b. Personal interview. Just Nature Organics, Cramond.

WITTIG, H. 1998. Personal interview. Co-owner - H&K Enterprises, Wartburg.

WYLLIE, D. 1998. Personal interview. Piggery Manager - Baynesfield Estates, Baynesfield.

WOOD, R.A. 1998. Personal interview. SASA Agricultural Research Consultant, Mt Edgecombe.

WOOD, R.A. 1981. "Nitrogen availability in soils as influenced by organic fertilisers having different C/N ratios". Paper delivered at the South African Sugar Technologists' Association's fifty-fifth annual congress. Durban.

WORLD RESOURCES 1992-93. 1992. A Guide to the Global Environment. "Toward Sustainable Development". Report by The World Resources Institute. Oxford University Press. New York.

APPENDIX 1

SOIL ANALYST QUESTIONNAIRE

SOIL ANALYST QUESTIONNAIRE

Fact File

Name:..

Age:.....................Gender (M/F):...........

Company/Institution:...

Address:...

....Code:...................

Telephone:.... ....Cell:............................

The purpose of this questionnaire is to gather information to be included in a thesis for the degree M. Agric. Admin. The topic regards an investigation into the sustainability of using a blended organic fertiliser as a soil conditioner and nutrient source in especially sugarcane production in KwaZulu-Natal.

The study is being done through the University of Stellenbosch. Information will be dealt with appropriately and with the utmost professionalism and any data considered confidential will be handled as such.

I thank you sincerely for your assistance and time.

Yours truly,

Darryl Tweedale

This Questionnaire:

Please answer all the relevant questions. Where space is allocated for comments please fill in as completely as possible. Any additional information or suggestions will be most welcome.

Section 1: Sustainability

Sustainability has different meanings for different people in different situations. Bearing this in mind, and employing your knowledge on the topic, consider the following:

1.1. In your opinion, is sustainability important in commercial farming operations?:

Yes	
No	

1.2. Is sustainability feasible in commercial farming operations?:

Yes	
No	

1.3. Concisely, what is your reason for this opinion?:

....

....

....

....

....

1.4. Give a brief definition of a sustainable farming operation in your opinion:

....

....

....

....

....

1.5. In your experience, do commercial farmers see sustainability within their operation as important?:

Yes	
No	

1.6. If not, why is this so?:

Don't understand concept	
Fear of decreased production and less profit	
Change from conventional too costly and risky	
Don't believe sustainability is possible	
Couldn't be bothered	
Other (please specify)	

....

1.7. If they do see sustainability as important, are they doing something to improve the sustainability of their farming operation/production?:

Yes	
No	

1.8. If they are attempting to improve the sustainability of their production, what are they doing?:

Using manure as nutrient source	
Low input of chemical fertilisers	
Low input of chemical weed- and pesticides	
Minimum tillage	
Other (please specify)	

....

1.9. If they are not trying to improve the sustainability of their production, why not?:

Don't understand concept	
Fear of decreased production and less profit	
Change from conventional too costly and risky	
Don't believe sustainability is possible	
Couldn't be bothered	
Other (please specify)	

....

Section 2: Sugar Cane Production in KwaZulu – Natal

2.1. Are the soil conservation practices of sugarcane farmers in KwaZulu-Natal working towards sustainable production?:

Yes	
No	

2.2. What is being or could be done by these farmers to improve the sustainability of their production especially w.r.t. soil conservation?:

Using manure as nutrient source	
Low inputs of chemical fertilisers and weed- / pesticides	
Minimum tillage	
Leave mulch on land	
Filter cake (milo)	
Other (please specify)	

....

2.3. In your opinion, give a brief description of the ideal sugar cane production practice which would couple production with sustainability?:

....

....

....

....

....

....

2.4. Is this ideal production realistically obtainable?:

Yes	
No	

2.5. How close are the majority of producers within the study area to this ideal at present?:

Not close at all	
Relatively close	
Very close	

2.6. Would the use of an organic (blended) fertiliser promote sustainable production in sugar cane?:

Yes	
No	

Section 3: An Organic Fertiliser

The product under investigation is one which is organic (manure) based and blended with chemical components of conventional fertilisers to give a more complete product.

3.1. Is there a place for such a product in the market?:

Yes	
No	

3.2. Would the use of an organic (blended) fertiliser promote sustainable production in sugar cane?:

Yes	
No	

3.3. In your opinion, would producing a range of these products be:

	Yes	No
Feasible		
Possible		

If not, why not?: ....

....

....

....

....

....

3.4. What manure would be best suited to use in the production of such a product (allocate 1 for most suited, 2 for second most suited, etc.)?:

Battery Manure (Layers)	
Chicken Litter (Broilers)	
Feedlot Cow Manure	
Slurry Cow Manure (Dairy)	
Pig Manure	
Sheep/Goat Manure	
Other (please specify)	

....

3.5. Reason(s) for allocation order in 3.4.:

	Position	
Battery Manure (Layers)		
Chicken Litter (Broilers)		
Feedlot Cow Manure		
Slurry Cow Manure (Dairy)		
Pig Manure		
Sheep/Goat Manure		
Other (please specify)		

....

3.6. What would be important advantages of using such a product as a soil conditioner and soil nutrient source (again, 1=most important, 2=second most important, etc.)?:

	Soil Conditioner	Soil nutrient source
Increased organic content		
Soil conditioning		
Better meeting of nutrient requirements		
Improved balance w.r.t. nutrient supply		
Other (please specify)		

....

Further comments: ....

....

....

3.7. What would be the most important disadvantages of using such a product as a soil conditioner and nutrient source (again, 1=most important, etc.)?:

	Soil conditioner	Soil nutrient source
Application difficulties		
Imbalance in nutrient supply		
Volumes needed		
Waste through drying out and washing away		
Other (please specify)		

....

....

3.8. Would such a product, applied at the correct rate, be as effective as conventional fertilisers in supplying the necessary nutrients?:

Less effective	
No difference	
More effective	

3.9. Is the soil conditioning effect of manures on soil important and significant?:

	Yes	No
Important		
Significant		

3.10. In what other spheres (agricultural or otherwise) do you foresee a possible demand for such an organic fertiliser blend?:

Vegetables	
Nurseries	
Municipalities	
Domestic household	
Other (please specify)	

....

3.11. General comments on the idea of producing such a product:

....

....

....

....

....

....

THANK YOU FOR YOUR ASSISTANCE

APPENDIX 2

COMPETITORS QUESTIONNAIRE

COMPETITORS QUESTIONNAIRE

Fact File:

Name of company / business:………………………………………………………………

Name of manager / owner:……………………………………………………………………

Address:………………………………………………………

………………………………………………………

…………………………………Code:………………

Telephone:……………………………………Cell Phone:……………………………

Physical address / location:…………………………………………………………………

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

The purpose of this questionnaire is to gather information to be included in a thesis for the degree M. Agric. Admin. The topic regards an investigation into the sustainability of using a blended organic fertiliser as a soil conditioner and nutrient source in especially sugarcane production in KwaZulu-Natal.

The study is being done through the University of Stellenbosch. Information will be dealt with appropriately and with the utmost professionalism. Any data considered confidential will be handled as such.

I thank you sincerely for your assistance and time.

Yours truly,

Darryl Tweedale

This Questionnaire

Please answer all the relevant questions. Where space is provided for comments or further discussion please fill in as completely as possible. Any additional information or suggestions will be most welcome.

Section 1: Your Business and Product

1.1. What product (s) are produced by your business (supply a percentage of total production per product)?:

	% of total	% of total	% of total
Animal Feeds			
Compost			
Inorganic fertiliser			
Other (please specify)			

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

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

1.2. Who makes up your main target market as a percentage of total sales?:

	Animal Feeds	Compost	Inorganic Fertiliser	Other (specify) …………………
Direct to Agriculture	%	%	%	%
Co- Ops / Middleman	%	%	%	%
Nurseries	%	%	%	%
General Public	%	%	%	%
Other (please specify)	%	%	%	%

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

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

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

1.3. If agriculture makes up a portion of the target market, which sector within agriculture do you supply and with which products?:

	Animal Feeds	Compost	Inorganic Fertiliser	Other (specify) …………………
Vegetables	%	%	%	%
Maize	%	%	%	%
Sugar Cane	%	%	%	%
Cattle	%	%	%	%
Sheep	%	%	%	%
Orchards	%	%	%	%
Other (please specify)	%	%	%	%

………

………

1.4. What is the present trend with regard to the target market per product?:

	Increasing	Remaining constant	Decreasing
a) Animal Feeds			
b) Compost			
c) Inorganic fertiliser			
d) Other (please specify)			

………

………

1.5. What is the present trend with regard to the quantity demanded per customer per product?:

	Increasing	Remaining constant	Decreasing
a) Animal Feeds			
b) Compost			
c) Inorganic fertiliser			
d) Other (please specify)			

....

1.6. What factors most influence the demand (demand curve shifters)?:

	Animal Feeds	Compost	Inorganic Fertiliser	Other (specify) ....
Quality of own product				
Competitors prices				
Seasonal variations in demand				
Economic position of target market				
Other (please specify)				

....

1.7. Where, geographically, does your target market for each product lie?:

Animal Feeds	
Compost	
Inorganic Fertiliser	
Other (please specify)	

....

1.8. How is your product(s) transported to the customer?:

	ROAD		RAIL		SHIP		OTHER (specify)	
	Own	Hired	Own	Hired	Own	Hired	Own	Hired
Animal Feeds								
Compost								
Inorganic Fertiliser								
Other (please specify)								

....

1.9. Transportation characteristics of products:

	Animal Feeds		Compost		Inorganic Fertiliser		Other (specify)	
Weight & Costs / Packaging	Volume in unit weight	Tran-sport costs/ weight /km	Volume in unit weight	Tran-sport costs/ weight /km	Volume in unit weight	Tran-sport costs/ weight /km	Volume in unit weight	Tran-sport costs/ weight /km
Loose								
Bulk								
Mini – Bulk								
Bagged								
Other (specify)								

....

....

1.10. What is the final cost of the product per unit weight?:

Animal Feeds	
Compost	
Inorganic Fertiliser	
Other (please specify)	

....

1.11. . What is the average production per unit time?:

Animal Feeds	
Compost	
Inorganic Fertiliser	
Other (please specify)	

....

1.12. What factors influence this production?:

Availability of inputs	
Consumer requirement fluctuations	
Climatic factors	
Other (please specify)	

....

1.13. Who are the main competitors in your industry?:

1. ....

2. ....

3. ....

Section 2: Raw Materials

2.1. What type of manure is used in producing your product(s)? (If more than one type of manure give percentages per product):

	Animal Feeds	Compost	Inorganic Fertiliser	Other (specify) …………………
Broiler Litter				
Layer Battery Manure				
Cow Manure (Feedlot)				
Cow Manure (Dairy)				
Pig Manure				
Sheep/ Goat Manure				
Other (please specify)				

……

2.2. Why is this type of manure used specifically?:

	Broiler Litter	Battery Manure	Feed-lot	Dairy/ slurry	Pig	Sheep /Goat	Other (specify) …………
Form of product							
Concentration of product							
Soil nutrient value of product							
Soil conditioning properties of product							
Livestock nutrition value of product							
Cost of product							
Availability of product							
Other (please specify)							

……

2.3. Where is this material obtained (location or name of producer and distance from your business)?:

Broiler Litter	
Layer Battery Manure	
Cow Manure (Feedlot)	
Cow Manure (Dairy)	
Pig Manure	
Sheep/ Goat Manure	
Other (please specify)	

....

2.4. Raw material characteristics:

	Buying price per unit weight	Form of material (wet, dry, slurry, etc.)
Broiler Litter		
Battery Manure		
Cow Manure (Feedlot)		
Cow Manure (Dairy)		
Pig Manure		
Sheep / Goat Manure		
Other (please specify)		

....

2.5. How is the material collected at the source?:

....

2.6. Who is responsible for this collection?:

Your company (buyer)	
The producer (seller)	
Hired contractor	
Other (please specify)	

....

2.7. Who is responsible for the transportation of the raw material?:

Your company (buyer)	
The producer (seller)	
Hired transport company	
Other (please specify)	

....

2.8. How is the material transported?:

Enter type of manure here:	Own transport	Hired transport	Transport cost per unit weight	Distance - source to factory in km's by road	Distance to nearest railway siding in km
Road					
Rail					
Air					
Ship					
Other (please specify)					

....

2.9. How is the raw material stored prior to processing?:

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

2.10. Are there any social or environmental implications relating to this storage or to the production of the products ?:

	Social	Environmental
Storage		
Production		

2.11. If there are problems, what are they?:

	Storage	Production
Runoff		
Flies		
Smell		
Water and / or soil pollution		
Other (please specify)		

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

2.12. What is being or could be done to minimize these implications?:

Drying manure	
Adding chemicals	
Stricter storage regulations	
Other (please specify)	

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

2.13. What is the cost of implementing these measures?:

Drying manure	
Adding chemicals	
Stricter storage regulations	
Other (please specify)	

....

2.14. Is this cost included in the price of the final product?:

Yes	
No	

Further comments or suggestions:

....

....

....

....

THANK YOU AGAIN FOR ASSISTANCE

APPENDIX 3

RAW MATERIAL SOURCE QUESTIONNAIRE

RAW MATERIAL SOURCE QUESTIONNAIRE

Fact File:

Name of Company / Farm:...

Name of manager / owner:...

Address:..

....

...................................Code:.......................

Telephone:.. Cell:..

Physical address / location:...

....

Distance from blender (Cato Ridge) by road in km's:....................................

Name of and distance to nearest railway siding from your business in km's:

....

The purpose of this questionnaire is to gather information to be included in a thesis for the degree M. Agric. Admin. The topic regards an investigation into the sustainability of using a blended organic fertiliser as a soil conditioner and nutrient source in KwaZulu-Natal with special reference to sugarcane production.

The study is being conducted through the University of Stellenbosch. Information will be dealt with appropriately and with the utmost professionalism. Any data considered confidential will be handled as such.

I thank you sincerely for your assistance and time.

Yours truly,

Darryl Tweedale

This Questionnaire

Please answer all relevant questions. Where space is provided for comments please fill in as completely as possible. Any additional information or suggestions will be most welcome.

Section 1 : Production Characteristics

1.1. Type and amount of manure produced (include percentages produced if more than one manure?:

	Type and % of total production	Amount produced per unit time (specify) in tons
Broiler Chicken Litter		
Layer Battery Manure		
Cow Manure (Feedlot)		
Cow Manure (Dairy)		
Pig Manure		
Sheep/Goat Manure		
Other (please specify)		

....

1.2. Form of manure and percentages thereof when ready for disposal:

	% Raw/Wet	% Dry	% Slurry	% Other (specify) ....
Broiler Chicken Litter				
Layer Battery Manure				
Cow Manure (Feedlot)				
Cow Manure (Dairy)				
Pig Manure				
Sheep/Goat Manure				
Other (please specify)				

....

1.3. Do production levels vary over a time period?:

	Yes	No
Broiler Chicken Litter		
Layer Battery Manure		
Cow Manure (Feedlot)		
Cow Manure (Dairy)		
Pig Manure		
Sheep/Goat Manure		
Other (please specify)		

....

1.6. On what basis do these fluctuations occur ?:

	Broiler Litter	Battery Manure	Feedlot Manure	Dairy Manure	Pig Manure	Sheep/ Goat Manure	Other (specify) ....
Yearly							
Seasonally							
Monthly							
Other (please specify)							

....

1.7. Why do these fluctuations occur ?:

	Broiler Litter	Battery Manure	Feedlot Manure	Dairy Manure	Pig Manure	Sheep/ Goat Manure	Other (specify) …………
Feeding Patterns							
Stocking Rate							
Climatic Variations							
Other (please specify)							

………

1.8. By what percent does the production of these manures fluctuate (i.e. % difference between maximum and minimum production)?:

	% Variation
Broiler Chicken Litter	
Layer Battery Manure	
Cow Manure (Feedlot)	
Cow Manure (Dairy)	
Pig Manure	
Sheep/Goat Manure	
Other (please specify)	

………

Section 2 : Present Usage

2.1. What do you presently do with the manure and what percentage of total production is used in such a manner?:

	Broiler Litter	Battery Manure	Feedlot Manure	Dairy Manure	Pig Manure	Sheep/ Goat Manure	Other (specify) ....
% Sold							
% Own use							
% Discarded on farm							
% Discarded off farm							
% Other (please specify)							

....

2.2. If not sold or used privately, why is it not sold?:

....

....

2.3. Would you consider selling it?:

Yes	
No	

2.4. At what price would you sell the manure / ton?:

	Price/ton
Broiler Chicken Litter	
Layer Battery Manure	
Cow Manure (Feedlot)	
Cow Manure (Dairy)	
Pig Manure	
Sheep/Goat Manure	
Other (please specify)	

....

2.5. If it is sold, to whom is it sold?:

	Name & Location of buyer
Broiler Chicken Litter	
Layer Battery Manure	
Cow Manure (Feedlot)	
Cow Manure (Dairy)	
Pig Manure	
Sheep/Goat Manure	
Other (please specify)	

....

2.6. In what form is it sold and at what price per ton?:

	Broiler Litter	Battery Manure	Feedlot Manure	Dairy Manure	Pig Manure	Sheep/ Goat Manure	Other (specify) ....
Wet/Raw – loose	R	R	R	R	R	R	R
Wet /Raw – bagged	R	R	R	R	R	R	R
Dry – loose	R	R	R	R	R	R	R
Dry – bagged	R	R	R	R	R	R	R
Slurry	R	R	R	R	R	R	R
Other (please specify)	R	R	R	R	R	R	R

....

2.8. How is the manure collected from within the production units to be sold, used or discarded?:

	Method of collection
Broiler Chicken Litter	
Layer Battery Manure	
Cow Manure (Feedlot)	
Cow Manure (Dairy)	
Pig Manure	
Sheep/Goat Manure	
Other (please specify)	

....

2.9. Who is responsible for this collection and subsequent transportation once sold?:

	Collection responsibility	Transport responsibility
Seller (yourself)		
Buyer		
Hired contractor		
Other (please specify)		

....

2.10. How is the manure transported?:

	Road	Rail	Ship	Air	Other (specify) ....
Broiler Chicken Litter					
Layer Battery Manure					
Cow Manure (Feedlot)					
Cow Manure (Dairy)					
Pig Manure					
Sheep/Goat Manure					
Other (please specify)					

....

2.11. If transportation is your responsibility, transport costs (per ton) and % of total price of product?:

	Transport costs per ton/km	% of total cost (price) of product
Broiler Chicken Litter		
Layer Battery Manure		
Cow Manure (Feedlot)		
Cow Manure (Dairy)		
Pig Manure		
Sheep/Goat Manure		
Other (please specify)		

....

2.12. If manure is used privately, how is it used?:

	Broiler Litter	Battery Manure	Feedlot Manure	Dairy Manure	Pig Manure	Sheep/ Goat Manure	Other (specify) ....
On pastures / lawns							
On sugar-cane							
On maize							
On vegetables							
On orchards							
Livestock feed							
Other (specify)							

....

2.13. Why is it used for that specifically ?:

	Broiler Litter	Battery Manure	Feedlot Manure	Dairy Manure	Pig Manure	Sheep/ Goat Manure	Other (specify) ………
Soil conditioner							
Soil nutrient source							
Livestock nutrient source							
Effective method of waste disposal							
Other (please specify)							

……

2.14. In what form is it used?:

Wet/Raw – loose	Broiler Litter	Battery Manure	Feedlot Manure	Dairy Manure	Pig Manure	Sheep/ Goat Manure	Other (specify) ………
Dry – loose							
Pelletted							
Slurry							
Blended product							
Other (please specify)							

……

2.15. How is it applied to each use area?:

	To pasture / lawns	To sugar cane	To maize	To vege-tables	To orchards	As livestock feed	Other (specify) …………
By hand							
Commer-cial / Standard fertiliser spreader							
Manure spreader							
Through irrigation							
Other (please specify)							

………

2.17. When is the manure applied to crops?:

	To pasture/ lawns	To sugar cane	To maize	To vege-tables	To orchards	Other (specify) ……………
During land preparation						
At planting						
After reaping						
Throughout the year						
Whenever manure is available						
Other times (please specify)						

………

2.18. Advantages of various uses of manure?:

Soil conditioner	
Soil nutrient source	
Livestock nutrient source	
Method of waste disposal	
Other (please specify)	

....

2.19. Disadvantages of various uses of manure?:

Soil conditioner	
Soil nutrient source	
Livestock nutrient source	
Method of waste disposal	
Other (please specify)	

....

Section 3: Storage - Environmental and Social Aspects

3.1. Does the production or storage of manure have environmental and social implications for your business?:

	Environmental		Social	
	Yes	No	Yes	No
Production				
Storage				

3.2. What form do these implications assume (smell, flies, runoff, etc.)?:

	Production	Storage
Smell		
Runoff		
Water / Soil pollution		
Flies		
Other (please specify)		

....

3.3. What practices do you follow to minimize these problems (describe briefly)?:

Dry manure	
Wet manure	
Add chemicals	
Other (please specify)	

....

Further comments:..

....

....

3.4. Does addressing these problems have cost implications?:

	Yes	No
Dry manure		
Wet manure		
Add chemicals		
Other (please specify)		

....

3.5. What is the amount of these costs per unit time (e.g. per week, month, etc.)?:

	Cost
Dry manure	
Wet manure	
Add chemicals to manure	
Other (please specify)	

....

3.6. Does implementing these measures have any influence on the quality of the manure?:

Yes	
No	

3.7. If yes, in what ways?:

....

....

....

THANK YOU AGAIN FOR YOUR ASSISTANCE

APPENDIX 4

FARMERS QUESTIONNAIRE

FARMERS QUESTIONNAIRE

Fact File:

Name of company / farm:..

Name of manager / owner:...

Size of farm:..

Area under sugar cane:................................

Address:..

....

....

.................................Code:..................

Telephone:..Cell Phone:...............................

Physical address / location:...

....

This Questionnaire

Please answer all the relevant questions. Where space is provided for comments or further discussion please fill in as completely as possible. Any additional information or suggestions will be most welcome.

Please send the completed questionnaire back to me in the envelope provided.

Thanking you in anticipation.

Section 1: Present Practices

1.1. Do you presently use organic material as soil nutrient source and/or conditioner?:

	Yes	No
Nutrient Source		
Conditioner		

1.2: The reason for your answer in 1.1. (why do you, or do you not use organic material)?:

....

....

....

1.3. Is there scientific evidence to validate the above reasons?:

Yes	
No	

If so, where is this evidence available from?:

....

....

....

1.4. In your opinion, are your production techniques moving towards sustainable production?:

Yes	
No	

1.5. Your reason for this answer?:

....

....

....

....

1.6. Give a description of your fertilisation programme for an average year:

Product used					
Date/ time of year applied					
Method of application					
Yearly fertiliser budget					
Other (specify)..................					
Other (specify)..................					

1.7. Do you burn the sugar cane before harvesting?:

Yes	
No	

1.8. What is the reason for the above answer?:

....

....

....

....

Section 2: The Materials

2.1. Fertilising material characteristics for the last season:

Materials used (specify below)	Acquisition source	Cost per unit weight	Transport method to farm	Transport responsibility	Transport cost per unit

2.2. Why are these materials used specifically (rank according to importance: 1 = most important)?:

Material (specify below)	Availability	Cost	Form	Soil conditioning value	Soil nutrient value	Other ....

2.3. Storage characteristics of materials on farm:

Material (specify)	How packaged	How stored	Storage time

2.4. Are there any social and/or environmental implications relating to the use and/or storage of these products (specify which products in spaces below)?:

	Social	Environmental
Use		
Storage		

2.5. What form do these implications assume (specify which products are responsible for which implications)?:

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

2.6. What measures, if any, are being implemented to combat these implications?:

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

2.7. Do these measures have a cost and what is it (specify per measure)?:

……………………………………………………………………………………………

……………………………………………………………………………………………

2.8. Application characteristics of manures / organic material:

	Application Responsibility	Material Type	Application Method	Payment Responsibility	Application cost (R / ton)
Yourself (farmer)					
Seller					
Contractor					
Other (specify)					

……………………….

2.9. Application characteristics cont'd:

Material used	Rate of application (planting)	Rate of application (ratoon)	Rate of application (top dressing)	Rate of application other (specify) ……………………	No. of seasons used

Section 3: A blended product

3.1. If a product was developed which had the nutritional value of inorganic fertilisers, with the organic (soil conditioning) components of manure, would you consider applying it to your sugar cane?:

Yes	
No	

3.2: Are you aware of the existence of such a product?:

Yes	
No	

3.3. What factors would influence your decision with regard to using this product or not (assign 1 for most important aspect, 2 for second most important, etc.)?:

Price	
Quality	
Volumes required	
Bulkiness	
Soil conditioning properties	
Nutrient source	
Water retention properties	
Other (specify)	

....

3.4. Preferred product characteristics for your sugar cane requirements:

FORM		PACKAGING		MANURE BASE	
Loose		Bulk		Chicken litter	
Granulated		Mini-bulk		Battery manure	
Pelleted		Bagged (specify volume)		Feedlot manure	
Other (specify below)		Other (specify below)		Other (specify below)	

....

3.5. Compared to regular fertiliser, would you be prepared to pay more per ton for such a product if:

	Yes	No
Amounts of N, P and K are higher		
N, P and K are the same		
N, P and K are less		

3.6. If yes, on what basis would you justify this increased expenditure (assign 1 for most important, etc.)?:

Soil conditioning properties (reduction in acidity, etc.)	
Nutrient source	
More balanced nutrient supply	
Water retention properties	
Reduction in supplementary fertilising needs	
Other (specify)	

....

3.7. Other crops you might consider applying such a product to on your farm:

Orchards	
Vegetables	
Maize	
Pastures	
Other (specify)	

....

3.8. Additional comments or suggestions?:

....

....

....

....

....

THANK YOU FOR YOUR ASSISTANCE