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A GEOGRAPHICAL ANALYSIS
OF
FARMING IN EAST GRIQUALAND

Submitted as an integral part of the course
for the M.A. Degree in the Department of
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by

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PREFACE

A number of issues in the thesis need to be clarified and will be discussed individually below.

- The title of the thesis is "A geographical analysis of farming in East Griqualand". The study focusses on spatial aspects of farming and particularly how distance from marketing centres influences farming activity. However, not all aspects of farming activity could be given close attention due to the limited time and funds available and it was decided to isolate two aspects of farming activity for detailed study, namely, farm size and intensity. Other variables, such as land-use, are looked at in relation to the two main variables.

- Although East Griqualand is the general area selected for study, for practical purposes it was decided to select areas within East Griqualand for an in-depth study. As the study focusses on the influence of distance from marketing centres on farming activity, it was decided to select marketing centres in East Griqualand around which farming takes place. There are six of these centres in East Griqualand, that is, Kokstad, Matatiele, Cedarville, Franklin, Swartberg and New Amalfi. Two marketing centres, Cedarville and Swartberg, were selected and the farms served by these centres became the two sub-areas in which the research was conducted. The selection of the marketing centres and the justification for this selection is discussed in Chapter Four.

- A problem arose when calculating the distance from the farming unit to the marketing centre where a single set of books is kept even though the farming unit does not consist of one contiguous area. It was, however, found that all farmers conduct farming operations from a central farm, usually that on which they reside and on which farming implements and other farming requirements are stored. The distance was therefore calculated from the farm gate of the farm from which farming operations are controlled.

- The general study area is shown in Figure 6. However, it was difficult to delimit the exact study area on the map as many of the farm boundaries were imperfectly known by farmers and were considered confidential information by local agricultural officials. The two sub-areas consist of the areas surrounding the marketing centres of Cedarville and Swartberg respectively.

- As a study of this nature has not previously been conducted in East Griqualand, it was decided that the study should constitute a pilot survey. As such, the study is a preliminary survey aimed at identifying general trends of the relationship between distance to marketing centres, farm size and intensity of farming in the selected areas. The study could therefore be used to provide pointers for further research and act as a basis for a more comprehensive study of the same nature in East Griqualand.

CHAPTER ONE

INTRODUCTION

Buchanan (1959, 1) defines agriculture as being any "systems of utilizing the soil for the production of foodstuffs or raw materials for human use". Strictly speaking, agriculture refers to the cultivation of the soil and therefore does not always cover activities such as animal husbandry. As the research is concerned with farming as a whole, the term agriculture may be replaced by the term farming activity defined as being any activity which involves crop production or animal husbandry in order to produce foodstuffs for human consumption or raw materials for human use.

Although geographers have for many years been concerned with farming as a way of making a living, there has in recent years, been a growing interest in the field of urban geography at the expense of rural geography, of which the geography of farming forms a significant part (Clout, 1972). Grigg (1969) states that agriculture, a term often used synonymously with farming, is the most important activity from the point of view that most people in the world gain a living from it. Coupled to the occupational importance of farming is the idea that, in the face of a rapidly increasing world population and the resulting increase in the demand for food and raw materials, farming activity should form an integral part of geographical studies.

Geography can be defined as being "the investigation and understanding of the spatial patterns of human and physical phenomena on the earth's surface and their interrelationships" (Symons, 1967, 1). This definition of geography emphasizes the concern in geography with spatial analysis. Two types of spatial analysis can be distinguished in geographical studies, that is, the study of spatial distributions of phenomena on the one hand and the analysis of the effect of distance on the location of phenomena on the other. The two approaches may converge since, if distance does affect the location of a particular phenomenon, it will give rise to a spatial distribution of that phenomenon.

Geography is not only concerned with identifying spatial patterns but also with identifying the processes or factors which give rise to these patterns in order to arrive at an understanding of the way in which they are distributed. Distance is one such factor and, in the past the

geography of farming has concentrated on the distribution of farming activity and the way in which selected factors have given rise to these distributions, distance from the market being central to many of these studies (Von Thünen, 1826; Stephan, 1944; Visher, 1955; Chisholm, 1963, 1968, 1979; Van Wyk, 1963; Daniel, 1975).

Factors affecting farming can, for convenience sake, be divided according to whether they form part of the physical environment or part of the socio-economic environment. Physical and socio-economic factors do not occur in isolation, however, and are interrelated to a large extent (Symons, 1967). Physical factors such as rainfall, soil characteristics, veld type and quality determine or influence the carrying capacity of an area and hence its farming potential. Socio-economic factors, on the other hand, influence the way in which the area is utilized and the extent to which farming potential is realized. Socio-economic factors are directly related to the impact of man on farming and include factors such as the characteristics and management abilities of the farmers, economic or market forces and the interrelationships between the marketing area and the producing area. Because time and available funds were limited, it was decided to isolate the factor of distance for special reference while taking other factors into account where necessary. Factors affecting farming activity will be discussed in more detail in the theoretical section of the thesis and the factors considered pertinent to the thesis will be isolated on the basis of the discussion.

Von Thünen (1826), Stephan (1944), Visher (1955), Chisholm, (1963, 1968, 1979), Van Wyk (1963) and Daniel (1975) have isolated distance as a factor which affects farming activity. Daniel (1975) points out that although distance is not the only factor influencing farming, it is nevertheless a factor which warrants careful attention. Daniel states that the method of analysis developed by Von Thünen provides a suitable method for the investigation of the effect of distance on farming activity. The method of analysis Von Thünen used in order to investigate distributional patterns of farming activity was to isolate the variable of transport cost (a function of distance) and hold all other factors constant. Von Thünen used this method of analysis to investigate the types of distributional patterns which would develop around the urban market and his concern was with two main objects of inquiry, namely, the crop theory and the intensity theory. The crop theory postulates that farming systems vary from place to place and that this phenomenon is

related to distance from the market whereas the intensity theory postulates that a given crop or farming system varies in intensity from place to place and that this phenomenon is also related to distance from the market (Hall, 1966). These two theories he combined into a single theory of land-use. Closely linked to the question of distance from the market and intensity is the question of farm size. Von Thünen himself posed the question: "What is the effect of distance from the market on the optimum size of farms"? (Von Thünen, 1826, 243). The Second Report of the Commission of Inquiry into Agriculture (Marais, 1970) is also concerned with the question of farm size which it perceives as being one of the greatest problems in farming in South Africa. Other writers who have dealt with the question of farm size have been concerned with identifying spatial distributions of farm size (Grigg, 1963, 1966) or debating the relative merits of large and small farms (Raup, 1972). Little attempt has been made to study the factors which give rise to patterns of farm sizes, notable exceptions being Grigg (1966) and Daniel (1975). The research will therefore be concerned with examining how distance from the market together with other, selected factors affect farm size and intensity of farming using Von Thünen's theory as a framework for the investigation. His ideas will be discussed in detail in Chapter Two which deals with theoretical issues, outlining Von Thünen's theories and discussing the implications of using his ideas as a framework for the investigation.

The overall aim of the research is to examine the possible influence of distance from the market or marketing points on farm size and intensity of farming in East Griqualand. Marketing points can be defined as being points at which produce from surrounding farms is collected and then transported to the major markets or consuming areas. Marketing points include, amongst others, stock sales, railheads and collecting depots for milk. The term marketing centre will be used to describe markets and marketing points. The research will constitute a pilot survey in which the aim will be to discover general trends related to the influence of distance from markets and marketing points, that is, marketing centres on farm size and intensity of farming. Other, selected factors, which will be chosen on the basis of the theoretical discussion in Chapter Two, will also be taken into account where necessary.

The general area selected for study is the farming area of East Griqualand. East Griqualand is situated in southern Natal and is a peripheral area in relation to its major market which is the urban areas

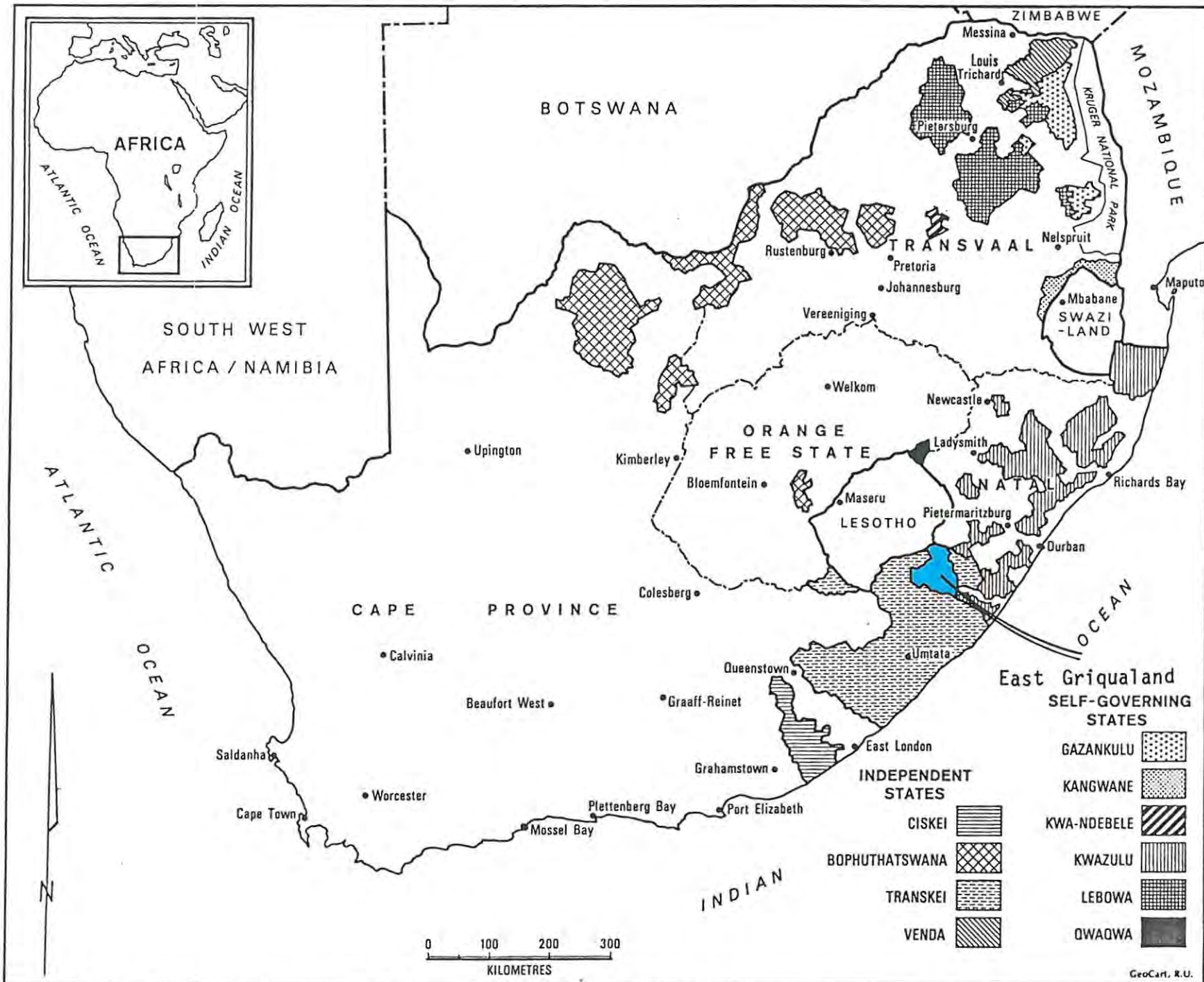


Figure 1: Position of East Griqualand in relation to homeland development.

of Durban and Pietermaritzburg. Because of its remoteness from the major market it is anticipated that distance from the market will play an important role in influencing farming activity in East Griqualand. A factor contributing to the geographical isolation of East Griqualand is its proximity to homeland development, as shown in Figure 1, which largely cuts it off from "white" South Africa. The characteristics of the study area will be discussed in more detail in Chapter Three of this thesis.

Although East Griqualand is the general area selected for study it was decided that it was too large an area to be covered given the limited amount of time and funds available. Consequently it was decided to select two areas within East Griqualand, called sub-areas, for an in-depth study. In order to investigate the effects of distance from marketing centres on farming size and intensity in East Griqualand, a research survey was undertaken involving personal interviews with a number of farmers in the two selected areas. Chapter Four outlines the methodological procedure undertaken for the research and includes a description of and justification for the selection of the specific sub-areas in which the research was conducted. The results of the survey are presented and discussed in Chapter Five and Chapter Six concludes the thesis by drawing the threads of the argument together and providing a concluding statement with suggestions for further research.

CHAPTER TWO

THEORETICAL AND EMPIRICAL BACKGROUND

The major aim of the thesis is to examine the effect of distance from marketing centres on farming activity in East Griqualand. Von Thünen (1826), assuming all other factors constant, isolated the factor of distance from the market and analyzed its effect on the spatial distribution of farming. The theory he developed will be used as a framework in which the examination will take place. One aspect of farming activity in East Griqualand has been selected for special reference based on evidence presented by past commissions of inquiry into agriculture, that is, farm size (Marais, 1970; Du Plessis, 1972). The discussion which follows will attempt to indicate the way in which Von Thünen's theory can be used as a framework in which to investigate the effect of distance from the market on farm size. The discussion will be presented in four interrelated sections. The first section will outline the key aspects of Von Thünen's theory in order to show how he interpreted the effects of distance from the market on farming activity. The second section will summarize some of the evidence which exists that the theoretical patterns Von Thünen anticipated are observable in real world situations, providing evidence of the empirical validity of his theory. As is the case with any theoretical exposition, writings have emerged which either dispute or modify Von Thünen's original ideas. The third section will outline these modifications and contradictions as they provide an understanding of some of the factors which may modify the effect of distance from the market on farming activity. In addition, some applications of Von Thünen's theory will be considered in order to outline the flexibility and adaptability of his ideas to a wide range of topics, justifying the choice of his theory as a framework for the research. The fourth section will deal with the question of farm size paying attention to those aspects of farm size that are considered problematic and therefore worthy of study and how Von Thünen's theory can contribute to an understanding of farm size. As distance is not the only factor affecting farm size, a consideration of the way in which other, selected factors affect farm size will be given. It should be noted that concepts such as distance and farm size involve a definitional problem and the chapter will conclude with precise definitions of the major concepts used for the purposes of the thesis.

A. An Outline of Von Thünen's Theory

Von Thünen's method of analysis, from which his theory is developed, is based on his own empirical observations and detailed cost-accounting on an agricultural estate in Mecklenburg, Germany (Alexander, 1963). He derived the method of analysis in order to explain the way in which land-use patterns are arranged around an urban market. Various authors have described Von Thünen's method of analysis in detail and the description which follows is based on information gained from these authors (Grotewald, 1959; Johnson, 1962; Alexander, 1963; Alonso, 1964; Chorley and Haggett, 1967; Chisholm, 1963, 1968, 1979; Sinclair, 1967; Peet, 1969; Blunden, 1970; Gregor, 1970; Abler et al, 1971; Munton and Morgan, 1971; Tarrant, 1974; Rakitnikov, 1978).

Von Thünen's method of analysis is based on the following assumptions:

- (1) That production is on an isolated plain around a single urban market.
- (2) The plain is uniform in respect of fertility of soil and climatic attributes.
- (3) There is only one form of transport, that is, a horse-drawn cart.
- (4) Transportation costs are borne by the farmer and are proportional to distance.
- (5) The hinterland is inhabited by farmers who have perfect knowledge and who desire to maximize their profits and are capable of adjusting their type of farming to the demands of the market.

Based on these assumptions Von Thünen demonstrates how land in an ideal state would arrange itself in certain predictable patterns around an urban market. Von Thünen recognizes that there is competition between land-uses for the use of the most favourable land. The controlling factor in the competition for land is economic rent which can be defined as being the surplus returns or net profit produced by the application of inputs, such as capital and labour, at a given site as compared with the returns obtainable from land at the most marginal farming site (Chisholm, 1968; Blunden, 1970).

Marginal land is land of low quality measured in terms of either economic or physical attributes of the land. For example, Ricardo (1817) measures the quality of land in terms of the fertility of the soil whereas Von Thünen (1826), assuming soil fertility to be uniform, measures quality of land in terms of location with respect to the market, that is, land most remote from the market being the most marginal. Given that farmers are rationally self-interested, they will wish to locate where land yields the highest economic rent, that is, the most favourable land. If it is assumed that only one product is farmed with the application of a fixed quantity of inputs, then land nearest the market will yield the highest economic rent with economic rent declining with distance from the market. The decline in economic rent, as shown in Figure 2, can be attributed to the increase in the cost of transporting goods to the market as distance from the market increases. The figure as well as the discussion which follows is based on a discussion of this topic by Abler et al, 1971.

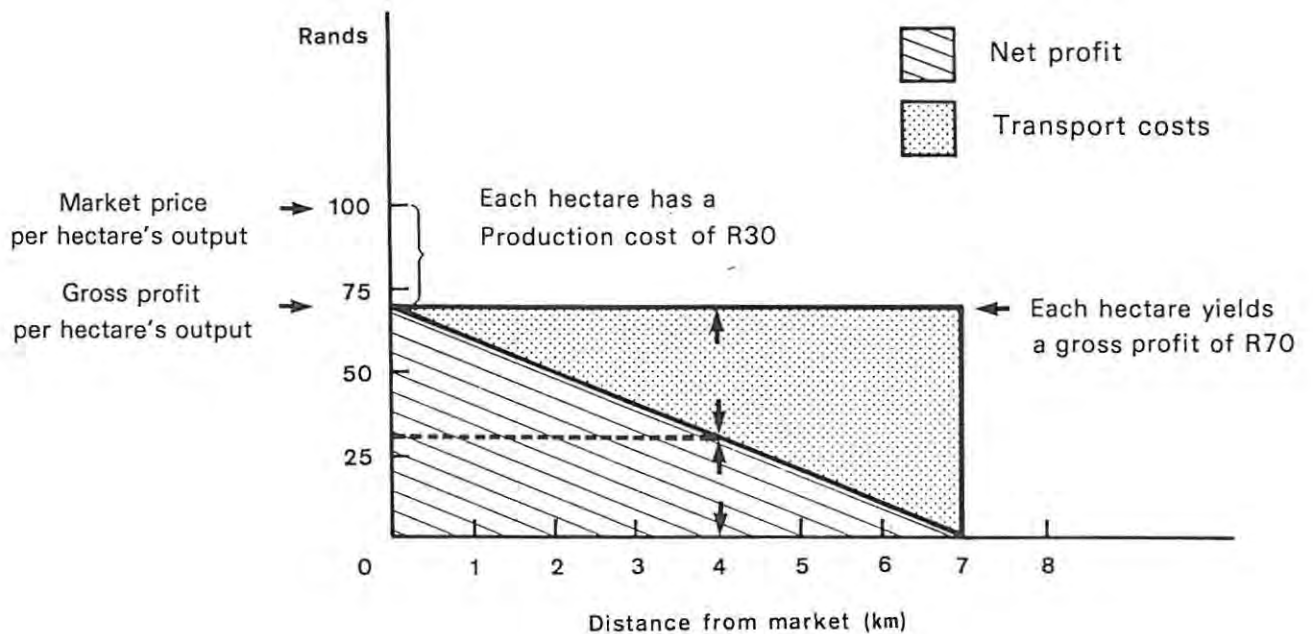


Figure 2: Revenue - cost curve for milk production in Von Thünen's isolated state (After Abler et al, 1971).

In Figure 2 the following conditions are found:

- (1) There is a fixed quantity of inputs therefore production costs per hectare are the same everywhere, that is, R30.

- (2) Because soil fertility and other physical conditions as well as the management ability of the farmers is the same throughout the isolated state, and because a fixed quantity of inputs is applied, yield per hectare is the same everywhere. The market price for yield from one hectare is R100.
- (3) The cost of transporting yield or output from one hectare is R10 per kilometre.

If a farmer is located at the market his returns on net profit per hectare, which determines economic rent, will be:

$$\begin{aligned} & (\text{Market Price} - \text{Production Costs}) - \text{Transport Costs} \\ & = (R100 - R30) - (R10 \text{ per kilometre} \times 0 \text{ kilometres}) \\ & = R100 - R30 - R0 \\ & = R70 \end{aligned}$$

A farmer located at 4 kilometres from the market, on the other hand has a net profit per hectare of:

$$\begin{aligned} & (R100 - R30) - (R10 \text{ per kilometre} \times 4 \text{ kilometres}) \\ & = R100 - R30 - R40 \\ & = R30 \end{aligned}$$

In the same way a farmer located at 7 kilometres from the market receives no profit whatsoever. Net profit, therefore, decreases with distance from the market due to increasing transport costs. At 7 kilometres from the market it would no longer be profitable for a farmer to produce milk and production would cease at this distance if milk production is the only option available. Fortunately there are other options available which enable the farmer to maximize net profit or economic rent at any particular site. The farmer can maximize economic rent in one of two ways, that is, by choosing an activity which yields the highest economic rent at a particular location or by choosing a level of intensity, at which to farm a particular product, which yields the highest economic rent at a particular location. Intensity in this context is defined as being the quantity of inputs of capital and labour applied to a unit area of land (Peet, 1969). The two options available to the farmer for maximizing economic rent have been referred to as the crop theory and the intensity theory respectively (Horvath, 1967) and will be discussed in

order to show how Von Thünen explained variations in land-use and intensity with distance from the market.

- (1) The crop or location theory states that variations in the spatial distribution of land-uses are related to distance from the market. The term "crop theory" is misleading in this context as it implies that only cropping systems are being considered whereas Von Thünen actually attempts to explain variations in all farming land-uses. "Location theory" is therefore a more appropriate term. As has been stated earlier, there is competition between land-uses for land nearest the urban market. In the competition for land, the land-uses yielding the highest economic rent will "win". Figure 3 illustrates how the competition for land-uses to occupy the most accessible land is resolved. Figure 3 and the discussion which follows are based on the discussion by Abler et al, 1971.

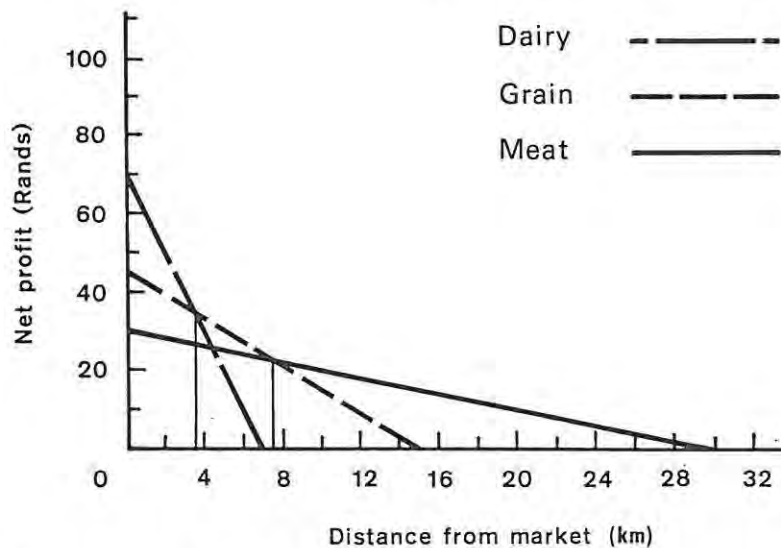


Figure 3: Graph showing the relationship between net profit and distance from the market for three different products in Von Thünen's isolated state (After Abler et al, 1971).

Figure 3 illustrates the case where farmers in the isolated state have a choice between farming three different products, that is, milk, grain and livestock. Each of these products have different revenue - cost curves depending on:

- (a) The demand for the product which influences what people are prepared to pay for the product and hence the market price per

unit area of output. If demand is high people will be prepared to pay a higher price for the product.

- (b) The yield per unit area of the product which influences both the cost of transporting output from a unit area as well as the price received per unit area of output. If the yield per unit area is high, transport costs and market price per unit area of output will also be high.
- (c) The production costs per unit area of land.
- (d) The cost of transporting output from a unit area of land which depends on the bulk and the perishability of the product as well as on the yield per unit area of land, that is, a bulky or perishable item will be correspondingly expensive to transport.

A farmer faced with the option of producing one of the three products will choose the product which gives the highest net return per unit area of land. For example, milk has high production costs but because of its high market price and high yield per unit area, it gives a high net return per unit area when produced at the market where transport costs are negligible. Grain, on the other hand, has lower production costs but has also a lower market price and lower yield per unit area than milk. It therefore gives a lower net return per unit area than milk when produced at the market. However, because the transport costs of milk are high due to its bulk, perishability and high yield per unit area, the net profit decreases rapidly with distance from the market whereas grain, having lower transport costs, has a net profit which decreases less rapidly with distance from the market. At a certain distance from the market grain will give a higher net profit than milk. In Figure 3 this occurs at 3,5 kilometres from the market. Farmers who farm within 3,6 kilometres from the market will choose to produce milk, between 3,6 kilometres and 7,5 kilometres grain is produced and beyond that meat is produced because beyond 7,5 kilometres meat is the most profitable activity having low transport costs which decline gradually with distance from the market. Beyond 30 kilometres production ceases altogether as net profit for meat becomes 0.

- (2) The intensity theory postulates that, given a particular product, the intensity of land-use decreases with increasing distance from the market. Assuming that all farmers in the production zone produce milk as in Figure 3, if all farmers apply the same inputs, that is, farm at the same level of intensity, their production costs, output per unit area and rate of transportation costs will be the same, resulting in a decline in net profit with distance from the market. One way of adjusting to this situation in an attempt to maximize economic rent is by the substitution of products (Figure 3). Another way of adjusting in order to maximize economic rent is by producing the same product using different intensity levels. Chisholm (1968) states that under any system of farming it is possible to vary the level of inputs, such as fertilizer, resulting in lower production costs. He states further:

"By the 'law' of diminishing returns, each successive increase of inputs yields a smaller increment of production than the last. Under these conditions, if we move towards the market from a distant place, it becomes worthwhile to intensify production, in so far that savings in transport costs compensate for higher production costs" (Chisholm, 1968, 26).

There is, due to the reasons given by Chisholm, a spatial distribution of farming systems with a general increase in intensity, measured by the amount of inputs, with decrease in distance to the market. There are exceptions to the general rule and Chisholm (1968) quotes two examples:

- (a) The first exception occurs where production output per unit area is large, despite a low intensity farming system. For example forestry, in Von Thünen's time, was situated near the market although it was an extensive land-use. This was largely due to its bulk, resulting in high transport costs, coupled with the high demand for firewood at the urban market.
- (b) The second exception occurs where a high level of intensity yields a small bulk of high value end-product, for example cheese and butter, which can then afford to locate further away from the market.

Von Thünen combined the location theory and the intensity theory into a single theory aimed at explaining the spatial distribution of farming. In order to illustrate the theory he drew up a model of the way in which land-use would or could be arranged around an urban market in the isolated state (Figure 4). As a model, the concentric zones of production are a simplification of reality in order to arrive at an understanding of the essential forces shaping the rural landscape around an urban centre. The particular production zones Von Thünen outlined are not of importance in themselves but rather the method of analysis which he used to arrive at these production zones (Chisholm, 1968).

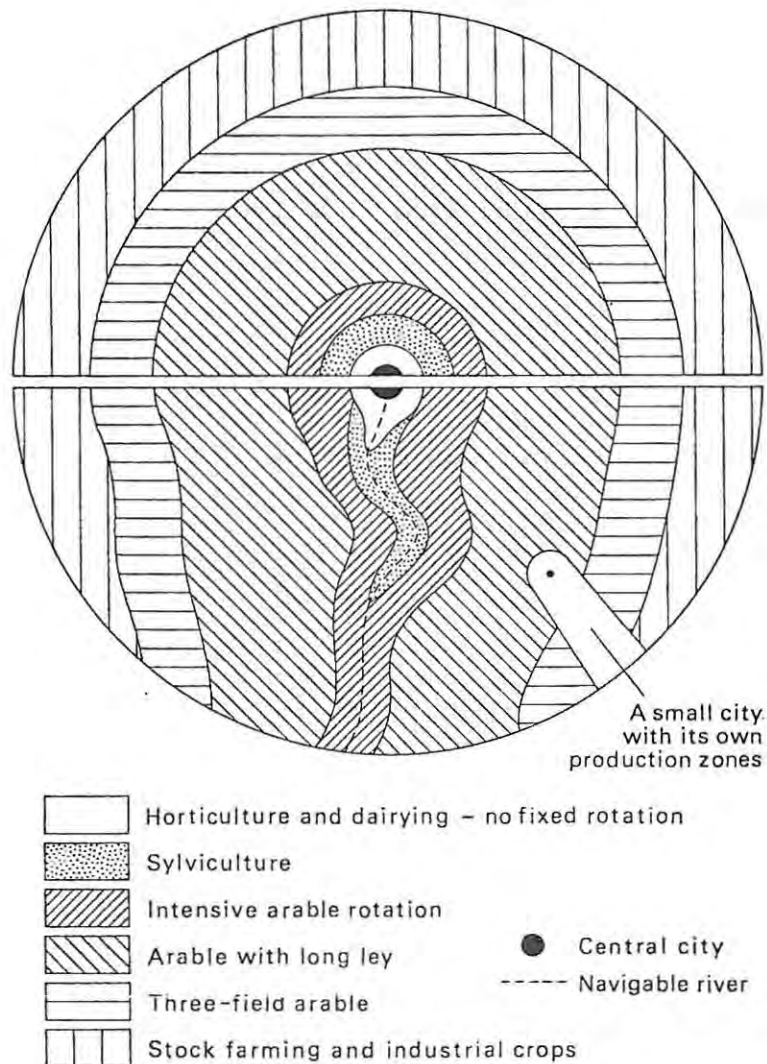


Figure 4: Von Thünen's system of land-use (Chisholm, 1979, 20).

Although Von Thünen published Der Isolierte Staat in 1826, it only began receiving serious consideration in 1925 by the German geographers Schmidt

and Sapper and by Jonasson, a European geographer (Gregor, 1970). Evidence of the Thünian pattern in the landscape has been reported by a number of authors and a few examples of this evidence will be discussed in order to demonstrate that Von Thünen's theory has empirical validity.

B. Empirical Evidence of Thünian Patterns

Chisholm (1979) notes that the analysis of the effect of distance on farming activity can occur at a number of levels or a variety of different scales. Empirical evidence of Thünian patterns has been noted at the continental scale, the regional scale as well as the local scale.

One of the earliest documentations of evidence of Thünian patterns at the continental scale is by Jonasson (1925) who used both economic and physical factors in order to create agricultural regions of Europe. The economic factor which Jonasson took into account was distance from major consuming centres and he used Von Thünen's argument to justify his choice. He linked the major consuming centres with the major industrial centres which had developed during the industrial revolution and showed how the intensity of land-use was high around these industrial centres. Jonasson also states that due to improvements in transportation technology since Von Thünen's day and horse-drawn carts, production zones in Europe had expanded. North-west Europe, the region of densest population, he regarded as one vast conurbation and as being one geographic centre of consumption. The inner belt of horticulture, dairying and other intensive land-uses was centred around the industrial regions, where land values were high, because these activities yielded high returns. On the other hand in Argentina, where industry was undeveloped and land values low, agriculture was extensive and wheat, corn and beef were found. Jonasson's production zones thus centred on North-west Europe and were expanded to include a place as distant as Argentina. Unfortunately, Jonasson does not make mention of the other zones around the single geographic area of consumption but did make use of the economic factor of distance in combination with physical factors, for example climate, in delimiting major agricultural regions of Europe.

Peet (1969) supports the idea of a world market when he argues for the existence of a Von Thünen World City appearing in Britain, Western Europe and north-eastern North America in the 19th century surrounded by a series of large, concentric, agricultural zones. The zones were pushed

outwards by the growth in demand for food and raw materials during the Industrial Revolution. Peet states that the frontier of the world system is dynamic and that movements of the frontier are caused by changes in supply and demand of products. In order to illustrate the expansion of production zones, Peet drew up a table which summarizes changes in the average distance from London to regions from which imports are derived. For example, in Table 1, fruit and vegetables were produced at the market between 1831 and 1835 but this distance gradually increased to 1880 miles between 1909 and 1913.

Table 1: Average distance from London (miles) to region from which each import type derived (Peet, 1969).

TIME PERIOD:	1831-1835	1856-1860	1871-1875	1891-1895	1909-1913
IMPORT TYPE	Distance (miles)	Distance (miles)	Distance (miles)	Distance (miles)	Distance (miles)
Fruit and Vegetables	0	324	535	1150	1880
Live Animals	0	630	870	3530	4500
Butter, Cheese eggs etc	262	530	1340	1610	3120
Feed grains	860	2030	2430	3240	4830
Meat and tallow	3000	2900	3740	5050	6250
Wheat and flour	2430	2170	4200	5150	5950
Wool and hides	2330	8830	10000	11010	10900
Flax and seeds	1520	3250	2770	4080	3900
Weighted average above all imports	1820	3650	4300	5050	5880

At the regional level of analysis, Buchanan and Hurwitz (1951) and Hurwitz (1957) distinguished a four zone pattern of production in Natal which decreased in intensity with distance from the market. These zones of production centred on the Durban - Pietermaritzburg axis and were found in the following order, beginning at the market: horticulture, dairying, cereals and meat and wool. Although East Griqualand was not part of Natal in the 1950's, the economy of East Griqualand has always been tied up intimately with that of Natal as its major consumer areas are concentrated around Durban and Pietermaritzburg. As East Griqualand is peripheral to Pietermaritzburg and Durban, it could be expected to fall into the outermost zone of production, namely meat and wool production. Evidence from Scotney et al (1978, 11) suggests that this is the case:

"Because of the high cost of transport to the consumer areas which are concentrated around Pietermaritzburg and Durban, the production of meat and wool is favoured as they are high value commodities relative to grain".

However, other types of land-use are important in East Griqualand, for example Yates (1966) states that in 1950 East Griqualand contributed 3,7 percent of all fresh milk to the Durban Milkshed and in 1960 this had increased to 8,9 percent. This increase in the contribution of East Griqualand to Durban's milk supply was related to refrigerated transport which made it feasible to transport milk several hundred kilometres without it turning sour. The changes in land-use patterns in East Griqualand illustrate once again the dynamic aspect of Von Thünen's theory where improved transportation and possibly an increase in the demand for milk in Natal, led to an expansion of the production zone of milk.

Another example of analysis at the regional level is the study by Müller (1973) who used trend surface analysis in order to examine variations in intensity in the northern United States, east of the Rocky Mountains. Taking the north-eastern megalopolis conurbation as the urban centre, Müller found that in the study area intensity decreased with distance from the market. He found that a peak area of intensity, measured by net income per acre, occurred around the megalopolis. Concentric contour lines of intensity were found with respect to the megalopolis with elongations of contours along the national transport artery. Where results did not conform to the general pattern, the skewing was due to the influence of secondary markets such as California. Müller concludes

by stating that Von Thünen is still an important factor influencing the agricultural component of America's space economy. Von Thünen's intensity theory holds in Müller's study, and where the pattern is modified it is due to factors which Von Thünen had introduced with relaxing assumptions for example, transport arteries and subsidiary markets.

At the local level of analysis Horvath (1969) applied Von Thünen's crop theory to the area around Addis Ababa in Ethiopia and discovered patterns resembling Von Thünen type circles. However, he states that physical conditions did skew his results, for example, availability of water was found to be an important factor influencing the location of vegetable production. A second example of analysis at the local level is that by Oyeleye (1973) who examined agricultural land-use in the tobacco producing area of the Oyo Division in Nigeria. The tobacco farmers were divided according to whether they used flue-curing or air-curing methods for curing tobacco as, according to Oyeleye, the two different systems have different distance-price and distance-cost functions resulting in different relationships between economic rent and distance from the market. In the investigation Oyeleye found zones of agricultural land, for example, in the flue-cured area he found three zones, namely:

- (1) A zone of intensive cultivation was found around the barnsite where flue-curing took place. Intensity was measured by the total area cultivated plus the input of capital and labour per acre. Intensity decreased outwards from the barnsite.
- (2) The second zone consisted of part-time farmers who cultivated foodcrops and, either engaged in trade, or kept one or two plots of tobacco.
- (3) The third zone consisted of full-time farmers who cultivated distant farms. Distance from the barnsite was great, which made it unprofitable to produce tobacco with the result that no tobacco was grown in the third zone.

Von Thünen's theory has been shown to be useful as an analytical tool when examining the spatial distribution of farming at various scales. Whether it is the continental scale, the regional scale or the local scale of analysis, distance from marketing centres has been shown to

affect both the pattern of types of land-uses as well as the intensity of land-use which decreases with increasing distance from markets. Although Von Thünen's model of land-use (Figure 4) has been termed a static economic model by Harvey (1966) it has been shown that certain aspects of the model can cope with changing circumstances, for example, the industrial revolution led to an increase in the demand for food and raw materials and at the same time led to improved, less costly transportation. This resulted in an expansion of the production zones in Europe to incorporate other countries in one world system.

According to Gregor (1970) the list of affirmations of Von Thünen's theory is matched by accounts of deviations from the theoretical pattern. The deviations which arise either in the form of modifications or contradictions, are due to the non-conformity of reality to the assumptions upon which Von Thünen based his theory or to changes in technology. Despite these modifications and contradictions however, the method of analysis developed by Von Thünen has been applied in a wide range of investigations. The following section will discuss some of these modifications, contradictions and applications in order to outline the flexibility and adaptability of a theory which is over 150 years old.

C. Modifications, Contradictions and Applications

Some of the earliest modifications of Von Thünen's theoretical patterns were centred around the expansion of specific zones of production. Durand (1940) states that farmers in the corn belt in the United States, despite their close proximity to the Chicago market and despite favourable railroad facilities, refused to change to dairying. Their refusal to change was based on the argument that cash-grain or corn-hog-beef farming was more remunerative and required less, and less regular, work than dairying. The Chicago milkshed, therefore, had to expand into Wisconsin. Hurwitz (1957) also notes the expansion of dairy-farming. He states that in Natal the zone of fresh milk supply which had originally been centred around Durban and Pietermaritzburg, had extended along the main railway route to as far as Estcourt. The expansion of dairy farming to areas further away from the market than is expected from the theoretical exposition can be ascribed to the improvements in transportation technology, especially the introduction of refrigerated transport which makes it feasible to transport fresh milk

over longer distances without deterioration in its quality. Fulton and Hoch (1959) state that improved transport also lowers the cost of transport making distance from the market less important as a factor affecting locational decisions. Grotewald (1959) takes Fulton and Hoch's point further by declaring Von Thünen's theory no longer relevant except in its historical and regional context. Reports by Boal and McAodha (1961), Birch (1963) and Durand (1964) appear to confirm Grotewald's denunciation in showing how transport cost is declining in importance as a factor affecting the spatial distribution of farming.

According to Leaman and Conkling (1975) and Hart (1978), improved transportation and the resulting decline in transportation costs, has led to an increase in the importance of the effect of the physical environment in determining locational decisions in farming. They cite as evidence, that there has been an increase in the regional specialization of farming systems in areas which are most suitable to them, for example, Hart (1978) shows how harvested cropland in southern U.S.A. is concentrated in "islands" separated by expanses of woodland. He argues that this concentration, which has increased since World War II, is due to environmental conditions being more favourable in the "islands". The areas with the greatest decline in harvested cropland since World War II suffer from major environmental limitations such as steep slopes and/or infertile soils.

Improved transportation is one example of technological change which has modified Von Thünen's theoretical patterns. Visser (1980) examined the relationship between intensity, which he defines as being the degree of non-land inputs per unit area of land, distance from the markets and technological change in the United States. He comes to the conclusion that agricultural intensity is a decreasing function of market access. He feels, however, that this cannot be attributed to technological change as technological change is not uniform but specific to certain agricultural types, for example, irrigated farming gains from technological change because it can replace an increasingly costly labour force with capital. The agricultural types most affected are the intensive types and in addition are those located in environmentally suitable areas, for example, irrigated farming, which requires the availability of water, will locate where it has easy access to water. Therefore, at a national level of analysis, physical factors are found to

be more important than market access in explaining spatial variations in agricultural intensity. However, Visser (1980) goes on to state that at the local level of analysis, technological improvements result in an intensification of farming around local urban centres where farming is already more intensive than farming further away from these local centres. This steepens the intensity gradient with distance from local centres and enhances Von Thünen's logic in explaining variations in intensity at the local level of analysis.

Winsberg (1980) took up the debate centering around the way in which technological change and the resulting decline in the cost of transportation has led to an increase in the locational importance of local comparative advantage, based on physical factors, for the production of farming produce. He points out that recent technological innovations in the United States have presented opportunities to reduce local comparative advantage based on the physical environment, for example, genetic improvements in plants and animals permit them to be raised in a wider range of physical environments. He argues that the reduction in this local comparative advantage should lead to a decrease in concentration and regional specialization of farming produce at the national level of analysis. In order to test this hypothesis, Winsberg examined the changes in location of agricultural products between 1939 and 1978 in the United States. He used the index of dissimilarity as an indication of the degree of regional specialization. He defines the index of dissimilarity as being "... the percentage of the total farm sales of a specific agricultural product which would have to be reapportioned among the other states to enable them to correspond with the distribution of the farm sales of another agricultural product" (Winsberg, 1980, 185). He goes on to state that, although it is debateable whether this is a true measure of regional specialization, it shows the degree of isolation of farm sales of one product from another. His results are set out in Table 2 for the years 1939 and 1978 for 12 of the products considered and they show that the majority of products increased in concentration whereas those which decreased in concentration did so only slightly. For example, the dissimilarity index between cattle and corn increased from 39 to 52 between the years 1939 and 1978 indicating that the two products increased in their degree of isolation from one another. Winsberg's results support his hypothesis which in turn supports the argument that local comparative advantage has increased in importance in influencing location of farming activities.

Table 2: Indices of dissimilarity for selected products: 1939 and 1978 respectively (After Winsberg, 1980, 185).

	Cattle	Corn	Cotton	Dairy	Fruit	Hogs	Nursery	Poultry	Soybeans	Tobacco	Vegs.	Wheat
Cattle	39 52	73 67	41 55	70 80	31 49	51 62	35 60	68 60	86 89	58 67	42 48
Corn	79 92	50 56	75 86	17 27	55 68	44 70	47 29	81 89	67 76	57 66
Cotton	83 77	78 72	85 90	83 65	79 66	95 76	79 95	74 63	84 87
Dairy	58 65	46 58	27 43	19 50	76 62	85 85	42 55	53 64
Fruit	78 87	51 37	55 72	89 89	79 91	30 21	70 79
Hogs	55 71	42 68	53 30	86 85	70 77	50 65
Nursery	26 51	72 72	80 86	31 24	58 70
Poultry	73 62	80 72	38 60	48 75
Soybeans	93 85	84 81	79 75
Tobacco	75 88	90 96
Vegs.	65 77
Wheat

Two major criticisms can be levelled against those who reject Von Thünen on the grounds of the increasing locational importance of local comparative advantage due to physical factors. Firstly, all the writers mentioned, that is, Leaman and Conkling (1975), Hart (1978), Visser (1980) and Winsberg (1980) have used the national level of analysis in order to prove their point. At the national level of analysis a wide diversity of physical environments is being considered. Von Thünen recognized the role of physical factors in affecting the spatial distribution of farming and for the purposes of his analysis assumed the physical environment to be uniform. Physical factors may therefore affect location of farming to a greater or lesser extent but this does not mean that distance from the market should be discounted altogether. In addition, the majority of writers consider only the location of farming types and not of intensity of farming. Where intensity is considered, namely, Visser (1980), he found that at the local level of analysis Von Thünen's logic is enhanced. The question to ask is therefore: To what extent and at what levels do physical factors modify Von Thünen's crop theory and/or intensity theory? In the thesis an attempt will be made to ascertain the extent to which physical factors modify the intensity theory at the local level of analysis. Secondly, the writers mentioned base their argument on the fact that transport costs have decreased due to improvements in transportation technology. However, declining transport costs are not permanent and both Leaman and Conkling (1975) and Hart (1978) recognize that the increasing cost of fuel prices may reverse the trend of increased regional specialization due to physical factors.

In recent years there has been a concern for the way in which expanding urban centres modify land-use patterns. In 1959 Grotewald noted with regard to land-use around Kansas City and St Louis in U.S.A. that there was a decline in perishable and bulky commodities and a decline in intensive types of farming. Sinclair (1967) and Bryant (1974a, 1974b) ascribe the decrease in intensity of farming, around major urban centres to the anticipation of urbanization. Sinclair (1967) points out that the anticipation of urban expansion results in an increase in land values of land bordering on growing urban centres. Sinclair (1967) argues that farmers will be unwilling to invest in land which will eventually be taken up by urban land-uses which provide greater returns per unit area than farming land-uses. Peet (1967) criticizes Sinclair by stating that two types of spatial cost variation can be identified in farming, namely,

marketing costs which vary with distance to the market and production costs, which vary with the prices of the factors of production and the factors necessary to produce a given quantity of output which, in turn, vary with physical conditions. Horvath (1967) on the other hand, criticizes Sinclair for not distinguishing between the crop theory and the intensity theory. Chisholm (1969) in reply to the discussion initiated by Peet (1967) and Horvath (1967) states that the real issue centres around the fact that it is not Von Thünen's results that are important but the method of analysis he used to obtain those results. Uncertainty, he argues, modifies the patterns but does not make them obsolete.

It is important to note that uncertainty can modify Von Thünen's theoretical patterns. This is because, if uncertainty exists, one of the vital assumptions of perfect competition, that is, the existence of perfect knowledge, does not hold (Madden and Partenheimer, 1972). Several kinds of uncertainty have been outlined by Madden and Partenheimer (1972) and Cromley (1982). They include:-

- (1) Price uncertainty, which is uncertainty about what the prices of products will be.
- (2) Yield uncertainty, which is uncertainty as to what the yields of products will be.
- (3) Cost uncertainty, which is uncertainty about the cost of inputs.
- (4) Technological uncertainty, which is the uncertainty as to what technology will be available for the farmer.
- (5) Human uncertainty, for example, the uncertainty which derives from dealing with people in both the buying of production factors as well as the marketing of produce.
- (6) Institutional uncertainty, that is, uncertainty in what decisions affecting farming, government or other institutional bodies are likely to make. An example of institutional uncertainty in South Africa would be the uncertainty experienced by farmers who live in disputed areas with regard to homeland incorporation which could possibly lead to a decline in the intensity of farming in those areas.

- (7) Environmental uncertainty, which is uncertainty about environmental factors such as how much rain there will be.

Von Thünen's assumption that individual operators have perfect knowledge and use this knowledge to make rational decisions in order to maximize their returns has been criticized by many authors. There is evidence that the assumption does not hold in reality, for example, Horvath (1969) shows how, in a plural society, found in Addis Ababa, the assumption of rational economic behaviour is met in different degrees by different ethnic groups. Harvey (1966), Olsson and Gale (1968), King (1969), Found (1971) and Cromley (1982) all support the idea that a study of decision-making is important if a thorough understanding of spatial patterns of agriculture is to be reached. Found (1971) makes the point that land-use patterns reflect the decisions of thousands of groups and individuals. Tarrant (1974), on the other hand points out that the extent to which the decisions of farmers can be said to be rational depends upon the extent to which information is available and by the ability of the farmers to see the implications of a number of actions and the ability to carry out the action they decide upon. Fotheringham and Reeds (1979) conducted a study in the Norfolk Tobacco Belt of Southern Ontario of the way in which selected factors affect the decision-making of farmers. They found that the following four variables were the most important in explaining farmer's decision-making processes, that is, age, area of land owned, amount of labour derived locally and the amount of expansion recently undertaken on the farm. For example, with regard to age, it was found that younger farmers were more likely to take risks and chose very intensive, high risk crops such as strawberries whereas older farmers chose low risk crops which had a more stable market. Fotheringham and Reeds (1979), on the basis of their study, distinguish between "satisfiers" to whom the most attractive goal is to minimize losses, and "gamblers" who are more willing to take risks if the pay-off is likely to be high.

Factors such as technological improvements, local comparative advantage, uncertainty and the decision-making ability of farmers have been used in attempts to modify and criticize Von Thünen's theory. However, despite criticisms and modifications of Von Thünen, many authors have used his theory to conduct a variety of investigations. Isard (1956), Alonso (1964), Dunn (1967) and Jones (1978, 1979) have attempted to develop the theory into a normative statement by using economic theory, especially

equilibrium theory. For example, Jones has paid particular attention to the way in which land rent is influenced by shifts in supply and demand of the equilibrium model. Isard (1956) and Alonso (1964) examine Von Thünen's theory as a step in the search for a general theory of land rent and location which can be applied to both farming and industry. Other authors have used mathematical theory in order to provide proof of one or more aspects of Von Thünen's theory and/or to develop mathematical models which will explain the relationship between the various factors considered by Von Thünen (Garrison and Marble, 1957; Casetti, 1972; Bannister, 1977; Visser, 1979, 1982). The usefulness of these studies lies in that they provide mathematical validity to Von Thünen's theory. However, the mathematical theory is often difficult for the uninitiated to understand.

Authors such as Smith (1966), Jones (1976) and De Lisle (1978) have used Von Thünen's framework of analysis to test real-world farming patterns at different scales. On the other side of the coin, O'Sullivan and Ralston (1980) and Huff (1981) examine different aspects related to the demand, or consumer-half of Von Thünen's isolated state. For example, O'Sullivan and Ralston (1980) use the basic Von Thünen model to show how consumer surplus, that is, difference between what a person is prepared to pay for a product and the current market price, is related to economic rent. Huff (1981) states that consumers do not all have the same buying power and that the demand of the rich for luxury items leads to the production of these luxury items on the most favourable and accessible land, inflating the price of staples which have to be grown further away.

The point of the brief review of literature dealing with aspects of Von Thünen's work is to outline the flexibility and adaptability of his work for a wide range of topics. All the authors mentioned, despite criticisms and modifications of Von Thünen have used his ideas as a starting point in their investigations. The theory developed by Von Thünen provides a suitable framework for investigating the influence of distance on various spatial aspects related to farming activity as he was concerned with the types of distributional patterns which would develop around an urban market if one isolated the factor of transport cost and held all other factors constant. One aspect of farming which has received very little attention is the influence of distance from the

market on farm size, a notable exception being Daniel (1975). The following questions arise:

- (1) Is farm size a variable worth investigating and if so, why?
- (2) How can Von Thünen's theory be used as a framework in which to investigate the effect of distance from the market on farm size?
- (3) What other factors may distort the effects of the influence of distance from the markets on farm size?

In the discussion which follows, an attempt will be made to arrive at answers to these questions.

D. The Question of Farm Size

The Second Report of the Commission of Inquiry into Agriculture (Marais, 1970) raises the issue of farm size when it states that one of the greatest problems in present day farming is that farming units are too small. The problem of farm size is re-iterated in the Third (Final) Report of the Commission of Inquiry into Agriculture (Du Plessis, 1972). It has been pointed out that the problem of farm size is linked to the question of viability, as a farm that is too small may constitute an uneconomic farming unit (Van Wyk, 1963; Marais, 1970; Munton and Morgan, 1971). The Second Report of the Commission of Inquiry (Marais, 1970) see the aspect of an economic size unit as constituting a definitional problem as viability does not depend solely on the physical size of the farming unit. Farmers can convert a viable farm into a non-viable one by using farming methods which lead to soil erosion, overgrazing and other types of wasteful exploitation of resources. In addition, an uneconomic unit can be converted to an economic unit if new techniques can step up production on the same area of land.

Many factors besides farm size influence the viability of a farming unit, for example Van Wyk (1963) states that: climatic factors, variations in physical potential of land, the relationship between resources, the management ability of the farmer, the living requirements of the farmer and his family as well as price relationships between products and price levels are all factors which influence the extent to which a farm can be

regarded as a viable economic unit. Van Wyk (1963) points out that in view of the number and variability of factors which influence the viability of a farming unit, there is only one scientific way of determining an economic unit, that is, it must be calculated for each individual case. He goes on to state that the limits of the economic unit should be determined in such a way that future operators will be able to make a living on the same unit. Therefore the limit cannot be based on the level of either the "best" farmer or "worst" farmer because the economic unit will either be too small or too big. For this reason viability should be determined for the average farmer having average living requirements, that is, an economic farming unit can be defined as being

"... the minimum size of land that, under specific conditions, will assure the user with an average managerial capacity of an adequate nett family income (that is, the average annual amount that would be retained by the farmer and his family after provision is made for current farming expenses, interest costs and capital redemption and creation) to enable him and his family to maintain a standard of living in keeping with that of comparable callings of other sectors of the economy" (Marais, RP 84/1970, 29).

The above definition of an economic farming unit is somewhat vague in certain respects, for example, who decides what is an "adequate nett family income" or what other sectors of the economy are comparable to farming. However, the definition does stress that economic units should be determined for the average case and that they will vary with specific conditions (that is, physical and economic). In addition, the definition stresses the importance of a minimum size of farming unit. If a farm falls below the minimum size under particular conditions the farmer will find it difficult to make a living and the farm will become susceptible to over-exploitation, undermining of the fertility of the soil and the destruction of the natural vegetation. If a farmer cannot make a living on the farm because it is too small to be economically viable, social consequences of poverty and related poor standards of living and low levels of education may result.

According to Grigg (1963, 1966) and Ball and Heady (1972) most studies on farm sizes have concentrated on advantages and disadvantages of different

scales and sizes of farm enterprise whereas very little work has been done on spatial distributions of farm size. Closely related to the study of spatial distributions of farm sizes is an evaluation of the factors which may give rise to a spatial pattern of farm sizes. The aim of the thesis is therefore not to debate whether or not farming units are viable, but rather to examine selected factors influencing the spatial distribution of farm size and intensity of farming.

Distance has been isolated as a factor influencing farming activity and the theory outlined by Von Thünen as a suitable framework in which to investigate the influence of distance on farming activity. The question of farm size is closely linked to Von Thünen's intensity theory and Von Thünen himself first posed the question: "What is the effect of distance from the market on the optimum size of farms?" implying that farm size varies with distance from the market (Von Thünen, 1826, 243).

In order to recap, the intensity theory states that a given crop or farming system decreases in intensity with increasing distance from the market. It was pointed out earlier on in this chapter that the increase in intensity near the market is possible because savings in transport costs compensate for higher production costs. Daniel (1975) states that even if inputs are not increased, the savings in transport costs brought about as a result of being located nearer the market, should increase the level of income. He hypothesizes that as distance to the market decreases, income per unit area increases or a given level of income could be maintained on a smaller farm. Following on from this, Daniel notes that if this hypothesis holds it should result in a spatial distribution of farm sizes with farm size increasing with distance from the market. There should also be an inverse relationship between average farm income per unit area, that is, the income derived only from the sale of farm produce, and distance. Stated differently, the further away from the market, the lower the average income per unit area. Daniel quotes evidence from the Midkar region which supports the hypotheses he put forward. The hypotheses put forward by Daniel will be tested in East Griqualand in order to examine the extent to which distance from marketing centres affects farm size and/or farming intensity.

Distance is not the only factor affecting farm size and intensity and other factors may skew or modify the theoretical pattern in the real world situation. The role of some of these factors in affecting farm

size and/or intensity, will be discussed in order to understand ways in which they could possibly modify the theoretical pattern based on Von Thünen's theory.

- (1) Many authors have pointed out that the managerial ability of the farmer is an important factor influencing farming activity as it is he who is the decision-maker. The management ability of the farmer and his financial position, which may affect his ability to adopt new techniques if they require large amounts of capital investment, will affect the extent to which a farmer can make a living on a given area of land. His management ability also affects the extent to which he perceives size as being an important factor governing economic viability of the farming unit. It could be argued that the role of management in affecting the extent to which a farming unit is viable, may undermine the size factor. Indeed, it does qualify the importance of the size factor in certain instances and therefore could modify the expected pattern of increasing farm size with distance from the market. However, it is difficult to measure management ability - an entire research project could be devoted to just that topic - and for the purposes of the present project it will be assumed that all farmers are possessed of an average managerial capacity.

- (2) The living requirements of the farmer also affects the extent to which a farming unit of a particular size can be said to be economically viable. The age of the farmer, his financial position, his standard of living, objectives and family size are all factors dictating the net family income of the farmer and therefore the size of farm he requires to meet his living requirements (Van Wyk, 1963). Van Wyk (1963) defines net family income as being the average annual amount of income that would be retained by the farmer and his family after provision has been made for current farming expenses, interest costs and capital redemption and creation. Tarrant (1974) points out that Von Thünen mentions the fact that some farmers, that is, those living in remote areas, would have less sophisticated wants and might be prepared to accept a lower standard of living. In such a case, the farmer may be able to meet his living requirements on a smaller farm, at the same distance from the market, than one whose living requirements are higher. The living requirements of different farmers may also

modify expected patterns of farm size and/or intensity. However, the establishment of living requirements is also very difficult and requires examination of the farmers entire financial position, wich is a sensitive issue, and for the purposes of the research will be assumed a constant.

- (3) Physical factors such as rainfall, veld type and quality determine or influence the carrying capacity of the farm and influence the size a farm should be in a particular area. Grigg (1966) states that when the natural environment has a high productivity, farms are smaller than in areas where the productivity is low. Other physical factors, for example, topography may also influence size and intensity of farming. For example, Hidore (1963) established an association between flat land and cash grain farming, which is a high intensity land-use, in the Midwest of the United States, that is, 56 percent of the area devoted to cash grain farming was situated on flat land. The reason for this association is that cash grain farming requires a high level of mechanization which is suited to level areas.
- (4) The type of farming enterprise also influences the minimum economic size unit of a farm, for example, dairying requires less land than beef farming as it is an intensive type of land-use. The type of farming enterprise needs to be taken into consideration as a possible modifying influence on expected patterns.
- (5) Daniel (1975) notes that age appears to be a factor affecting farm size. He found in the Midkar region that the larger farms were generally owned by younger age groups and puts forward three possible reasons for this pattern:-
 - (a) When a farmer gets older and begins thinking of retirement, he may dispose of part of his property either to members of the family or by sale to other farmers.
 - (b) The farms belonging to older groups are smaller because they were bought in times of economic hardship during the 1920's and 1930's depressions.

- (c) The younger farmers, possibly due to better education, appreciate the problems associated with non-viable farming units and have made an effort to acquire larger farms than the previous generation. The possible influence of age and education on farm size will be investigated in the research.
- (6) Political uncertainty is another factor which may influence farm size and/or intensity in East Griqualand. If there is political uncertainty, a farmer may not be willing to invest in his land resulting in a decrease in intensity. On the other hand, many farmers may leave the land resulting in more land becoming available to the farmers remaining who may either buy or rent the land in order to supplement their own farming unit leading to an increase in average farm size.

The research will therefore examine the extent to which distance from marketing centres, which includes markets and marketing points, affects the spatial distribution of farm size and intensity of farming in selected areas in East Griqualand. In order to carry out this examination it is necessary to define distance, intensity and farm size as precisely as possible.

(1) Distance

As Daniel (1975) has pointed out, in looking at the influence of distance on farming activity, it is relevant to ask what distance will be measured. According to Chisholm (1968) the analysis of the influence of distance can take place at three levels, that is:

- (a) The distance from the farmstead to the fields.
- (b) The distance from the farm to the railhead.
- (c) The distance from the farm to the major consuming area.

For the purposes of the research levels (b) and (c) will be considered, namely, the distance from the farm to any marketing centre.

(2) Intensity

Much controversy surrounds the definition of the concept of intensity. Most definitions either use intensity in the sense of yield per unit area

or conversely, inputs per unit area. Dayal (1978) points out that yield per unit area is a measure of efficiency rather than intensity as other factors may influence the eventual yield of the crop. Bannister (1977) states, however, that inputs and outputs are related. Visser (1982) defines intensity as being the amount of inputs of labour and capital applied per unit area of land. It is, however, very difficult to measure accurately the amount of labour and capital invested in the land and there is also a problem in that it is difficult to standardize a measurement for both labour and capital. If, as Bannister states, inputs and outputs are related, then a measure of output per unit area could serve as an indication of intensity. Various measures of output have been used to indicate intensity, two of the most common being gross income and net income per unit area (Belshaw and Jackson, 1966; Müller, 1973; De Lisle, 1978; Turner and Doolittle, 1978). Net income per unit area is difficult to obtain as it involves an examination of the farmers entire financial position and is tantamount to asking him what his salary is. As net income involves such a sensitive issue and, as the aim of the thesis is to discover general trends in farming activity, rather than fixed laws, gross income per unit area is considered as an adequate measure of intensity for the purposes of the thesis. It is important to note that gross income here refers to gross farm income which is derived only from the sale of farm produce.

(3) Farm Size

The definition of what constitutes a farming unit is problematic and therefore the identification of farm size is also problematic. Grigg (1966) points out that the size of a farm should not be confused with the size of a property. A farmer may hold a number of title deeds but still operate the different units of land as one. For the 1950 World Census of Agriculture the F.A.O. defined a holding or farm for census purposes as being "... land that is used wholly or partly for agricultural production and is operated, directed or managed by one person along or with the assistance of others, without regard to title, size or location. It may consist of two or more parcels of land, even if widely separated, provided that they form part of the same technical and economic unit" (Grigg, 1966, 207). For the purposes of the thesis a farm will be defined as being all land for which the farmer keeps one set of books and which he farms as one unit, regardless of whether he owns or leases the land.

Once the relationship and the strength of the relationship between farm size, intensity and distance from marketing centres has been established, the effect of selected modifying factors such as carrying capacity, type of farming enterprise, age and education of farmer and political uncertainty will be examined. In concluding this section on theoretical and empirical background it is noted that Von Thünen's theory is based on certain assumptions outlined at the outset of the chapter. Reality, as it occurs in the actual study area, may not conform to these assumptions and may therefore modify or even nullify expected patterns based on Von Thünen's theory. The following chapter deals with an outline of East Griqualand and one of the issues which will be dealt with will be the extent to which Von Thünen's assumptions conform to conditions in the study area.

CHAPTER THREE

STUDY AREA - EAST GRIQUALAND

The area selected for study is the farming area of East Griqualand situated in southern Natal. East Griqualand was originally known as Nomansland and consisted of the area south of the Mzimkulu River stretching from Pondoland westwards to the Drakensberg mountains (Harber, 1975). The eastern boundary was the Ingeli mountain range, the southern boundary stretched from the source of the Mtamvuna River to a beacon called Jacob's ladder on the Mzimvubu River and the western boundary extended as far as the Kinira River (Harber, 1975) (Figure 5). Parts of the original Nomansland have been incorporated into the Transkei so that the present day East Griqualand comprises only the magisterial district of Mount Currie (Figure 6).

East Griqualand was chosen as the general study area because it is a peripheral area with respect to its major urban market which is the urban areas of Durban and Pietermaritzburg. Being a peripheral area in respect to its major market, it is expected that distance from the market will play a significant role in influencing farming activity in the area. East Griqualand's relative geographical isolation makes it a suitable area for the application of Von Thünen's theory as he assumed an isolated state in which farming occurred.

The history of East Griqualand has been one of political insecurity and there is a need to examine the way in which disputes over land in the area have contributed to political insecurity. In addition, the development of towns and communication networks will be examined in order to understand the development of the area's infrastructure and the arrangement of the space-economy in East Griqualand which makes it possible to transport farming produce to the markets and import requirements for farming into the area. There is also a need to examine the extent to which the conditions in the study area conform to the assumptions as outlined by Von Thünen for the isolated state. One of these assumptions relates to the physical characteristics of the study area which will be examined in detail. The characteristics of farming in East Griqualand will also be discussed as background to the research.

A. Historical Background:

The history of East Griqualand, as it is known today, can be traced back to the resettlement of the Griquas from north of the Orange River. In

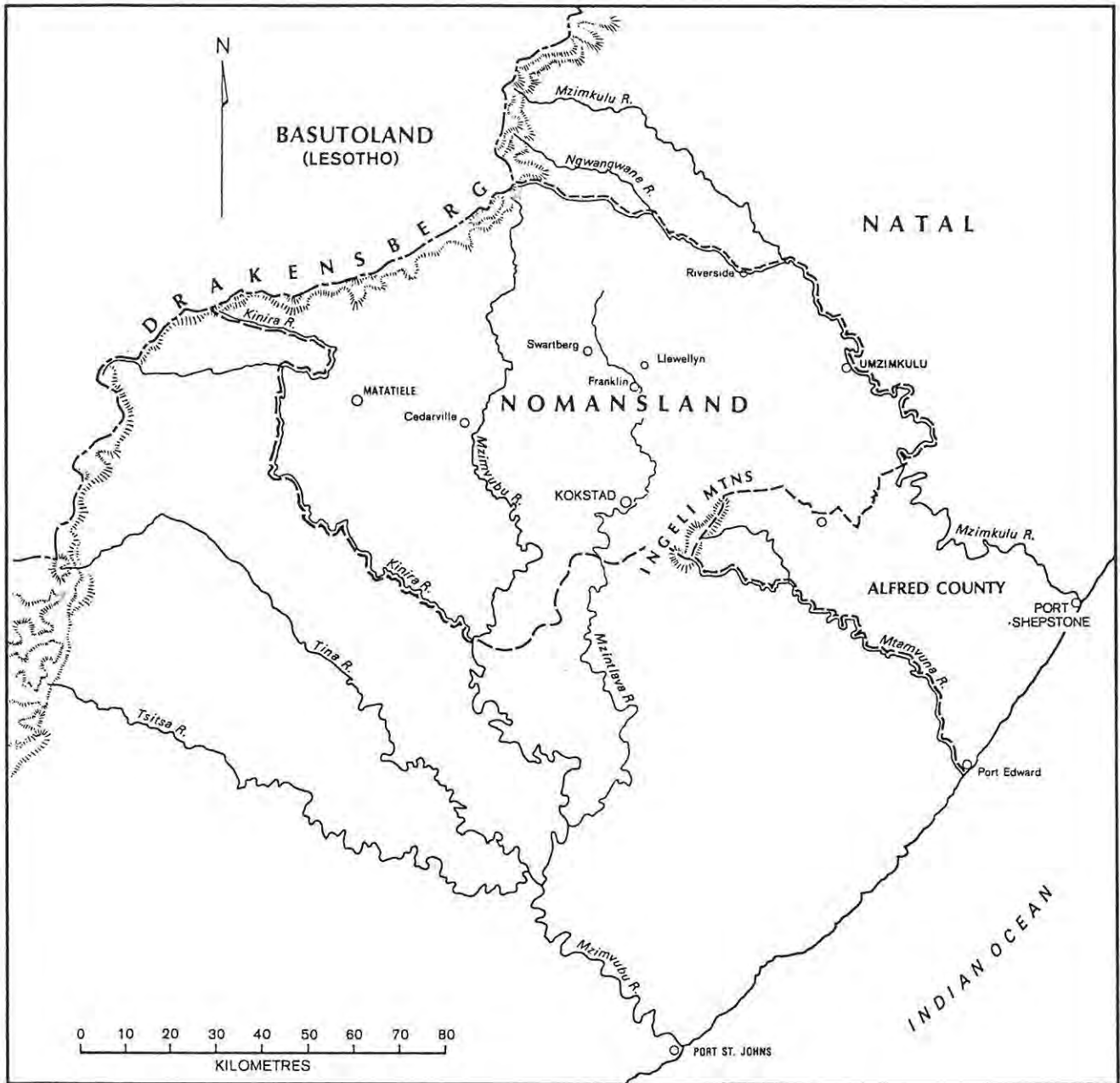


Figure 5: Nomansland in 1861 as described by Harber (1975).

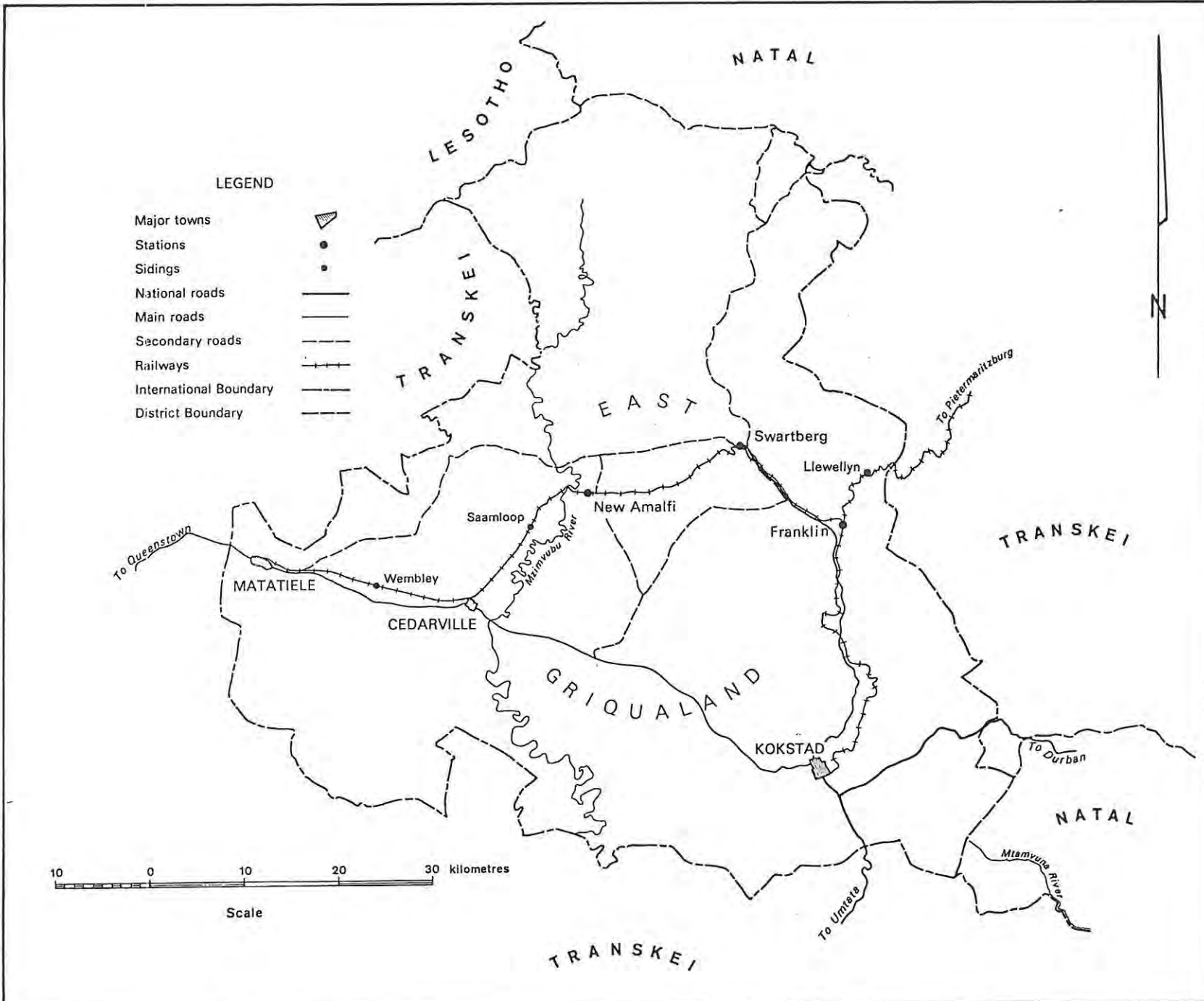


Figure 6: East Griqualand showing major towns and transportation networks.

1862 the Griquas, under the leadership of Adam Kok III, left the Free State Republic due to disputes with the Boers over land and judicial rights and trekked to the area then known as Nomansland, later renamed East Griqualand (Dower, 1902; Ross, 1976; Shepherd, 1976).

Disputes over rights to land in East Griqualand existed right from the beginning. According to Ross (1976) other groups, besides the Griquas, coveted the area. The Mpondo under Faku claimed that the area was under their jurisdiction and in 1850 had ceded part of the land, namely, the area between the Mtamvuna and Mzimkulu Rivers, to Natal (Figure 5). Theophilus Shepstone, who was then Secretary of Native Affairs in Natal, wished the land to be used for the resettlement of Natal's large black population which had been displaced by internecine warfare (Harber, 1975; Ross, 1976). In addition, Nehemiah Moshoeshoe, son of the Basuto chief Moshoeshoe, was attempting to establish himself as a semi-independent prince at Matatiele not far from where the Griquas wished to settle. Sir George Grey, then governor of the Cape, ignoring other claims to Nomansland, gave the Griquas permission to settle there. Shortly afterwards he was recalled to England and his successor, Philip Wodehouse, gave Kok independent power which he exercised until 1874. During the time that Kok governed East Griqualand, a number of white farmers and traders migrated into the area and many of them bought farms from the Griquas. Kok had jurisdiction over the white and black populations in East Griqualand. During Kok's reign frequent disputes broke out between the Griquas and surrounding black tribes, especially the Bhaca (Dower, 1902; Ross, 1976). In 1874 the British annexed East Griqualand and justified the annexation by claims that Kok had no control over the security situation in the area (Shepherd, 1976). The annexation came as a severe blow to the Griqua's pride in themselves as a self-governing nation and in 1878 a few leading Griquas staged an unsuccessful rebellion which was quickly suppressed by British troops. A few years later in 1880 the Basutoes near Matatiele staged a rebellion which was also suppressed (Ross, 1976). These two rebellions give an indication of political unrest at an early stage in East Griqualand's history.

After annexation East Griqualand became part of the Cape Province although it was cut off from the rest of the Cape Province by the Transkei. In 1900 the white inhabitants of East Griqualand first approached the British government with a request to be incorporated into

Natal. Later, when South Africa became a Union the request was taken to the South African Government. After Transkei Independence in 1976 the request was finally granted in April 1978. Presently East Griqualand is being considered for possible inclusion into Transkei and, as was pointed out in an earlier part of the chapter, parts of East Griqualand have already been ceded to the Transkei. (Figure 7)

Historical factors have contributed to political insecurity in East Griqualand. Disputes over rights to land in East Griqualand have existed since very early on in its history. These disputes are particularly significant in the light of the policy of separate development where tracts of land can be taken over by the government for inclusion into the so-called independent states. Locational factors add to the ambiguous political and historical nature of East Griqualand as it is bordered by two independent states, namely, Transkei and Lesotho, and is situated in close proximity to the fragmented Kwa-Zulu homeland. Feelings of political insecurity related to historical, locational and political factors may well have a destabilizing effect on white farmers in East Griqualand and may affect farming practices.

According to Shepherd (1976) the Griquas failed to develop Nomansland during the time they had possession of it. However, they did settle the area and established the first towns and communication networks which today form the basis of the East Griqualand infrastructure.

B. Development of Infrastructure:

When the Griquas arrived in Nomansland they formed a laager on the slopes of Mount Currie. It was from this point that the Griquas gradually began to spread over the land, each claiming the three thousand acres of land which they had been granted. In 1870 the Griquas left the laager to take up residence at the site of the present day Kokstad. Kokstad therefore became the first town established in Nomansland (Harber, 1975; Shepherd, 1976).

The second town established in Nomansland was the town of Cedarville. Several farmers from the north-eastern Cape had been granted permission to buy and occupy farms west of the Mzimvubu River. A white settlement grew up in the vicinity of the present day Cedarville. These white settlers called for the establishment of a town to act as a religious and



Figure 7: Transkei land claims and boundary changes, 1975-1976 (From Merrett, 1984).

commercial centre. By April 1880 the site was surveyed on the farm Cedarville A306 and the town Cedarville was established (Harber, 1975).

Matatiele was first established on a hillside near the junction of the roads leading to Lesotho and to the Transkei. After the 1880 Basuto War the town was moved to its present site in 1881. The town then consisted of the Paris Mission but gradually the jail, magistrate's offices and school were built and from these early beginnings the present day Matatiele developed (Harber, 1975).

Franklin, Swartberg and New Amalfi developed as railheads and today provide very basic services to their respective hinterlands for example, banking facilities, postal services, garages, farming requirements and general stores. Farming requirements include, amongst other things, stockfeed, stock remedies, seeds and fertilizers. The centres also act as collecting depots for farming produce from which produce is distributed to the urban markets.

Von Thünen's isolated state consisted of one urban centre surrounded by concentric zones of production. East Griqualand has no major urban centre. The biggest centre, Kokstad, is only classified as a major country town by Cook (1969). Other towns, namely Franklin, Swartberg and New Amalfi are little more than railheads providing very basic services and are not even classified as urban by the South African census as they have populations of less than 500. However, they do act as service centres, railheads and marketing points for surrounding farmers. In addition, although the populations of Franklin, Kokstad and Matatiele have increased since 1960, the other centres, as indicated in Table 3, have experienced a decline in population.

Although East Griqualand has no major urban centre, its main market consists of the urban areas of Durban and Pietermaritzburg which can be regarded as being one regional market known as the Durban-Pietermaritzburg complex. In the thesis the effects of distance from the farm to the small local centres as well as the major regional centre, on farming, will be considered. However, all farmers may not use the marketing centres and this may influence the results. Marketing patterns will therefore be taken into consideration as possibly modifying expected patterns based on Von Thünens theory.

By 1887, according to Shepherd (1976), there were no roads in the sense the word is used today. Roads were little more than rutted tracks over the open veld. In 1899 the East Griqualand Farmer's Congress stressed

Table 3: Size of total urban populations of service centres in East Griqualand according to the South African census.

Service Centre	Total Urban Population (all races)		
	1960	1970	1980
Cedarville	1062	961	560
Franklin	787	classified rural	800
Kokstad	7926	10227	11600
Matatiele	3251	3853	3660
New Amalfi	< 500	classified rural	classified rural
Swartberg	< 500	classified rural	classified rural

the importance for proper communications for the marketing of produce and importation of essential farming supplies. At that time the railway from the Cape stopped at Indwe and from Natal at Riverside. By 1911 the railway from Natal reached Llewellyn (Figure 6) and by 1924 it had been extended to Matatiele and Kokstad so that today all the service centres in East Griqualand are connected by rail to Natal. However, the railway from the Cape has not yet reached East Griqualand which is an important reason why the economy of East Griqualand has always been closely linked to that of Natal rather than the Cape and why Pietermaritzburg and Durban remain East Griqualand's major marketing centres.

The earliest main road in East Griqualand was a wagon road which ran from Kokstad across the Mzimvubu drift to Llewellyn. An alternative route ran through Franklin to Umzimkulu (Shepherd, 1976). Shepherd (1976) points out that farmers who lived between Matatiele and the Indowana River along the Drakensberg foothills had no direct means of communication with the market at Pietermaritzburg. Added to the poor development of communications in the early days was the poor conditions of the roads which did exist. The conditions of the roads were especially bad after heavy rains and river crossings became impassable. Because of the importance of a well-developed transportation network for farming activity, the farmers formed a Road Board in 1906 for the improvement of communications (Shepherd, 1976). Since the establishment of the Road Board there has been a considerable improvement in the quality of the transportation network in East Griqualand.

Relief has influenced the development of communications in East Griqualand. East Griqualand is a high-lying area where the altitude varies from 1370 metres to over 2300 metres. Parts of the area are very mountainous which provides a barrier to the development of communications. The most prominent peaks are Mount Currie, in the south-eastern corner which is 2394 metres above mean sea level, Pramberg (2,225 metres) west of Franklin and the Bokkiesberg Range, which lies between Cedarville and Franklin and rises above 2300 metres. In south-western East Griqualand is the Mvenyane area which is also mountainous, the highest peak being Cedarberg which has an altitude of 2080 metres. A mountain range east of Franklin rises in places to an altitude of 2020 metres (Scotney et al, 1978). Contrasting with these mountainous areas are two large plains. The biggest of these low-lying areas is the Cedarville Flats which covers an area of 160 km² and extends westwards towards Matatielle. Surrounding Franklin is another smaller area of flat land (Scotney et al, 1978). It is notable that the first tarred road to traverse East Griqualand joins Kokstad, Cedarville and Matatielle and runs across the Cedarville Flats. Today another tarred road runs through Swartberg from Natal and links Swartberg with Kokstad. The most poorly developed section of the transportation network, on the other hand, is found in the foothills of the Drakensberg surrounding Swartberg and in the mountainous Mvenyane area in the south-western part of East Griqualand.

At present the only town served by a national road is Kokstad although a new national road is being constructed from Natal through Swartberg to join the main road between Cedarville and Kokstad. Secondary roads, which serve the other service centres and feeder roads to the farms are untarred and deteriorate in quality during wet weather.

It is clear that the quality of the transportation network varies in East Griqualand so that accessibility to the market is not only a function of distance from the market but also a function of the quality of the transportation network. This variability in the quality of the transportation network applies more to the road network than to the rail network as the rail network, although not well developed, serves each of the service centres equally well whereas the roads serving the service centres do not.

In his analysis of the isolated state, Von Thünen (1826) assumed that there was only one form of transport. This assumption does not hold in

the study area as farm produce is transported by road and by rail. In addition, the quality of transportation network varies from place to place in the study area. However, there is a degree of uniformity in transporting farm produce as, with the exception of dairy produce, all farm produce is transported by road from the farm to the railhead from which it is transported by rail to the major urban centres. Milk is taken to collecting depots at Cedarville, Franklin and Kokstad and then transported by road in bulk tankers or used locally in cheese factories. In order to simplify the analysis, the research will concentrate on beef, mutton and wool production as these are the major farming enterprises in East Griqualand (Scotney et al, 1978). Dairy farms may not conform to expected patterns based on Von Thünen's theory and will be taken into account where necessary as modifying expected patterns when analyzing the results.

One of the major assumptions outlined by Von Thünen (1826) was that the isolated state consists of a plain which is uniform in respect of fertility of soil and climatic attributes. As has already been pointed out in this chapter, the relief of East Griqualand is not uniform but varies from very flat areas, for example, the Cedarville Flats, to very mountainous parts. In respect of other physical factors the study area also contradicts the assumption of a uniform plain as outlined by Von Thünen. Physical characteristics of the study area will be discussed to show how and to what extent they vary and how the variations may affect farming in East Griqualand.

C. Physical Characteristics of East Griqualand:

According to Scotney et al (1978) East Griqualand can be divided into four main bioclimatic subregions on the basis of climatic conditions and veld type characteristics (Table 4) (Figure 8).

Three main Veld Types occur in East Griqualand. These are Highland Sourveld, Southern Tall Grassveld and Highland Sourveld to Cymbopogen - Themeda Veld Transition (Acocks, 1953). Highland Sourveld dominates the landscape and has the characteristic of having a high summer carrying capacity which drops off in winter, making it necessary to grow fodder. Carrying capacity can be defined as being the ability to support one large stock unit on a given area of land without deterioration in veld quality. Carrying capacity varies, amongst other things, with sub-region as well as seasonally. For example, subregion 4e has the highest carrying capacity and can therefore support the largest number of large

Table 4: Bioclimatic subregions in East Griqualand showing physical characteristics of each (After Scotney et al, 1978).

Bioclimatic Subregion	Elevation (metres)	Veld Type (Acocks, 1953)	Mean Annual Rainfall (mm)	Carrying Capacity (ha per L.S.U.)
Highland to Submontane (4e)	1680 - 2270	Highland Sourveld (moist)	850+	1,8
Highland to Submontane (4f)	1370 - 1680	Highland Sourveld (dry) and Southern Tall Grass	700-800	2,2
Upland -drier (8b + c)	1370 - 1520	Highland Sourveld to Cymbopogon - Themeda Veld Transition	600-700	2,8

stock units (L.S.U.'s) per unit area of land. The carrying capacities of the subregions vary with rainfall as well as with the elevation, that is, the higher the elevation, the higher the rainfall, the higher the carrying capacity. Rainfall in the study area is seasonal with 82 percent falling between September and February. (Scotney et al, 1978). The summer rainfall corresponds with the high summer carrying capacity of the veld. Rain is often in the form of severe thunderstorms which can cause damage to crops. However, less intense orographic rain also falls.

Annual rainfall varies from between 600 to over 900mm of rain although East Griqualand is subject to periodic and severe droughts which seriously affect farming activities and are especially hazardous to crop production which is reliant on good rains (Scotney et al, 1978).

Temperature in the study area varies from 18°C - 20°C mean for the growing season. Winters are very cold with frost and sometimes snow. Frost days usually begin between the 1 - 10 May and end between the 11 - 20 September and there are usually about 50 days of frost per annum. Late frosts occur in spring and can cause damage to crops (Scotney et al, 1978).

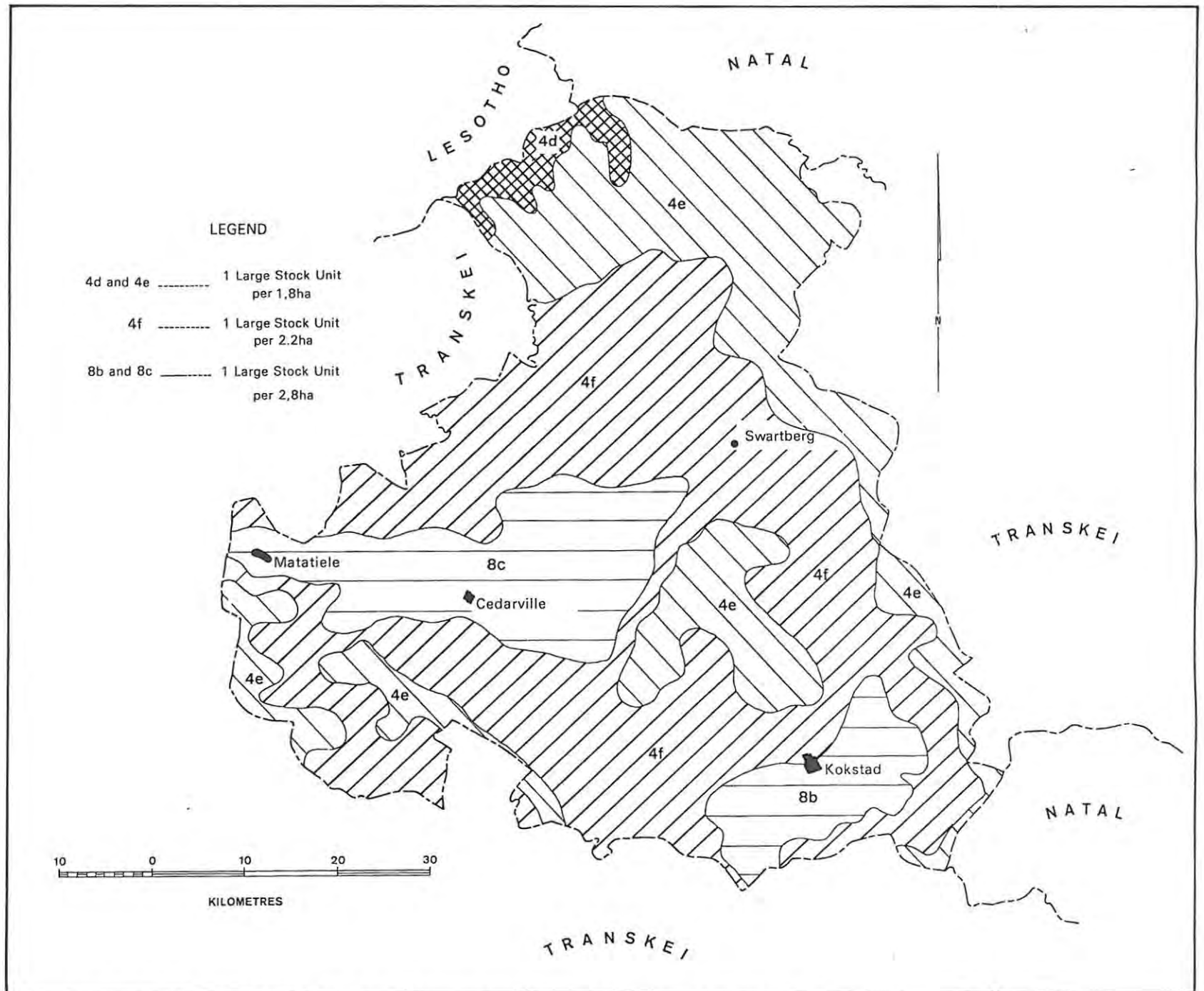


Figure 8: Main bioclimatic subregions of the study area (Scotney et al. 1978).

The elevation of land in East Griqualand varies from 1370 - 2290 metres and this varies according to bioclimatic subregion. The relief consists mainly of rolling to rugged terrain contrasting with two large areas of flat land. The steep slopes limit agricultural potential as they restrict the use of farm machinery.

Physical characteristics of the study area are not uniform and this is reflected in the varying carrying capacity of the different bioclimatic subregions. Carrying capacity will therefore be a factor analyzed to see to what extent it modifies the expected results based on Von Thünen's theory. In addition, it should be noted that physical conditions in East Griqualand are more suited to stock-farming than crop production.

D. Farming in East Griqualand:

Scotney et al (1978) state that East Griqualand is essentially stock farming country. The rolling to rugged terrain and the abundance of natural veld are suitable for semi-intensive cattle and sheep enterprises. Beef, mutton and wool production are the major farming activities although other activities, for example, dairying and crop production are also found. Crops are grown mainly for fodder purposes although there is also cash-cropping of, for example, sunflowers, potatoes and maize. (Yates, 1966; Scotney et al, 1978).

Table 5 summarizes the major types of land-use in East Griqualand. The highest percentage of land is veld which is used for grazing, whereas crop production accounts for only 17,7 percent of the total area. Other land-uses include dams, farm-houses, and outbuildings and account for 2,5 percent of the total area.

Table 6 provides a summary of stock farming in East Griqualand. Cattle and sheep make up the highest number of stock with horses, pigs and other types of stock farming a negligible proportion of the total number. Beef cattle make up 81,5 percent - 82,7 percent of the total number of cattle and wool sheep make up 95 percent - 95,5 percent of the total number of sheep. These figures give an indication of the importance of beef and wool production in East Griqualand.

Table 5: Summary of farming land-use in East Griqualand (After Fotheringham, 1981).

Land-Use	Total Area Covered (ha)	% of Total Area
1. Veld	325 423	79,8
2. Crop Production		
(a) Dryland Crops	47 968	11,8
(b) Irrigation Crops	1 405	0,3
(c) Dryland Pasture	19 374	4,7
(d) Irrigation Pasture	3 699	0,9
3. Other	10 195	2,5
Total	408 064	100,0

Table 6: Stock farming in East Griqualand (After Fotheringham, 1981).

Type of Stock	Total Head (Summer)	%	Total Head (Winter)	%
Beef Cattle	100 910	20,4	118 370	23,4
Dairy Cattle	22 968	4,7	24 691	4,9
Wool Sheep	345 266	69,9	339 536	67,1
Mutton Sheep	18 157	3,7	15 962	3,2
Horses	3 189	0,6	3 479	0,7
Pigs	1 953	0,4	2 125	0,4
Other	1 722	0,3	1 808	0,3
Total	494 165	100,0	505 971	100,0

Table 7 is a summary of the major farming enterprises in East Griqualand which confirms the observation that beef and wool production and the cultivation of pastures and other fodder crops for stock form the most important farming activities in East Griqualand.

Table 7: Summary of major farming enterprises in East Griqualand (After Fotheringham, 1981).

Enterprise	Total Area/Mean No of Head	No. of Farms involved in Enterprise
1. <u>Crop Farming</u>	<u>Total Area (ha)</u>	
Maize	12 054	252
Potatoes	305	63
Kikuyu	1 054	137
Eragrostis Curvula	9 579	247
All pastures	22 886	316
Fodder Crops	27 303	318
2. <u>Stock Farming</u>	<u>No of Head (mean of Summer and Winter totals)</u>	
Beef Cattle	109 640	396
Dairy Cattle	23 830	204
All Sheep	359 460	343

The spatial distribution of the major enterprises in East Griqualand is illustrated by Figures 9 and 10. These maps show that beef and sheep farming are widely distributed throughout the study area as is the growth of fodder crops. Maize, which is the major cash crop, and dairying are concentrated close to the railheads and collecting depots for milk, namely, Kokstad, Cedarville and Franklin. Maize and milk are expensive to transport and their concentration around depots and railheads



FODDER CROPS

KEY: AVERAGE INTENSITY OF MIS. FOODCROP

- + > 5 HA PER 100 HA
- x > 10 HA PER 100 HA
- e > 25 HA PER 100 HA



MAIZE

KEY: AVERAGE INTENSITY OF MAIZE

- + > 5 HA PER 100 HA
- x > 10 HA PER 100 HA
- e > 25 HA PER 100 HA



ALL PASTURES

KEY: AVERAGE INTENSITY OF ALL PASTURES

- + > 5 HA PER 100 HA
- x > 10 HA PER 100 HA
- e > 25 HA PER 100 HA

SKAAL 1:1500000 SCALE

□ 2250 Ha

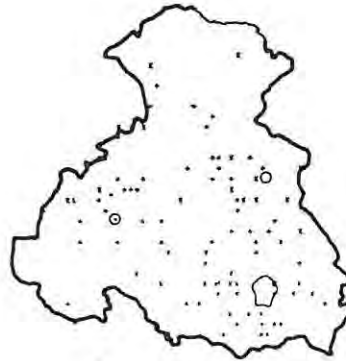
Figure 9: Crop farming in East Griqualand (After Fotheringham, 1981).



BEEF CATTLE

KEY: AVERAGE INTENSITY OF BEEF CATTLE

- + > 10 HEAD PER 100 HA
- x > 25 HEAD PER 100 HA
- e > 75 HEAD PER 100 HA



DAIRY CATTLE

KEY: AVERAGE INTENSITY OF DAIRY CATTLE

- + > 10 HEAD PER 100 HA
- x > 25 HEAD PER 100 HA
- e > 75 HEAD PER 100 HA



ALL SHEEP

KEY: AVERAGE INTENSITY OF ALL SHEEP

- + > 10 HEAD PER 100 HA
- x > 50 HEAD PER 100 HA
- e > 200 HEAD PER 100 HA

SKAAL 1:1500000 SCALE

□ 2250 Ha

Figure 10: Stock farming in East Griqualand (After Fotheringham, 1981).

indicates that the cost of transport may have influenced the spatial distribution of farming in East Griqualand. Distance to the major urban market has also influenced farming activity in East Griqualand according to Scotney et al (1978, 11) who state that "Because of the high cost of transport to the consumer areas which are concentrated around Pietermaritzburg and Durban, the production of meat and wool is favoured as they are high value commodities relative to grain."

E. Conclusion:

Because of its geographical isolation and remoteness from major urban markets, East Griqualand was considered a suitable study area for the application of Von Thünen's theory in order to examine farming activity. Although conditions in the study area do not conform exactly to Von Thünen's assumptions, a measure of conformity is present. East Griqualand is a relatively isolated area geographically speaking and the area has one major marketing centre. Although the assumption of only one form of transport does not hold in the study area, a degree of uniformity in transporting farm produce exists as the majority of produce is transported by rail from local marketing points. Where assumptions do not hold, for example, the assumption of physical homogeneity, this will be taken into account as a modifying factor. That is, Von Thünen's ideas will be used as a framework for analysis and selected factors will be taken into account where necessary to see the extent to which they modify expected results based on Von Thünen's theory.

CHAPTER FOUR

Methodology

Haring and Lounsbury (1975) state that a research report should include a chapter which explains the methods and techniques which are employed to organize and test material because, as Shipman (1981) points out, it is important to give sufficient detail on the way in which evidence was produced so that the credibility of the research can be assessed. The discussion in this chapter will focus on the methodological procedure which was followed in order to fulfill the aim of the research. The procedure can be divided into six steps. These are:

1. Outlining the aims and specific objectives of the research as a starting point for the research.
2. Setting up the hypotheses to be tested in order to fulfill the aims and objectives of the research. In order to simplify the analysis certain assumptions have been made, on which the hypotheses are based, on the basis of theoretical evidence presented in Chapter Two.
3. Choice of a study area in which to carry out the research.
4. Sampling of specific individuals from whom data will be collected.
5. Data collection.
6. Analysis of data which includes testing of the hypotheses and an interpretation of the results achieved.

A Aims, Objectives and Hypotheses:

The aim of the research is to investigate the effect of distance from the market or marketing points on farm size and intensity of farming in selected areas in East Griqualand, using Von Thünen's theory as a framework for the investigation. In order to fulfil this aim the following specific objectives have been set:

- (1) To investigate the effect of distance from the farm to the main, regional market of Durban-Pietermaritzburg on farm size and intensity of farming, measured as gross farm income per unit area.

- (2) To investigate the effect of distance from the farm to local marketing points on farm size and intensity of farming.
- (3) To investigate whether the following factors modify the effect of distance from marketing centres on farm size and intensity of farming.
 - (a) Type of farming enterprise,
 - (b) Physical characteristics, especially carrying capacity, of the farm,
 - (c) Age and education of farmers.
 - (d) Perceptions of political uncertainty.
 - (e) The use of marketing centres.

In order to achieve the objectives as set above, the following hypotheses have been set:

- (1) With an increase in the distance from the farm to the main marketing centre of Durban - Pietermaritzburg, there is a corresponding increase in farm size.
- (2) With an increase in the distance from the farm to the main marketing centre of Durban - Pietermaritzburg, there is a corresponding decrease in the intensity of farming.
- (3) With an increase in the distance from the farm to local marketing points, there is a corresponding increase in farm size.
- (4) With an increase in the distance from the farm to local marketing points, there is a corresponding decrease in the intensity of farming.

In order to simplify the analysis of the effect of distance on farming activity, and hence the testing of the hypotheses, the research will be based on a number of assumptions. Some of these assumptions are made explicit and others are implicit in Von Thünen's theory which is discussed in Chapter Two. The assumptions are:

- (1) All farmers are possessed of perfect knowledge and use their knowledge to farm rationally.
- (2) All farmers possess an average managerial capacity.
- (3) Living requirements are the same for all farmers.
- (4) All goods are transported from local railheads to the main marketing centre by rail.

By testing the hypotheses put forward, based on the assumptions outlined above, it is hoped to gain a greater understanding of the general nature of farming activity in East Griqualand and in particular the effect of distance from marketing centres on farm size and farming intensity. Because East Griqualand was considered too large an area for the pilot survey, sub-areas were selected for study and the selection of these will be discussed in the next section.

B. Choice of Study Area:

The choice of East Griqualand as the general study area was based on its geographical isolation and remoteness from the major markets (Chapter Three, page 34). However, farms in East Griqualand cover a total area of 408 000 hectare and there are altogether 433 farms in the area. (Fotheringham, 1981). Given the limitations of time and funds it was not possible to cover the entire area and sub-areas were therefore selected for study.

A list of farmers was obtained from the extension officer as this was the most up-to-date list known to be available. The only means of obtaining an accurate, complete and up-to-date list of landowners in East Griqualand would have been to sort through all the title deeds for land at the Deeds Office in Pietermaritzburg. Even then there would have been discrepancies in the list of farmers obtained as the list would have excluded farmers who leased land and would have included people who owned land but did not farm it. The list would therefore have comprised names of landowners rather than farm operators. The list provided by the extension officer was consequently used and supplemented by reference to telephone directories and inquiries in the field.

Once a relatively complete list was drawn up, the farmers were grouped according to their postal addresses as it was felt that this showed an

affiliation to a particular town or service centre. For example, if a farmer's postal address was Matatiele, then he was grouped under Matatiele. Six groups resulted, namely, Matatiele, Swartberg, Cedarville, New Amalfi, Franklin and Kokstad (Figure 6). It was further established that each of these towns, with the exception of Matatiele, hold stock sales every month where the main types of farm produce, that is, sheep and cattle, are marketed. Because the Matatiele farmers sell their stock at the Cedarville sales they were grouped together with the Cedarville farmers. Two of the resulting five railheads were selected and the area covered by the farms grouped under these selected railheads became the chosen sub-areas.

The sub-areas were chosen according to the extent to which they are uniform in respect of three criteria. The first of these criteria is related to the size and function of the marketing centre which serves the area whereas the other criteria are related to two of the assumptions outlined by Von Thünen for the isolated state, namely the assumption related to transportation of goods to the market, and the assumption related to concentric zones of production. The criteria will be discussed in turn and there will also be a discussion of the final choice of sub-areas which was based on the three criteria.

1. The Size and Function of the Marketing Centre:

One of the principles upon which central place theory is based is that each central place will serve a hinterland the size of which will depend upon the number and range of services offered by the centre. In order that the selected sub-areas be of more or less the same size, they should be served by centres with approximately the same central place functions. Davies (1967) states that the initial step in analyzing central places is to identify classes within what he calls, the functional continuum of a system of towns. The classes are determined by isolating central place functions to which are allocated weighted scores. A centrality index is then calculated based upon the sum of the weighted scores. Finally, the relationship between the centrality index and population is determined graphically and this is used as a framework for recognizing significant breaks in the urban continuum and distinctive orders of towns in the urban hierarchy are isolated. (Davies and Cook, 1968). Davies (1967) and Davies and Cook (1968) isolate eight orders of towns. These are:

- (a) Primate Metropolitan Areas (Order 1)
- (b) Major Metropolitan Areas (Order 2)
- (c) Metropolitan Areas (Order 3)
- (d) Major Country Towns (Order 4)
- (e) Country Towns (Order 5)
- (f) Minor Country Towns (Order 6)
- (g) Local Service Centres (Order 7).
- (h) Low Order Service Centres (Order 8)

Using the methodology outlined above, towns and service centres in East Griqualand were assigned orders in the urban hierarchy (Table 8).

Table 8: Orders of service centres in East Griqualand based on the South African urban hierarchy. (After Davies and Cook, 1968).

Service Centre	Function	Order
Kokstad	Country Town	5
Matatiele	Minor Coutry Town	6
Cedarville	Local Service Centre	7
Franklin	Low Order Service Centre	8
New Amalfi	Low Order Service Centre	8
Swartberg	Low Order Service Centre	8

Kokstad has the widest range of central services available which means that it will attract buyers and sellers from a relatively large hinterland. Matatiele is next in importance with an order of 6, followed by Cedarville and then Franklin, New Amalfi and Swartberg. Davies and Cook (1968) tested the significance of the groupings by using a students "t" test which showed that the selected breaks between the groups were statistically significant except for the break between orders 7 and 8. They therefore suggest, that orders 7 and 8 could be classed together as one group. From their observation it can be deduced that Cedarville, Franklin, New Amalfi and Swartberg are comparable in terms of central place functions, whereas Kokstad and Matatiele are not.

2. Transportation

In his description of the isolated state Von Thünen (1826) initially assumed that all goods were transported by means of a horse-drawn cart and that transport could proceed from any point in the isolated state to the market with equal ease. Later he relaxed this assumption by introducing a navigable river and showed how market access was increased along such a transport route. For the chosen sub-areas to be comparable they should have more or less equally well-developed transportation networks so that market access is a function only of distance from the market. Figure 6 shows that Kokstad is the only town situated on a national road and Franklin is the only town situated at a railway junction giving these two towns an advantage in terms of market access. Kokstad and Franklin are therefore not comparable to the other towns in terms of transportation network development.

3. Concentric Zones of Production:

Von Thünen's isolated state consisted of a single marketing centre surrounded by concentric circles of production. If a town is situated on an international boundary, it is likely that the circular distribution of production around that town will be distorted along the line of the boundary. A case in point is the border between the South African Republic and the independent black states where the border marks a dividing line between white, fully commercialized farming on the one hand and black, semi-subsistence farming on the other. In East Griqualand the towns of Franklin, Kokstad and Matatiele are situated very close to the Transkei border and were therefore not considered in the final selection of possible sub-areas.

4. Final Choice of Sub-areas:

Based on the three criteria discussed above, the service centres of Cedarville, Swartberg and New Amalfi were selected as possible marketing points whose service areas could serve as sub-areas in which the research could be conducted. These towns were found to be comparable in terms of the criteria used for selection, that is, all situated on the same branch line with very little difference in central place function and situated away from the Transkei border. Because Cedarville and Swartberg are situated furthest apart of the three towns, it was decided to select

these as the sub-areas as the chances that their spheres of influence would overlap was minimal.

C. Sampling

Various authors have stressed that, when examining farming activity, the most useful unit of study is the individual farm as it is the operating unit. (Blaut, 1959; Coppock, 1964; Tarrant, 1974). The chosen sub-areas consist of 123 individual farming units as defined for the purposes of the thesis in Chapter Two, page 32. 70 of these farms were grouped with Cedarville and 53 with Swartberg according to the method of grouping as outlined on pages 54-55. It would not have been possible to cover all 123 farms given the limitations of time and funds available. As large a sample as possible was drawn from each sub-area, that is, 72 percent of the total number of farms in each sub-area was sampled. This constituted 50 farms around Cedarville and 38 farms around Swartberg.

Wood (1955), Blaut (1959), Tarrant (1974) and Gregory (1978) discuss different methods of sampling and the following three were considered:

- (1) Area or block sampling, that is, a grid consisting of squares of unit size is placed over the study area. Each square is assigned a number and then squares are selected at random using a random numbers table until the required area has been sampled (Gregory, 1978). If, for example, the study area covers a total area of 300 000 km² and a sample of 1/3 of the area is needed, a grid consisting of squares of 1 km² each could be placed over the study area. If the scale is 1 : 100 000 then each square would represent 1 km². Once the squares have been numbered a total of 100 000 squares would have to be selected in order to have sampled the required 1/3 of the study area, that is, 100 000 km². The disadvantage of using this method is that it biases the sample in favour of larger farms. Because larger farms cover a larger area than smaller farms, more squares would be needed to cover the larger farm and it would therefore have more chance of being selected than the smaller farm.
- (2) Stratified sampling, that is, a list of farms is obtained and then classified according to some criterion judged relevant to the

problem being studied. For example, stock farms may be classified according to whether they are dairy farms or beef - sheep farms, if this is considered an important factor influencing the size of farms. Once the farms have been classified in strata, a random sample of each stratum is drawn such that in each stratum the number of farms selected corresponds to the proportion of that particular type of farm to the total number of farms in the study area. For example, if 20 percent of farms in the study area are dairy farms then the stratum for dairy farms must contain 20 percent of the farms selected for the sample. Blaut (1959) points out that stratified sampling requires more advance information than pure random sampling.

- (3) Pure random sampling, that is, a list of farms is drawn up, each farm numbered and then the required number of farms is selected using the random numbers table. According to Tarrant (1974), if what is desired is a representative cross-section of the farming structure in the area, there is no alternative to pure random sampling. Pure random sampling was the method finally selected for sampling the required number of farms in the sub-areas as it was not biased in favour of large farms and little advance information was required.

A list of farmers was drawn up separately for each sub-area. Each farmer was assigned a number from 1 to 70 for farmers grouped under Cedarville and from 101 to 153 for farmers grouped under Swartberg. In each sub-area farmers were selected randomly for interviewing by using a random numbers table (Gregory, 1978, 9).

D. Data Collection:

Tarrant (1974) points out that there are a number of ways in which data on farming can be obtained, for example, censuses, land-use surveys, sample farm studies and remote sensing techniques. Another data source, which the author encountered when looking for information on farming in East Griqualand, is study group reports compiled by extension officers for the Department of Agricultural Technical Services. The problem with study group figures, land-use surveys such as that conducted by Agriquest, and census data is that information obtained for individual farming units is not available due to the confidential nature of these data sources. Information for individual farming units can be

ascertained by using remote sensing techniques, for example, maps and photographs. However, it can only provide a part of the information required, that is, visible aspects of the rural landscape. Data on socio-economic aspects such as the characteristics of the farmer, his financial position and perceptions of farming, cannot be ascertained by reference to maps or photographs. It appears that the most viable method available for obtaining a wide range of data related to each individual farming unit and the decision-maker for that unit is a sample survey of farms using the questionnaire method. (Birch, 1954; Grigg, 1969; Gregor, 1970; Tarrant, 1974).

The reliance on the questionnaire as the sole means of data collection in social sciences research has been criticized by many authors as the method has a number of disadvantages. Some of the most prominent disadvantages are:

- (1) Farmers selected for interviewing are under no obligation to agree to being interviewed and in certain cases there may be an outright refusal to be interviewed or to answer more personal, confidential questions (Webb et al, 1970; Bailey, 1978).
- (2) Interviewees may give dishonest or inaccurate answers. The answer the interviewee gives will to a certain extent be influenced by his perception of the interviewer and he may deliberately answer dishonestly in an effort to impress the interviewer. Alternatively, he may answer in the manner in which he thinks the interviewer expects him to, especially if the interviewer asks leading questions (Webb et al, 1970; Smith, 1975; Georges, 1980).
- (3) Questions that are badly phrased may result in ambiguity and consequently misinterpretation of the question (Smith, 1975).
- (4) The quality of the interview may differ from one interview to the next, especially if the interviewer becomes tired or bored (Webb et al, 1970). The quality of the interview affects the quality of information obtained and it is important that interviewing remains of approximately the same standard throughout.

The disadvantages listed above can be overcome to a certain extent. If the interviewee is made aware of how the research can benefit him

personally he may be more willing to co-operate and give honest, accurate answers. An alternative way of ensuring accurate information is by asking a question in two different ways and then checking one reply against the other. If there are any discrepancies, the interviewee can be re-contacted and the discrepancy, hopefully, resolved. Many of the disadvantages associated with the questionnaire method of data collection can be minimized if the interviewer is made fully aware of them and takes steps to overcome them as far as possible, for example, the interviewer can take steps to ensure that his interviewing remains of approximately the same standard throughout the interviews if he is aware of how quality of interviewing can vary and how this affects the quality of information received.

Despite the disadvantages associated with using a questionnaire for the purposes of collecting data, it has many advantages which make it a useful data source. Firstly, it is the only method available whereby a wide range of individual farm data can be obtained. In addition, it is an efficient method in that it provides large amounts of data at relatively low cost and the data obtained are amenable to statistical analysis (Smith, 1975).

The main body of data for the research was obtained by personal interviews with the farmers. The questionnaire formed the basis of the interview and each interview was conducted personally by the author who paid careful attention to the disadvantages associated with questionnaire research and attempted to overcome these as far as possible. The balance of data was obtained from Agriquest (which is based on a land-use survey of Natal), government reports and interviews with the East Griqualand extension officer. The following section will deal with the contents of the questionnaire in detail and an attempt will be made to assess the effectiveness of this method of collecting data for the purposes of the thesis.

E. The Questionnaire (Appendix A):

The questionnaire was compiled in English but, once the final draft had been drawn up, translated into Afrikaans as these are the two main languages spoken by farmers in the study area. The final draft was drawn up after the questionnaire had been tested out on a small group of farmers to ascertain to what extent the questions were adequately

phrased and unambiguous and to what extent the data sought in the questionnaire was available from farmers, that is, how answerable the questions were.

The questions in the questionnaire cover aspects relating to the characteristics of the farm which is the unit of operation, the farmer who is the decision-maker, and marketing practises. All information is requested for the same financial year, that is, 80/81 as figures for this year were recorded and available from all farmers at the time of the survey.

Information requested about the farm cover seven characteristics of the operating unit. These are:

1. Farm size, or, more precisely, size of the total farming unit for which one set of books is kept, regardless of whether the farming unit is fragmented or not and regardless of whether the farm is owned or leased. Because it is the farm operator who is responsible for farm management decisions, size of farming unit is defined in terms of who farms the land rather than landownership.
2. Distance from the farm to marketing centres. Three types of marketing centre are considered. Firstly, the major Pietermaritzburg - Durban market is considered. Because the Pietermaritzburg station is closer to East Griqualand than the Durban station, and because the additional distance from each of the East Griqualand railheads to the Durban station is the same, the distance to the Pietermaritzburg station is taken as indicative of the distance to the major markets. This distance is calculated by adding the road distance from the farm-gate to the railhead used most frequently by the farmer for receiving or sending-off goods, to the rail distance from that railhead to the Pietermaritzburg station. The latter distance is not requested in the questionnaire as, once the name of the railhead used for receiving and sending-off goods is known, the rail distance from the railhead can be calculated by measuring the distance on a map and converting it to the actual distance by using the scale of the map. The second and third types of marketing centre considered are local centres, that is, railheads and towns used most frequently by the farmer when conducting business related to farming. These distances are taken as being the road distance from the farm-gate of the farm from which farming operations are controlled to the town or railhead in question.

3. Gross farm income which is used as an indication of intensity of farming. A definition of gross farm income and the choice of it as an indicator for intensity was discussed in Chapter Two, pages 31-32.
4. Land-use which provides information about the types of farming predominating in East Griqualand.
5. The percentage contribution of each farming enterprise to the gross farm income which provides information about the relative importance of enterprises on each individual farming unit. This question provides additional information about the main types of farming in the study area.
6. Types and amounts of produce sold which is used to check the information relating to gross farm income. The average price for each commodity was obtained from the extension officer. Once the amount sold of a particular type of commodity is known, the income from that commodity can be estimated and checked against the income stated by the interviewee. For example, in the case of wool, the average price is given as 225c per kg. If a farmer sold 400 kg of wool, his income from wool can be estimated at R900. If a big discrepancy exists between estimated income and income given by the farmer for any type of produce, the farmer could be recontacted and the discrepancy rectified. In most cases the average price is given per kilogram of commodity, however, very few farmers keep a record of the weight of stock sold and so an average price for cattle and sheep had to be used as a basis for estimating the income obtained from stock sold. The estimates are therefore not entirely accurate, however, they do provide an indication of expected income from each type of produce so that gross discrepancies could be detected and queried.
7. Carrying capacity which gives an indication of the extent to which carrying capacity varies from one farm to the next.

In addition to information related to the farming unit, the questionnaire requests information about the decision-maker of each unit. Age and education of the farmer are requested as these are two factors which Daniel (1975) suggests could modify the effect of distance from the

markets on farm size. (Chapter Two, page 30-31). Another factor related to the characteristics of the decision-maker about which information is requested is the farmer's perception of how proximity to the Transkei border may affect farming in East Griqualand. Interviewees are asked whether proximity to the Transkei border creates any problems for them as farmers and how they view the future of white farmers in East Griqualand in view of homeland development. These questions are asked in order to ascertain the extent to which uncertainty in the political future of East Griqualand exists as uncertainty is seen to be a factor which could possibly modify the influence of distance from markets on farms size and/or intensity of farming (Chapter Two, page 31).

As the aim of the thesis is to examine the influence of distance from marketing centres on farm size and intensity of farming, it is essential to know the exact location of marketing centres at which East Griqualand's farm produce is marketed. To this end, information on marketing is requested to ascertain the extent to which produce is sent to the regional Durban - Pietermaritzburg market and the extent to which it is marketed elsewhere.

An overall evaluation of the questionnaire must take place in the light of the fact that it was used in a pilot survey of farming in East Griqualand. As such, the questionnaire is a preliminary one which yields preliminary results acting as pointers to further research. If further research is undertaken, the questionnaire would need to be updated in the light of knowledge about its shortcomings which became apparent during the pilot survey. The shortcomings which were revealed during the survey will be discussed in turn.

Question 5.2 (Appendix A) requests information on the area of each farm which is devoted to growing pastures. It was discovered that this question yielded information of little value to the reasearch. It would have been more useful to request information on the area devoted to growing all fodder crops so that a distinction could be drawn between fodder crops and cash crops. This information would have shown the extent to which crops are grown for sale, therefore constituting a different farming type, or merely to supplement stock farming as feed. Fortunately the author recognized this shortcoming at a very early stage in the research and was able to obtain the correct information from all farmers.

Question 9 (Appendix A) which requests information on carrying capacity for individual farms did not prove to be very useful as farmers either did not know or else gave the average carrying capacity for East Griqualand as a whole which is 2,5 hectares per large stock unit.

Question 13 (Appendix A) which requests information on educational levels of the farmer only distinguishes between three levels of education, that is, primary, secondary or tertiary. However, the question should have distinguished between lower secondary, that is, Std 6 - Std 8 and higher secondary, that is, Std 9 - Std 10 as there may be a substantial difference in knowledge between someone with a Std 6 as opposed to someone with matric.

The questionnaire could have included a question on the mode of transporting goods to the market as road and rail distance differ in actual distance as well as cost and time involved in transportation. In order to simplify the analysis it is assumed that goods are transported to the local centres by road and from there to the major market by rail (Page 54). Evidence suggested by field inquiries indicates that this assumption holds true for the general case but, unfortunately, no statistics are available to prove the assumption. Some farmers do transport produce directly to the major market by road, although these farmers are in the minority.

Despite the shortcomings listed above, the questionnaire served its purpose in the collection of information directly related to the aims and objectives of the research. The farmers responded well to the questions asked and no problems were encountered with respect to comprehension of the questions. It is felt that if the changes recommended above are effected, that, is, with respect to questions 5.2, 9, 13 and the inclusion of a question on mode of transportation, the questionnaire could be used as a basis for a similar but more comprehensive survey in East Griqualand.

F. Analysis of Data:

The analysis of data can be divided into four separate but related stages, moving from general background description to the more specific testing of hypotheses and the analysis of the implications of the results obtained. Each stage will involve the use of and/or interpretation of

statistical techniques. These techniques will be discussed in more detail below. To facilitate the handling of data, computer facilities were used and the data analyzed by means of SPSS, that, is, Statistical Package for the Social Sciences which is "... an integrated system of computer programs designed for the analysis of social science data" (Nie et al, 1975, 1).

The first stage of the data analysis will involve a consideration of the main variables being tested by the hypotheses formulated on page 53. The main variables are distance from marketing centres, farm size and intensity of farming measured as gross income per unit area of land. Simple descriptive statistics such as measures of central tendency and frequency distributions will be used to bring order in the raw data, that is, to describe and summarize the situation and to ascertain whether or not the data are normally distributed. Two measures of central tendency will be given, namely the mean and the median as, although the mean is the only measure of central tendency based on sound mathematics, in cases where distributions are significantly skewed the median gives a better indication of conditions which are most typical (Gregory, 1978). In the first stage of analysis the data will be examined at two levels. At the first level of analysis no distinction will be made between the two sub-areas, that is, the data will be considered to belong to one area. At the second level of analysis, the data will be grouped according to the sub-area from which they originate so that the results in the two sub-areas may be compared.

The second stage of the analysis will be concerned with testing the hypotheses developed from the theoretical background and set up on page 53. Correlation analysis will be used to measure the degree of association between variables, for example distance and farm size. If the data are normally distributed, Pearson's product - moment correlation coefficient, which is a parametric test used for data at the ratio level of measurement, will be used. However, if the data are not normally distributed the advisability of using a parametric test, which assumes a normal distribution, is brought into question (Ebdon, 1977). In cases where data are not normally distributed, Spearman's rank order correlation coefficient, which is a non-parametric test, will be used. The hypotheses will be tested at the same two levels outlined above for the first stage of analysis.

The third stage of the analysis will involve a consideration of the extent to which selected factors, outlined in Chapter Two, modify the expected results implicit in the hypotheses. The selected factors are: type of farming, physical characteristics of the farming unit especially its carrying capacity, age and educational level of farmers, perceptions of farmers about the future of East Griqualand and marketing patterns. Because many of the selected factors were measured at the nominal or ordinal levels of measurement, the SPSS subprogramme "Crosstabs" which is designed for the analysis of grouped data, will be used. The chi-square test will be used to determine whether a systematic relationship exists between variables and to test the significance of the relationship, Table 9 will be used. The chi-square test can also be used to test whether there is a significant difference between the two sub-areas in respect of any of the variables considered.

In all statistical tests which will be applied to the data, the 5 percent level of significance ($\alpha = 0,05$) will be used. Table 9 gives the critical values for some of the tests used at the 5 percent level. If the values obtained for these tests fall below the critical values then the results will not be considered statistically significant. When accepting results as being statistically significant the risk is run that the results are wrongly accepted. This is known as a Type I error (Gregory, 1978). If a hypothesis is accepted at the 5 percent level there is a 5 percent probability of being wrong. However, if the hypothesis is rejected at the 5 percent level there is also a probability of being wrong, that is, of rejecting a hypothesis which is correct. This is referred to as a Type II error (Gregory, 1978). In order to reduce the risk of making a Type II error the 5 percent significance level will be used although this increases the risk of making a Type I error. However, as the aim of the thesis is to discover general trends, the more stringent 1 percent and 0,1 percent levels, which increase the risk of making a Type II error, are not considered suitable for the purposes of the thesis. Moreover, it is conventional practice in the social sciences to use the 5 percent level.

The final stage of the analysis will involve a summary of the research findings and a discussion of the implications of these findings. It must be remembered that as a pilot survey the aim of the thesis is to outline general trends of the relationship between distance from markets or

marketing points, farm size and intensity of farming in East Griqualand. The results cannot therefore be seen as conclusive but should rather serve as pointers upon which further research in the field can be based.

Table 9: Critical values for selected statistical tests at the 5 percent level (After Bernstein, 1964; Snedecor and Cochran, 1974).

Chi-square		Skewness		Kurtosis	
<u>Degrees of Freedom</u>	<u>Critical Value</u>	<u>Sample Size</u>	<u>Critical Value</u>	<u>Sample Size</u>	<u>Critical Value</u>
1	3.841	35	0.621	50	3.99
2	5.991	40	0.587	75	3.87
3	7.815	50	0.533	100	3.77
4	9.488	80	0.432	125	3.71
5	11.070	90	0.409	150	3.65

CHAPTER FIVE

PRESENTATION AND DISCUSSION OF RESULTS

The results obtained from the questionnaire survey of farmers in East Griqualand are presented and discussed in this chapter. Firstly, there is an examination of the frequency distributions of the main variables investigated for the purposes of the thesis so that order may be brought to the raw data and the situation described and summarized. These variables are farm size, intensity of farming measured as gross farm income per unit area, distance from the farm to Pietermaritzburg, distance from the farm to the town or service centre used most frequently for business, and distance from the farm to the station or siding used most frequently for receiving or sending-off goods. The first section forms an introductory background upon which further analysis is based. The second section is concerned with testing the hypotheses formulated in Chapter Four in order to ascertain whether general trends in the variation of farm size and intensity of farming with distance from marketing centres can be identified. Thirdly, there is an assessment of the role, if any, of selected factors in modifying the relationship between distance from marketing centres and farm size or intensity of farming in East Griqualand. Finally, there will be a summary of the major findings and a consideration of the implications of the results.

A. Analysis of Frequency Distributions:

The purpose of the analysis of the frequency distributions of the main variables investigated in the research is twofold. On the one hand the analysis provides a summary of the main variables as background to the research. On the other hand the analysis is an attempt at ascertaining the extent to which the variables approximate a normal distribution as this will determine the test chosen to measure the association between the variables. As was stated in Chapter Four, data which are not normally distributed are not suited to parametric tests such as Pearson's product-moment correlation coefficient. If the data are not normally distributed, Spearman's rank order correlation coefficient will be used to measure association between the variables. Two statistics are used to examine the extent to which the data approximate a normal distribution. These two statistics are known as the skewness and kurtosis of the distributions. Skewness indicates the extent to which the

distribution is symmetrical and a value of zero indicates perfect symmetry, as in a normal distribution. Kurtosis measures the 'peakedness' of the curve. In a normal distribution, which takes the shape of a bell-shaped curve, the kurtosis is also zero. A very peaked or a very flat curve is not considered normal. To test whether or not the distributions have significant kurtosis or skewness values, the 5 percent significance level will be used. If the values are significant at the 5 percent level, the data will not be considered to be normally distributed and Spearman's rank order correlation coefficient will be used rather than Pearson's product - moment correlation coefficient.

In the analysis of frequency distributions the data have been classified into a number of classes. It is recognized that the choice of class intervals and class limits is largely arbitrary. However, in selecting class intervals and limits, there has been an attempt to select those which yield the best representation of the data. The following three guidelines proposed by Johnson (1976) have been followed:

- The most desirable number of classes is from five to twelve.
- Each class must be of the same width.
- When classes are set up each item of data must belong to exactly one class.

The frequency distributions of the variables farm size, intensity of farming, distance from the farm to Pietermaritzburg, distance from the farm to the town or service centre used most frequently for business and distance from the farm to the station or siding used most frequently for receiving or sending - off goods are first examined and discussed in order to summarize the data and then tested, using skewness and kurtosis, in order to establish the extent to which they approximate a normal distribution.

1. Summary of Main Variables:

(a) Farm size

Farm size in the area covered by the sample survey varies considerably, that is, from 108 hectares to 4856 hectares. The mean farm size of the sample is 1730 hectares and the median is 1432 hectares. Most farms occur in the lower size categories as set out in Table 10. For example, in the Cedarville sub-area 42 percent of the farms sampled fall below

1 000 hectares, in the Swartberg sub-area the corresponding figure is 23,7 percent and in the sub-areas together the figure is 34,1 percent. In the Cedarville sub-area there is therefore a higher percentage of farms occurring in the lower size categories than is the case with Swartberg.

In an examination of Table 10, it appears that the cut-off point in terms of size is 2500 hectares in both sub-areas with the majority of farms (78,4 percent) falling below this size. In the Cedarville sub-area 84-percent of farms and in the Swartberg sub-area 71,1 percent of farms fall below 2500 hectares. Although the range of farm size varies considerably, that is, by 4748 hectares, most farms tend to occur between 108 and 2500 hectares, grouped around the mean and median values. This results in a positive skewing of the distribution as shown in Figure 11.

Table 10: Distributions of farms in the sample according to the size of the farming unit.

Farms Size (ha)	Cedarville		Swartberg		Total Sample	
	Frequency	%	Frequency	%	Frequency	%
< 500	5	10	3	7,9	8	9,1
500 - 999	16	32	6	15,8	22	25,0
1000 - 1499	10	20	6	15,8	16	18,2
1500 - 1999	6	12	8	21,1	14	15,9
2000 - 2499	5	10	4	10,5	9	10,2
2500 - 2999	2	4	3	7,9	5	5,7
3000 - 3499	1	2	1	2,6	2	2,3
3500 - 3999	-	-	3	7,9	3	3,4
4000 - 4499	3	6	3	7,9	6	6,8
4500+	2	4	1	2,6	3	3,4
Total No. of farms	50	100	38	100,0	88	100,0

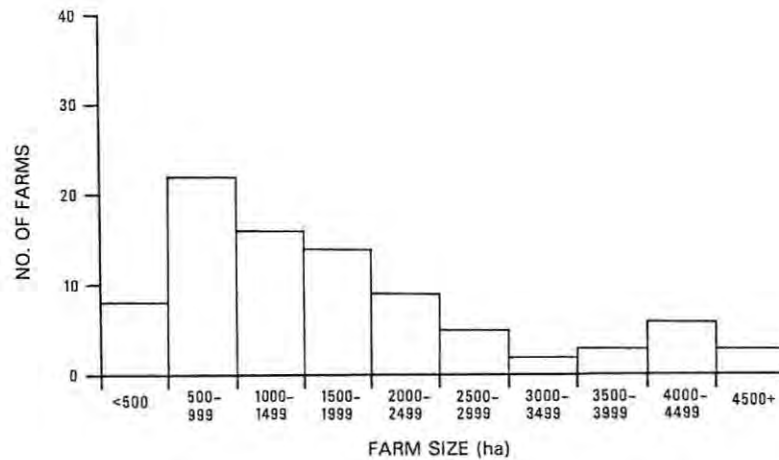


Figure 11: Histogram showing the distribution of farms in the sample according to the size of the farming unit.

(b) Intensity of farming:

The intensity of farming is measured as gross farm income per unit area of land. In the area covered by the sample survey, gross farm income varies from R14 per hectare to as much as R262 per hectare, the mean income being R76 per hectare and the median being R61 per hectare. Table 11 summarizes the distribution of farms in the sample according to the intensity of farming as calculated for the purposes of the thesis. The majority of farms have an intensity of less than R100 per hectare, that is, 78 percent of the Cedarville farms sampled, 78,9 percent of the Swartberg farms sampled and 78,4 percent of the total number of farms sampled. Because the majority of farms fall in the lower intensity categories, the distributions in Table 11 and Figure 12 are positively skewed. A large percentage of the farms, that is, 50 percent, fall in the category R50 to R99 per hectare which centres around the mean and median values.

A cut-off point for the intensity of farming shown in Table 11 appears to be R200 per hectare with only 3 farms falling in the top two categories

of R200 per hectare and above. It was established that on all three of these farms milk is produced, on two of the farms 50 percent and more of the gross farm income is produced from milk and, furthermore, on 2 of the farms cash crops as well as milk is produced. Of the farms sampled, 17 have an intensity of more than R100 per hectare. On 16 of these farms milk or cash crops are produced. On 9 of the 17 farms, dairy farming contributes more than 50 percent of the gross farm income and on one farm cash cropping contributes more than 50 percent of the gross farm income. In the majority of cases therefore, the high intensity can be explained with reference to the types of farming practised as on 16 out of the 17 farms dairy farming and/or cash cropping are found which are high intensity land-uses.

(c) Distance to major market:

Distance from the farming unit to the major market, which is the Durban - Pietermaritzburg complex, is measured as distance by road from the farm - gate to the railhead used most by the farmer, added to the distance from that railhead to the station at Pietermaritzburg. Durban and Pietermaritzburg stations are both on the same railway line from East Griqualand. The Pietermaritzburg station is the closer of the two to railheads in East Griqualand. As the distance between Pietermaritzburg and Durban is a constant and as it was not possible to determine the final destination for produce in all cases, Pietermaritzburg has been taken as the end point and the distance to Pietermaritzburg used as indicative of distance to the major urban market.

Distance from the farming units to the major market measured in this way varies from 175 kilometres to 267 kilometres, the mean and median being 218 and 226 kilometres respectively. Table 12 summarizes the distribution of farms in the sample according to their distance from the major market.

Because Swartberg is closer to the major market than Cedarville, farms in Swartberg are generally closer to the major market than farms in Cedarville (Table 12). Of the farms sampled in Swartberg, 50 percent lie closer than 200 kilometres to Pietermaritzburg whereas in the Cedarville sub-area no farms lie closer than 200 kilometres to Pietermaritzburg. The majority of farms sampled (64.8 percent) fall between 200 and 240

kilometres from Pietermaritzburg. Farms which lie at a greater distance than 240 kilometres from the major market are all found in the Cedarville sub-area. The distribution of farms sampled according to their distance from the major market only approximates a normal distribution, as shown in Figure 13, with the highest number of occurrences found in the central distance categories.

Table 11: Distribution of farms in the sample according to the intensity of farming.

	Cedarville		Swartberg		Total Sample	
Intensity (rands per hectare)	Frequency	%	Frequency	%	Frequency	%
< 50	12	24	13	34,2	25	28,4
50 - 99	27	54	17	44,7	44	50,0
100 - 149	5	10	3	7,9	8	9,1
150 - 199	5	10	1	2,6	6	6,8
200 - 249	-	-	1	2,6	1	1,1
250 +	1	2	1	2,6	2	2,3
Missing values	-	-	2	5,4	2	2,3
Total No. of Farms	50	100	38	100,0	88	100,0

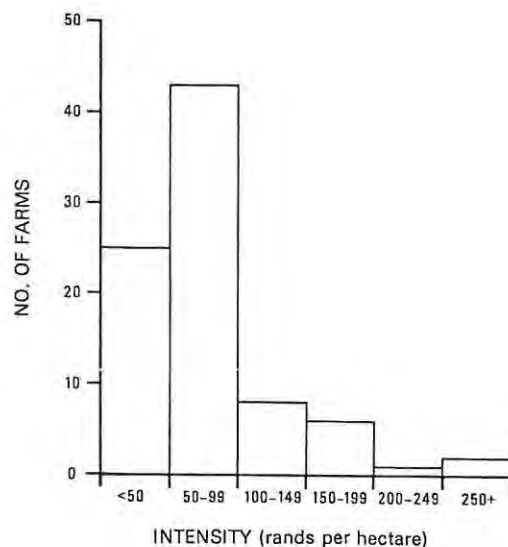


Figure 12: Histogram showing the distribution of farms in the sample according to the intensity of farming.

Table 12: Distribution of farms in the sample according to their distance from the major market.

Distance from the major market (km)	Cedarville		Swartberg		Total Sample	
	Frequency	%	Frequency	%	Frequency	%
< 180	-		2	5,3	2	2,3
180 - 189	-		6	15,8	6	6,8
190 - 199	-		11	28,9	11	12,5
200 - 209	5	10	5	13,2	10	11,4
210 - 219	-	-	8	21,0	8	9,1
220 - 229	19	38	4	10,5	23	26,1
230 - 239	14	28	2	5,3	16	18,2
240 - 249	7	14	-	-	7	7,9
250+	5	10	-	-	5	5,7
Total No. of farms	50	100	38	100,0	88	100,0

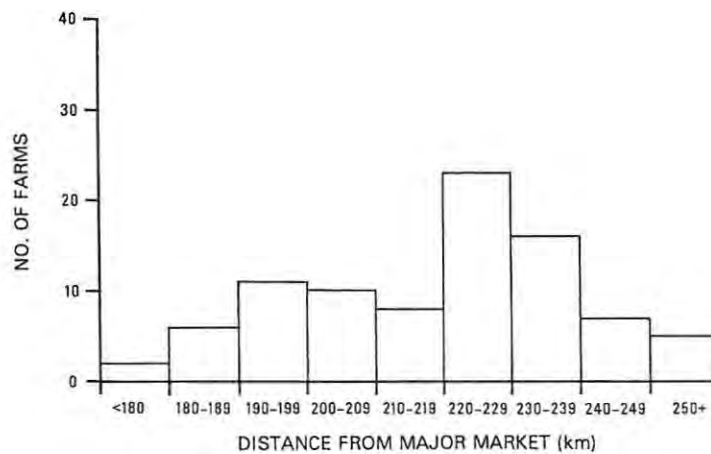


Figure 13: Histogram showing the distribution of farms in the sample according to their distance from the major market.

(d) Distance to town:

The distance farmers travel to town to do business varies considerably from one sub-area to the next as well as within each sub-area. In the

Cedarville sub-area farmers travel between 2 and 95 kilometres to do business. The mean distance travelled to town for business is 16 kilometres in the Cedarville sub-area as opposed to 52 kilometres in the Swartberg sub-area. The corresponding medians are 17 kilometres and 53 kilometres. The difference was found to be significant at the 5 percent level using the students t-test. The reason for this very significant difference between sub-areas is that in the Swartberg sub-area 31 out of 38 farmers do not use their nearest town for business but prefer to travel to Kokstad which, although further away, offers a wider range of services. In the Cedarville sub-area all but one farmer conduct most of their business at Cedarville. Table 13 summarizes the distribution of farms in the sample according to their distance from the town used most for business related to farming. Because of the significant difference between the sub-areas they could not be analyzed according to the same class intervals. A table is also included whereby both sub-areas are classified using the same intervals of distance (Table 14).

The results in Table 13 and 14 show that 74 percent of farms sampled in the Cedarville sub-area lie within 20 kilometres of the town used most frequently for business. The farm furthest away lies at 40 kilometres from the town used for business and belongs to a farmer who prefers to conduct his business in Matatiele although his farm lies closer to Cedarville, that is, at 27 kilometres from Cedarville. In the Swartberg sub-area the data in Tables 13 and 14 show that the majority of farms, (81,6 percent) lie at a distance of 40 kilometres or more from the town where business is conducted. Of these 31 farmers to whom these farms belong, 30 do not conduct their business at the nearest town which is Swartberg but prefer to travel to Kokstad for this purpose.

When the data for the total sample are considered, as in Table 14, the distribution shows a positive skewness with 75 percent of the farms falling in the lower distance categories at a distance of less than 50 kilometres from the town used most frequently for business (Figure 14). All the farms in the categories above this are found in the Swartberg sub-area.

Table 13: Distribution of farms in the sample according to their distance from the town used for business (using different class intervals for distance).

Distance from town (km)	Cedarville		Swartberg		Total Sample	
	Frequency	%	Distance from town (km)	Frequency	%	
< 5	3	6	10	6	15,8	
5 - 9	13	26	10 - 19	-	-	
10 - 14	7	14	20 - 29	-	-	
15 - 19	14	28	30 - 39	1	2,6	
20 - 24	7	14	40 - 49	9	23,6	
25 - 29	4	8	50 - 59	5	13,2	
30 - 34	1	2	60 - 69	6	15,8	
35 - 39	-	-	70 - 79	5	13,2	
40+	1	2	80+	6	15,8	
Total No. of farms	50	100	Total No. of farms	38	100,0	

Table 14: Distribution of farms in the sample according to their distance from the town used for business (using the same class intervals for distance).

Distance from town (km)	Cedarville		Swartberg		Total Sample	
	Frequency	%	Frequency	%	Frequency	%
< 10	16	32	6	15,8	22	25,0
10 - 19	21	42	-	-	21	23,9
20 - 29	11	22	-	-	11	12,5
30 - 39	1	2	1	2,6	2	2,2
40 - 59	1	2	9	23,6	10	11,4
50 - 59	-	-	5	13,2	5	5,7
60 - 69	-	-	6	15,8	6	6,8
70 - 79	-	-	5	13,2	5	5,7
80+	-	-	6	15,8	6	6,8
Total No. of farms	50	100	38	100,0	88	100,0

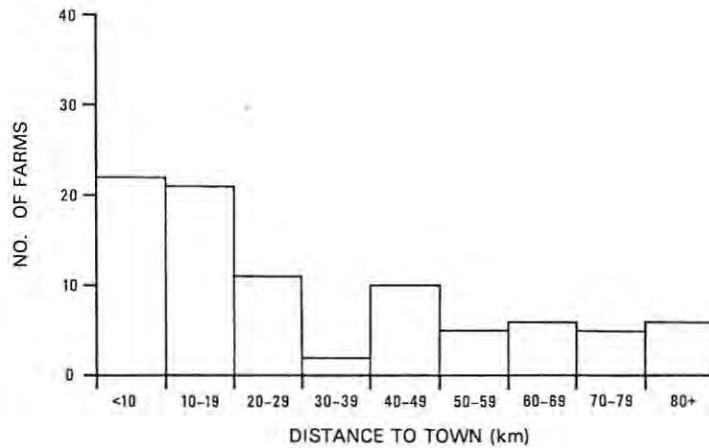


Figure 14: Histogram showing the distribution of farms in the sample according to their distance from the town used most frequently for business.

(e) Distance to station:

The distance farmers travel to a station or siding in order to receive or send-off goods varies from 0 kilometres (if they have a siding on their farm) to 45 kilometres, the mean distance being 12,3 kilometres for the Cedarville sub-area, 17,6 kilometres for the Swartberg sub-area and 14,6 kilometres for the sub-areas considered as a whole. The corresponding median values are 9,3 kilometres, 13,5 kilometres and 11,8 kilometres. Table 15 summarizes the distribution of farming units in the sample according to their distance from the station or siding used most frequently by the farmer for receiving or sending-off goods.

Farms in the Cedarville sub-area, as shown in Table 15, are generally closer to the station or siding used most frequently for receiving or sending-off goods than farms in the Swartberg sub-area. Of the farms in the Cedarville sub-area, 50 percent lie within 10 kilometres of the station or siding used and 80 percent lie within 20 kilometres. The corresponding percentages for Swartberg are 29 percent and 55,3 percent. Farms in the Swartberg sub-area are more or less evenly distributed through the distance categories whereas the distribution for Cedarville shows positive skewing with most farms occurring in the lower distance categories (Table 15). The distribution for the total sample shown in

Table 15: Distribution of farms in the sample according to their distance from the station or siding used most frequently for receiving or sending - off goods.

Distance from town (km)	Cedarville		Swartberg		Total Sample	
	Frequency	%	Frequency	%	Frequency	%
< 5	8	16	5	13,2	13	14,8
5 - 9	17	34	6	15,8	23	26,1
10 - 14	4	8	8	21,1	12	13,6
15 - 19	11	22	2	5,2	13	14,8
20 - 24	4	8	4	10,5	8	9,1
25 - 29	5	10	7	18,4	12	13,6
30 - 34	1	2	1	2,6	2	2,3
35	-	-	5	13,2	5	5,7
Total No. of farms	50	100	38	100,0	88	100,0

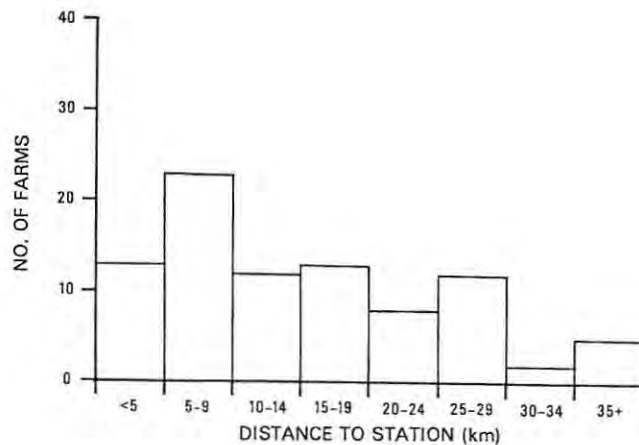


Figure 15: Histogram showing the distribution of farms in the sample according to their distance from the station or siding used most frequently for receiving or sending-off goods,

Table 15 and Figure 15 also shows positive skewness as most farms (69,3 percent) lie within 20 kilometres of the station or siding used. Of the 7 farms which lie at a distance of equal to or greater than 30 kilometres from the station or siding used, 6 are found in the Swartberg sub-area. In the Swartberg sub-area there is, therefore, a greater variation in the distance travelled by farmers to the station or siding they use most frequently for receiving or sending - off their goods.

2. Testing for Skewness and Kurtosis:

In the summary of the main variables, reference was made to distributions which show skewness. In order that Pearson's product-moment correlation coefficient be used, the distribution of the data must approximate a normal distribution. Two statistics are used to test the extent to which the data do or do not approximate a normal distribution, that is, skewness and kurtosis. If the skewness and kurtosis values are significant at the 5 percent level a non-parametric test, Spearman's rank order correlation coefficient, will be used in place of Pearson's in order to test the hypotheses. The values for skewness and kurtosis are set out in Table 16.

The following skewness values are significant at the 5 percent level for $n=40$, $n=50$ and $n=90$ respectively: 0.587, 0.533 and 0.409 (Snedecor and Cochran, 1974). The following kurtosis values are significant at the 5 percent level for $n = 50$ and $n = 100$ respectively: 3.99 and 3.77 (Snedecor and Cochran, 1974). As Snedecor and Cochran (1974) do not include the values for all sample sizes, the values for n closest to the sample sizes in the sub-areas were chosen for testing skewness and kurtosis. If the value for either skewness or kurtosis found in Table 16 equals or exceeds the value given by Snedecor and Cochran, the distribution in question will not be considered a normal distribution. The following distributions do, therefore, not approximate a normal distribution:

- Farm size in Cedarville and in the total sample area.
- Intensity of farming in Cedarville, Swartberg and in the total sample area.
- Distance to the town used most frequently for business in Cedarville and in the total sample area.
- Distance to the station / siding used most frequently for sending - off goods in Cedarville and in the total sample area.

Table 16: Skewness and kurtosis values for the distributions of the main variables.

	Cedarville n=50		Swartberg n=38		Total Sample n=88	
Variable	Skewness	Kurtosis	Skewness	Kurtosis	Skewness	Kurtosis
Farm size	1.665	2.493	0.577	-0.712	0.940	-0.055
Intensity of Farming	1.636	3.236	2.168	4.148	1.925	3.872
Distance to major market	-0.044	0.290	0.266	-0.803	-0.032	-0.848
Distance to town	2.938	12.517	-0.539	-0.559	2.340	12.260
Distance to station	0.622	-0.561	0.466	-0.867	0.737	-0.230

As most of the main variables are not normally distributed, and in order to standardize the testing of the hypotheses, Spearman's rank order correlation coefficient (R_s), which is a non-parametric test, will be used to test the hypotheses instead of Pearson's product-moment correlation coefficient. According to Snedecor and Cochran (1974) Spearman's rank order correlation coefficient has 91 percent of the power efficiency of Pearson's product moment-correlation coefficient which makes it a valid and useful test of correlation. The following section deals with the results of Spearman's rank order correlation coefficient in testing the hypotheses.

B Testing the Hypotheses:

Spearman's rank order correlation coefficient has been used to test the hypotheses set up in Chapter Four. The results of the testing of the hypotheses are set out in Table 17. The hypotheses state the expected nature of the relationship between distance from the farm to marketing centres, farm size and intensity of farming. At the regional scale of analysis the distance from the farm to the major regional market, that is, Durban-Pietermaritzburg, is taken into consideration whereas at the local scale of analysis the distance from the farm to local marketing

points is considered. Hypotheses 1 and 2 refer to the regional scale of analysis and hypotheses 3 and 4 refer to the local scale of analysis. The results of Spearman's rank order correlation coefficient as set out in Table 17 and as applied to the data in order to test the hypotheses, will be discussed for each hypothesis in turn.

1. The Regional scale:

Hypothesis 1 and 2 refer to the regional scale of analysis, that is, they state the expected nature of the relationship between distance from the farm to the regional market, farm size and intensity of farming. In order to recap, hypothesis 1 and 2 can be stated as follows:

Hypothesis 1: With an increase in the distance from the farm to the main consuming centre of Durban - Pietermaritzburg, there is a corresponding increase in farm size.

Hypothesis 2: With an increase in the distance from the farm to the main consuming centre of Durban - Pietermaritzburg, there is a corresponding decrease in intensity of farming.

In order to accept Hypothesis 1 the value of Spearman's rank order correlation coefficient would need to be a positive value significant at the 5 percent level. Spearman's rank order correlation coefficient for Hypothesis 1 shows a weak negative correlation which is not significant at the 5 percent level (Table 17). Hypothesis 1 can therefore not be accepted. Hypothesis 2 should yield a negative value for Spearman's rank order correlation coefficient which it does (Table 17). However, the coefficient is very weak and cannot be accepted at the 5 percent level. On the basis of Spearman's rank order correlation coefficient neither Hypothesis 1 nor Hypothesis 2 can be accepted at the 5 percent level of significance. At the regional scale of analysis, therefore, there does not appear to be a significant relationship between distance from the farm to the marketing centre and farm size or intensity of farming. The reason could be that, as farms in East Griqualand are all far from the market, the relatively small increase in distance from one part of East Griqualand to another makes little difference to farm size or intensity of farming.

2. The Local Scale

At the local scale of analysis, hypothesis 3 and 4 state the expected nature of the relationship between distance from the farm to local marketing points, farm size and intensity of farming. Two local marketing points were considered, namely, the town used most for business and the station or siding used most frequently for receiving or sending - off goods. Hypothesis 3 and 4 can be stated as follows:-

Hypothesis 3: With an increase in the distance from the farm to local marketing points there is a corresponding increase in farm size.

Hypothesis 4: With an increase in the distance from the farm to local marketing points, there is a corresponding decrease in the intensity of farming.

Hypothesis 3 and 4 were initially tested using the data for the total sample. However, no significant relationship was found between the variables. It was then decided to separate the data for the Cedarville and Swartberg sub-areas and the results as shown in Table 17 were found. In the Cedarville sub-area none of the values for Spearman's rank order correlation coefficient relating to Hypothesis 3 and 4 were found significant at the 5 percent level. The two hypotheses were therefore rejected in the Cedarville sub-area. The Spearman's rank order correlation coefficient values for Swartberg relating to Hypothesis 3 and 4 were found to be significant at the 5 percent level. For the relationship between distance from the farm to the town used for business and farm size and the relationship between distance from the farm to the station or siding used most frequently and farm size Spearman's rank order correlation coefficient in each case was found to be 0.6. This value indicates an increase in farm size with an increase in distance from local marketing points. Hypothesis 3 was therefore accepted in the Swartberg sub-area. When the relationship between distance from the farm to local marketing points and intensity of farming was tested, the value obtained was -0.5 which indicates a decrease in intensity of farming with distance from local marketing points. Hypothesis 4 was therefore also accepted in the Swartberg sub-area.

Table 17: Relationship between selected variables using Spearman's rank order correlation coefficient.

Variable	Marketing centre	Sub-area	Correlation coefficient (R_s)	Significant at 5 percent level?
<u>Regional Scale</u>				
1. Distance and farm size	Durban - Pietermaritzburg	Cedarville and Swartberg	-0.04	No
2. Distance and intensity of farming	Durban - Pietermaritzburg	Cedarville and Swartberg	-0.07	No
<u>Local Scale</u>				
3. Distance and farm size	Town used most for business	Cedarville and Swartberg	0.05 0.6	No Yes
	Station/siding used most frequently	Cedarville and Swartberg	-0.2 0.6	No Yes
4. Distance and intensity of farming	Town used most for business	Cedarville and Swartberg	0.01 0.5	No Yes
	Station/siding used most frequently	Cedarville and Swartberg	-0.1 -0.5	No Yes

The results in Table 17 show that at the local scale of analysis (Hypothesis 3 and 4) the hypotheses hold in the Swartberg sub-area but not in the Cedarville sub-area. In all cases the correlation coefficients for the Swartberg sub-area were found to be significant at the 5 percent level meaning that Hypothesis 3 and 4 can be accepted in the Swartberg sub-area with only a 5 percent chance of being wrong. The results appear to indicate that the relationship between distance from local marketing points, farm size and intensity of farming suggested by Von Thünen's analysis of the isolated state is borne out in the Swartberg sub-area but not in the Cedarville sub-area. Tables 18 and 19 illustrate the general trends of farm size, intensity of farming and distance from local marketing points. It must be noted that in Table 18 different class intervals are used for distance in the two sub-areas. The choice of class intervals was based on the frequency distributions discussed in Section A and as there was a significant difference between the two sub-areas in terms of the distance of the farms from the town used most frequently for business, it was decided to choose class intervals which best represent the data in each, individual sub-area.

The results shown in Tables 18 and 19 support the results of Spearman's rank order correlation coefficient as they show that in the Swartberg sub-area there is a definite trend of increasing farm size and decreasing intensity with increasing distance from local marketing points whereas there is no similar definite pattern in the Cedarville sub-area. Table 18 shows the distribution of average farm size and average intensity of farming at different distance intervals from the town used most frequently for business. In the Cedarville sub-area the average farm size increases with increasing distance from the town used most frequently up to a distance of 30 kilometres where the pattern is lost. Average intensity of farming in the Cedarville sub-area decreases with increasing distance from the town used with the exception of the figure for intensity at 0-9 kilometres from the town used which does not conform to the general pattern. In the Swartberg sub-area average farm size increases and average intensity of farming decreases with increasing distance from the town used most frequently for business.

Table 19 shows the distribution of average farm size and average intensity of farming at different distance intervals from the station or siding used most frequently for receiving or sending-off goods. In the Cedarville sub-area the average farm size decreases with increasing

distance from the station or siding used which contradicts expected results based on Von Thünen's theory. The average intensity of farming in the Cedarville sub-area decreases with increasing distance from the station or siding used except for the figure for intensity at 0-9 kilometres from the station or siding used which does not conform to the general pattern. In the Swartberg sub-area the average farm size increases and the average intensity of farming decreases with increasing distance from the station or siding used most frequently for receiving or sending - off goods.

Table 18: The relationship between distance from the farm to the town used most frequently, the average farm size and the average intensity of farming.

Distance (km)	Cedarville		Swartberg		
	Average Farm Size (ha)	Average Intensity (rands per ha)	Distance (km)	Average Farm Size (ha)	Average Intensity (rands per ha)
0 - 9	1334	73	0 - 19	598	172
10 - 19	1591	89	20 - 39	1500	133
20 - 29	1807	75	40 - 59	1922	56
30 - 39	518	58	60 - 79	2405	46
40+	1052	23	80+	2941	40

Table 19: The relationship between distance from the farm to the station used most frequently, the average farm size and the average intensity of farming.

Distance (km)	Average Farm Size (ha)		Average Intensity (rands per ha)	
	Cedarville	Swartberg	Cedarville	Swartberg
0 - 9	1627	909	81	125
10 - 19	1395	2247	92	59
20 - 29	1139	2477	75	54
30 - 39	518	3105	58	51
40+	-	3356	-	50

The results of Spearman's rank order correlation coefficient and the results in Table 18 and 19 show that in the Swartberg sub-area the results conform to expected results based on Von Thünen's theory whereas in the Cedarville sub-area, although trends can be identified, these are inconsistent and in certain cases contradict the expected patterns which should result from Von Thünen's theory. Whereas at the start of the survey it was thought that East Griqualand could be treated as a totality, it has become evident through the analysis that there are differences between the two sub-areas chosen for the purposes of the research. It could be that the differences in the results obtained for Spearman's rank order correlation coefficient in the two sub-areas are the result of other differences which affect the expected results based on Von Thünen's theory. In Chapter Two and Three factors which may modify Von Thünen's theory were selected on the basis of the literature survey and the assumptions outlined by Von Thünen. These factors include the type of farming, the physical environment, the characteristics of the farmers, uncertainty related to homeland development and the patterns of marketing. The next section attempts a comparison of the sub-areas in order to establish whether they differ in respect of these factors. In order to establish differences between the sub-areas the chi-square test will be used and the significance of the differences will be established at the 5 percent level. The results of chi-square can help to establish significant differences between the sub-areas in respect of the selected factors. However, the extent to which these factors have affected the results of Spearman's rank order correlation coefficient cannot be gauged. If differences are established this may act as a pointer for further research.

C Comparison of Sub-areas:

The results obtained by testing the hypotheses indicate that in the Swartberg sub-area there is a trend towards increasing farm size and decreasing intensity of farming with distance from local marketing points. In the Cedarville sub-area, on the other hand, there is no significant statistical relationship between the variables. The question which now arises is: Why does distance from marketing points appear to influence farm size and intensity in the Swartberg sub-area and not in the Cedarville sub-area? Selected factors have been pin-pointed as possibly modifying ideal results based on Von Thünen's theory of land-use. The factors will now be considered in order to ascertain whether the two sub-areas differ in respect of them which may suggest an answer to the question posed above. The factors will be considered under the following headings:

1. Characteristics of the farming unit.
2. Characteristics of the farmer.
3. Marketing patterns.

1. Characteristics of the farming unit:

On the basis of the literature survey in Chapter Two, two aspects of the farming unit were selected as possibly modifying Von Thünen's theoretical patterns. These were the type of farming practised and the physical characteristics of the farming unit.

Oyeleye (1973) states that different systems of rural land-use have different relationships between economic rent and distance from the market. If Oyeleye's statement holds true, a diversification in farming types in an area may influence the relationship between farm size, intensity of farming and distance from the market as these factors may vary depending on the relationship between economic rent and distance from the market. In such a case, a diversification of farming types may modify the expected results based on Von Thünen's theory. It was originally thought that East Griqualand represented an area with a uniform farming system of beef, mutton and wool production with dairying and cash cropping included to a lesser extent and possibly affecting the results. It could be however, that the two sub-areas differ in respect of the types of farming practised, which may in turn have affected the results of Spearman's rank order correlation coefficient. There is a need therefore, to compare the farming types found in the two sub-areas.

In his analysis of the isolated state, Von Thünen assumed that the area was uniform in respect of physical factors. In Chapter Three it was pointed out that East Griqualand is not completely homogeneous in respect of the physical environment and this may have affected the results. The two sub-areas will be compared in respect of the physical environment in order to establish whether there is a significant difference in physical characteristics which could have influenced the results of Spearman's rank order correlation coefficient.

(a) Main types of farming:

The main types of farming found in the sub-areas largely reflect those of East Griqualand as a whole. There are, however, differences between the

sub-areas in respect of the types of farming which are practised. Two aspects which give an indication of the relative importance of the types of farming practised are the contribution of the farming type to the gross farm income (Table 20) and the number of farmers engaged in each farming type (Table 21). All the information on farming types in this section is based on data obtained from farmers during the sample survey of the Swartberg and Cedarville sub-areas.

Table 20: Contribution to gross farm income of enterprises in the sub-areas.

	Cedarville		Swartberg	
	Income	% of Gross	Income	% of Gross
Produce	(to nearest thousand rand)	Farm Income	(to nearest thousand rand)	Farm income
Beef	2246 000	38,0	2007 000	46,2
Dairy	1575 000	26,7	493 000	11,3
Mutton	625 000	10,6	843 000	19,4
Wool	774 000	13,1	836 000	19,2
Cash Crops	616 000	10,4	134 000	3,1
Other	72 000	1,2	36 000	0,8
Total	5908 000	100,0	4349 000	100,0

Table 20 provides the results of the breakdown of the contribution of each farming type to the gross farm income. In both sub-areas shown in Table 20 the production of beef contributes the highest percentage to the gross farm income although this percentage is 8,2 percent higher in the Swartberg sub-area. In the Cedarville sub-area beef production is followed by dairying, wool production, mutton production and cash crops. In the Swartberg sub-area beef production is followed by mutton production, wool production, dairying then cash crops. Both dairying and cash cropping are more important in the amount they contribute to the gross farm income in the Cedarville sub-area than in the Swartberg sub-area. On the other hand, wool and mutton production contribute a greater percentage of the gross farm income in the Swartberg sub-area than in the Cedarville sub-area.

When the number of farmers engaged in each farming type is considered (Table 21) the results show that the majority of farmers in both sub-areas are engaged in the production of beef, mutton and wool. In the Cedarville sub-area the highest percentage of farmers (98 percent) produce beef. This is followed by wool (92 percent), mutton (82 percent), dairy products (62 percent), cash crops (38 percent) and other products (18 percent). In the Swartberg sub-area two farmers did not supply the required information, however, of the 36 who did, 97,2 produce beef, 97,2 produce wool, 91,7 produce mutton, 41,7 produce dairy products, 16,7 produce cash crops and 2,8 produce other products. The main types of farming in the sub-areas are similar, however, a greater percentage of Cedarville farmers produce dairy products and cash crops than is the case in the Swartberg sub-area. The difference in terms of the numbers of farmers who produce dairy products and cash crops in the two sub-areas was found to be significant at the 5 percent level.

Table 21: Number of farmers engaged in each farming type.

	Cedarville (n=50)		Swartberg (n=36)	
Type of farming	No. of farmers	%	No. of farmers	%
Beef	49	98	35	97,2
Dairy	31	62	15	41,7
Mutton	41	82	33	91,7
Wool	46	92	35	97,2
Cash Crops	19	38	6	16,7
Other	9	18	1	2,8
Missing Values	-	-	2	-

The main types of farming show similar patterns in the two sub-areas but with a significant difference existing in terms of dairying and cash cropping as more Cedarville farmers are engaged in these two farming types than is the case with Swartberg farmers and in addition, these two farming types contribute a greater percentage of the gross farm income in the Cedarville sub-area than they do in the Swartberg sub-area. The main farming types can be divided into two groups, that is stock farming which includes beef, mutton, wool and dairy production, and crop farming which involves the cultivation of crops. The main farming types will be discussed in more depth in order to ascertain whether further differences can be identified between the sub-areas.

(i) Stock farming:

Stock farming includes cattle farming and sheep farming. Cattle can be divided into two types, that is beef cattle and dairy cattle whereas sheep can be divided into wool sheep, mutton sheep and dual purpose sheep. Old dairy cows and oxen can be sold as beef and wool sheep can be sold as mutton whereas mutton sheep can be used for the production of wool. However, the type of stock determines the extent to which a farmer concentrates on a particular type of farming.

Table 22: Stock farming in the sub-areas.

Cattle Farming	Number of Cattle			
	Cedarville		Swartberg	
	No. (head)	%	No. (head)	%
Beef Cattle	17777	82,8	19051	91,9
Dairy Cattle	3703	17,2	1689	8,1
Total	21480	100.0	20740	100.0
Sheep Farming	Number of Sheep			
	Cedarville		Swartberg	
	No. (head)	%	No. (head)	%
Wool Sheep	42173	71,2	54135	67,4
Mutton Sheep	3908	6,6	2530	3,2
Dual Purpose Sheep	13149	22,2	23596	29,4
Total	59230	100.0	80261	100.0

As far as numbers of cattle are concerned, the results in Table 22 show that beef cattle outnumber dairy cattle in both sub-areas. However, in the Cedarville sub-area dairy cattle make up a greater percentage of the total number of cattle (17,2 percent) than is the case in Swartberg where dairy cattle make up 8,1 percent of the total number of cattle. This supports the statement made in the previous section that dairying is more important in Cedarville than it is in Swartberg.

As far as sheep farming is concerned, the results in Table 22 show that wool sheep far outnumber mutton and dual purpose sheep. Differences in sheep farming in the two sub-areas can also be distinguished. Cedarville has a higher percentage of mutton and wool sheep than Swartberg whereas Swartberg has a higher percentage of dual purpose sheep. However, as dual purpose sheep are used for mutton and wool production the differences cannot be used to indicate differences in farming types. The relative importance of the two different types of sheep farming (mutton and wool) can only be judged by the contributions of each to the gross farm income and the number of farmers engaged in each type. In the previous section it was seen that in the Swartberg area both mutton and wool production contribute a higher percentage to the gross farm income than in the Cedarville sub-area (Table 20). More farmers in the Swartberg sub-area are engaged in both mutton and wool production than is the case in Cedarville (Table 21). However, when the difference in the number of farmers engaged was tested using the chi-square test, it was not found to be significant at the 5 percent level. This result indicates that in terms of numbers of farmers engaged in mutton and wool production, the two sub-areas do not differ significantly.

(ii) Crop Production:

Crop production can be divided into the production of cash crops which are sold and therefore constitute a separate farming type and the production of fodder crops which are grown for stock feed. The results in Table 23 indicate that the greatest percentage of area devoted to crop production in the sub-areas is that devoted to the growing of fodder crops. In the sub-areas considered as a whole, 84,8 percent of the area devoted to crop production is for the growing of fodder crops and 15,2 percent is devoted to cash crop production. There are, however, marked differences between the sub-areas with respect to crop production. Swartberg has only 5,4 percent of its total crop production area devoted to cash crops whereas the corresponding figure in the Cedarville sub-area is 27 percent. The area devoted to irrigated crops is considerably less than the area devoted to dryland crops in both sub-areas, as can be expected.

Table 23: Crop production in the sub-areas.

Crop Production	Area Cultivated			
	Cedarville		Swartberg	
	Area cultivated (ha)	% of total area under crop produ- ction	Area cultivated (ha)	% of total area under crop produ- ction
<u>Cash Crops:</u>				
Irrigated	34	0,4	15	0,2
Dryland	2184	26,6	514	5,2
Total	2218	27,0	529	5,4
<u>Feed Crops:</u>				
Irrigated	303	3,7	248	2,5
Dryland	5700	69,3	9032	92,1
Total	6003	73,0	9280	94,6
Total Crop Production	8221	100,0	9809	100,0

Of the differences in crop production between the two sub-areas, it is the difference in the amount of land devoted to cash crop production which is the most important as cash cropping constitutes a separate farming type. If the differences in the area devoted to cash crop production, as shown in Table 23, is considered it can be seen that there is only a slight difference between the two sub-areas in respect of irrigated cash crops (0,4 percent and 0,2 percent respectively). The difference for dryland cash crops is more pronounced being 26,6 percent for Cedarville and 5,2 percent for Swartberg respectively. Table 24 summarizes the distribution of farmers in the sample according to the land they devote to dryland cash crop production. The results indicate that Cedarville farmers devote more land to cash crop production than do Swartberg farmers. For example 20 percent of Cedarville farmers cultivate between one and a hundred hectares of cash crops as opposed to 13,2 percent of Swartberg farmers. In addition, 16 percent of Cedarville farmers cultivate over a hundred hectares of cash crops, whereas 2,6 percent of Swartberg farms cultivate this amount. However, when the

difference between the sub-areas in terms of the amount of area devoted to cash crops was tested by the chi-square test it was found not to be significant at the 5 percent level. This result would indicate that the Cedarville and Swartberg sub-areas do not differ significantly in terms of the area devoted to cash crop production.

Table 24: Distribution of farmers according to the area they devote to cultivation of cash crops.

Area (ha)	Cedarville		Swartberg	
	No. of farmers	%	No. of farmers	%
0	32	64	30	78,9
1 - 100	10	20	5	13,2
>100	8	16	1	2,6
Missing Values	-	-	2	5,3
Total	50	100	38	100,0

(iii) Combinations of farming types:

Few farmers concentrate solely on one type of farming. A combination of farming types was established for each farmer in the sample by examining the contributions of the various types of farming to the gross farm income for each individual farmer. The most common combination of farming types in the study area is the combination beef - mutton - wool. In the Cedarville sub-area the two most common combinations are beef - mutton - wool and beef - mutton - dairy (28 percent and 24 percent of farmers respectively), 20 percent of Cedarville farmers farm with the combination beef - mutton - wool - dairy - cash crops and 8 percent farm with beef - mutton - wool - cash crops. In the Cedarville sub-area, therefore, 80 percent of farmers farm with the combination beef - mutton - wool including or excluding other farming types.

In the Swartberg sub-area 52,8 percent of the 36 farmers who provided information farm with the combination beef - mutton - wool, 22,2 percent farm with beef - mutton - wool - dairying, 8,3 percent farm with beef - mutton - wool - dairying - cash crops and 2,8 percent farm with beef - mutton - wool - cash crops. A total of 86,1 percent of Swartberg farmers farm with the combination beef - mutton - wool including or excluding other farming types. The combination beef - mutton - wool dominates in both sub-areas. The domination is, however, more marked in the case of

Swartberg where the three farming types together contribute 84,8 percent to the gross farm income, than in the case of Cedarville where the corresponding figure is 61,7 percent. Table 25 summarizes the percentage contribution of the combination beef - mutton - wool to the gross farm income of individual farmers in the two sub-ares. The results in Table 25 point to a difference between the sub-areas as regards the dominance of beef-mutton-wool with Swartberg farmers placing a greater reliance on th farming combination than Cedarville farmers. For example, in the Swartberg sub-area the combination beef - mutton - wool contributes over 80 percent of the gross farm income in 63,9 percent of the cases and over 50 percent of the gross farm income in 77,8 percent of the cases whereas in the Cedarville sub-area the corresponding figures are 38 percent and 58 percent.

Table 25: Percentage contribution of the combination beef - mutton - wool to the gross farm income of individual farmers in the sample.

% contribution of beef - mutton - wool to gross farm income	Cedarville (n=50)		Swartberg (n=36)	
	No. of farmers	%	No. of farmers	%
< 50	11	22	3	8,3
50 - 79	10	20	5	13,9
80+	19	38	23	63,9
Total	40	80	31	86,1

The difference between the two sub-areas in terms of the relative importance of the combination beef - mutton - wool as shown in Table 25 was found to be significant at the 5 percent level. This result indicates that Swartberg farmers rely more heavily on the dominant farming types for their farm income. In the Cedarville sub-area farmers rely more heavily on other types of farming such as cash cropping and dairying. Tables 26 and 27 show the relative importance of these two farming types in the two sub-areas. The results confirm that Cedarville farmers rely more heavily than Swartberg farmers for income from dairying and cash cropping, that is, from farming types other than those of the dominant farming types. For example, Table 26 shows that 22 percent of Cedarville farmers get 50 percent and more of their gross farm income from dairying

and 4 percent of these get over 80 percent of their gross farm income from dairying. In the Swartberg sub-area the corresponding figures are 11,1 percent and zero. Table 27 shows that 32 percent of Cedarville farmers and 16,7 percent of Swartberg farmers earn less than 50 percent of their gross farm income from the sale of cash crops whereas 6 percent of Cedarville farmers and no Swartberg farmers earn more than 50 percent of their gross farm income from selling cash crops.

Table 26: Percentage contribution of dairying to the gross farm income of individual farmers in the sample.

% contribution of dairying	Cedarville (n=50)		Swartberg (n=36)	
	No. of farmers	%	No. of farmers	%
< 50	20	40	11	30,6
50 - 79	9	18	4	11,1
80+	2	4	-	-
Total	31	62	15	41,7

Table 27: Percentage contribution of cash cropping to the gross farm income of individual farmers in the sample.

% contribution of cash cropping	Cedarville (n=50)		Swartberg (n=36)	
	No. of farmers	%	No. of farmers	%
< 50	16	32	6	16,7
50 - 79	3	6	-	-
80+	-	-	-	-
Total	19	38	6	16,7

The dominant farming system in the two sub-areas consists of the combination of farming types beef - mutton - wool. In the Swartberg sub-area the dominance of the main farming system is clear with 77,8 percent of farmers obtaining over 50 percent of the gross farm income from it. In the Cedarville sub-area there is less reliance on the dominant farming system with 58 percent of farmers obtaining over 50 percent of their gross farm income from it. In the Cedarville sub-area

there is a greater diversification of farming types with a greater percentage of farmers relying more heavily on other farming types such as dairying and cash cropping, for farm income. If one considers the number of farmers involved in each enterprise, there is, statistically, a significantly larger percentage of Cedarville farmers engaged in dairying and cash cropping than is the case with Swartberg. This result also suggests that there is a greater diversification of farming types in Cedarville than Swartberg.

It was initially assumed that East Griqualand was uniform in respect of its farming types. The results of farming types in the sub-areas show that this is not entirely the case. However, the Swartberg sub-area is more uniform in this respect than the Cedarville sub-area. It could be that the greater diversification of farming types in the Cedarville sub-area has influenced the results of Spearman's rank order correlation coefficient. Future research should take this factor into account by attempting to ascertain whether a diversification of farming types in an area modifies Von Thünen's theoretical patterns and, if so, to what extent this is the case.

(b) Physical Environment:

One of Von Thünen's basic assumptions concerns the uniformity of the physical environment. However, this assumption does not hold in East Griqualand where the physical environment can be divided into four main bioclimatic subregions. As was stated in Chapter Three, altitude, rainfall, veld type and hence carrying capacity vary with subregion. Table 4 summarizes the main characteristics of each subregion.

The farms sampled were classified according to the subregion in which they occur. Figure 8 illustrates the location of the subregions in East Griqualand. As some of the farming units lie in more than one subregion it was decided to place each farming unit in the subregion in which more than 50 percent of its area lies. If 50 percent of the farm lies in one area and 50 percent in another it was classified as belonging to an intermediate category with a carrying capacity which is the average of the two sub-areas. Table 28 summarizes the distribution of farms sampled according to the bioclimatic subregion, or combination of subregions, in which they lie.

Table 28: Distribution of farms in the sample according to bioclimatic subregion.

Subregion	Carrying Capacity (ha per L.S.U.)	Sub-area			
		Cedarville		Swartberg	
		No. of farms	%	No. of farms	%
8C (upland drier)	2.8	11	22	-	-
8C/4F	2,5	7	14	-	-
4F (Highland to Submontane)	2,2	25	50	23	60,5
4F/4E	2,0	5	10	2	5,3
4E (Highland to Submontane)	1.8	2	4	13	34,2
Total		50	100	38	100,0

In both sub-areas shown in Table 28, the majority of farms lie in the 4F subregion with a carrying capacity of 2,2 hectares per large stock unit (L.S.U.). This constitutes 50 percent of the Cedarville farms and 60,5 percent of the Swartberg farms. Carrying capacity in the Cedarville sub-area varies between 2,8 hectares per L.S.U. and 1.8 hectares per L.S.U. with 36 percent of farms falling below and 14 percent of farms falling above the mode of 2,2 hectares per L.S.U. In the Swartberg sub-area, on the other hand, no farms fall below the mode and 39,5 percent fall above it. The variation in carrying capacity is consequently between 1.8 and 2.2 hectares per L.S.U. The variation in carrying capacity in the Swartberg area is, therefore, less than the variation in carrying capacity in the Cedarville area. In addition, in the Swartberg sub-area two bioclimatic subregions are represented whereas in the Cedarville sub-area three bioclimatic subregions are represented. When the difference in the distribution of farms in the sub-areas according to bioclimatic subregion was tested by means of the chi-square test, the value obtained was found to be significant at the 5 percent level. The results of the chi-square test indicate that there is a significant difference in the way in which farms are distributed through the bioclimatic subregions in the two sub-areas. Cedarville farms are distributed through three bioclimatic subregions whereas Swartberg farms are distributed through two. In other words, there is a greater variation in the physical environment in the Cedarville sub-area than in

the Swartberg sub-area. Stated differently, the physical environment in the Swartberg sub-area is more uniform than that in the Cedarville sub-area and therefore Von Thünen's assumption of uniformity is met to a greater degree in the Swartberg sub-area. The greater uniformity in the physical environment found in the Swartberg sub-area could explain why the relationship between distance from marketing points, farm size and intensity of farming suggested by Von Thünen's theory holds better in the Swartberg sub-area. In this respect, the physical environment could modify expected results based on Von Thünen's theory and future research could pay more attention to physical factors, perhaps by stratifying the sample on the basis of physical factors so that samples homogenous in respect of physical factors are drawn.

2. Characteristics of Farmers:

Von Thünen assumed that all farmers in the isolated state were possessed of perfect knowledge and acted rationally on that knowledge in order to maximize profits. However, perfect knowledge can seldom, if ever, be attained. The managerial ability of farmers varies according to their access to knowledge and their ability to use knowledge in order to maximize profits. Because the measurement of managerial ability is problematic and time-consuming it was decided, for the purposes of the thesis, to assume that all farmers in the study area are possessed of average managerial capacity. Two other characteristics which are more easily measured and which possibly affect the decision-making of farmers, are age and the level of formal education reached.

For example, in Chapter Two it was pointed out that older farmers may own smaller farms irrespective of distance from the market for three possible reasons, that is:-

- being older and possibly less well-educated the older farmers may be less aware of the importance of the size factor.
- the older farmers may have bought their farms during the years of depression when they could not afford large farms.
- older farmers, having reached retirement age, may have disposed of parts of their farms to their sons (Daniel, 1975).

Fotheringham and Reeds (1979) also isolate age as a factor affecting decision-making. They distinguish between "gamblers" who are willing to take risks and "satisfiers" who aren't, and state that older farmers are

more likely to be satisfiers. This could be related to adaptation to change with older farmers being less willing to adapt to change than younger farmers.

Although it is not the only avenue through which farmers gain knowledge, formal education affects the farmers access to knowledge and the extent to which he possesses perfect knowledge. The level of formal education is used as an indication of the extent to which each individual farmer possesses perfect knowledge.

Education may contribute to the extent to which a farmer possesses perfect knowledge. Uncertainty, on the other hand, detracts from perfect knowledge. Where uncertainty exists the assumption of perfect knowledge is ruled out completely. Farmers are faced by many types of uncertainty, as outlined in Chapter Two. This research takes uncertainty into consideration as a factor which possibly modifies the expected results based on Von Thünen's theory. Institutional uncertainty, or political insecurity, is seen as a potentially important factor affecting farming in East Griqualand which is a disputed area in terms of homeland incorporation.

Three factors are seen as possibly affecting the results of Spearman's rank order correlation coefficient through their influence on the decision-making of farmers. These are age, level of formal education and political insecurity. An examination will be made of the factors by comparing the sub-areas in order to ascertain if there are significant differences between the sub-areas in respect of them.

(a) Age

Table 29 summarizes the distribution of farmers in the sub-areas according to different age categories. The farming population of the Cedarville sub-area appears to be slightly older than that of the Swartberg sub-area. For example, 66 percent of Cedarville farmers are under the age of 50 as opposed to 76,3 percent of Swartberg farmers. The biggest difference occurs in the age categories 30-49 years and 50 - 69 years. Of the farmers in the Cedarville sub-area, 58 percent are between the ages of 30 and 49 and 32 percent are between the ages of 50 and 69 whereas the corresponding percentages for Swartberg are 71 percent and 18,4 percent. However, when the chi-square test was applied the difference in age between the two sub-areas was not found to be significant at the 5 percent level. The areas can therefore be seen to

be comparable in terms of the age of the farming population and age is therefore probably not a factor which has affected the results of Spearman's rank order correlation coefficient.

Table 29: Distribution of farmers in the sample according to age.

Age	Cedarville		Swartberg	
	No. of farmers	%	No. of famers	%
< 30	4	8	2	5,3
30 - 49	29	58	27	71,0
50 - 69	16	32	7	18,4
70+	1	2	2	5,3
Total	50	100	38	100,0

(b) Education

The results obtained for education in the sub-areas are summarized in Table 30. The Swartberg sub-area has a better educated farming population with 47,4 percent of the Swartberg farmers having been to university or college as compared with only 26 percent in the Cedarville sub-area. The reason for this could be related to the fact that the Swartberg sub-area has a higher proportion of younger farmers. Table 31 shows that age and educational level are related with 24 out of the 31 farmers possessing tertiary education found in the 30 - 49 years age category. The difference between the sub-areas in respect of educational level was found to be significant at the 5 percent level when applying the chi-square test, indicating that Swartberg has a significantly higher proportion of farmers with tertiary education than Cedarville. Education may be a factor which has influenced the results of Spearman's rank order correlation coefficient in the two sub-areas, contributing to the greater degree of conformity of the results to expected patterns based on Von Thünen's theory.

Table 30 Distribution of farmers in the sample according to highest level of education attained.

Highest level of education	Cedarville		Swartberg	
	No. of farmers	%	No. of farmers	%
Primary	1	2	0	-
Secondary	36	72	20	52,6
Tertiary	13	26	18	47,4
Total	50	100	38	100,0

Table 31: Relationship between age and educational level in the sample.

Farmers attaining tertiary education				
	Cedarville		Swartberg	
Age	No. of farmers	%	No. of farmers	%
30	1	7,7	2	11,1
30 - 49	11	84,6	13	72,2
50 - 69	1	7,7	3	11,1
70+	-	-	1	5,6
Total	13	100	18	100,0

(c) Political Insecurity

When interviewed 14 Cedarville farmers and 10 Swartberg farmers admitted that proximity to the Transkei caused problems for them as farmers. 57,6 percent of farmers whose farms bordered directly on Transkei as opposed to 14,5 percent of farmers whose farms did not border directly on Transkei, experienced problems. The problems outlined by the farmers were related to stock-theft, veld-fires, damaged fences and other problems of a similar nature rather than the uncertainty related to potential for homeland incorporation. When questioned about their perception of a future for farming in East Griqualand only 3 Cedarville farmers and 2 Swartberg farmers admitted to uncertainty and only 1 farmer saw no future whatsoever. However, those who saw a future for farming in East Griqualand added that the future was good providing East Griqualand remained "white". Farmers were then asked the question: "Do you think East Griqualand will be incorporated into Transkei?" Table 32 summarizes the responses to this question.

Table 32: Responses of farmers in the sample to the question: "Do you think East Griqualand will be incorporated into Transkei?"

Response	Cedarville		Swartberg	
	No. of farmers	%	No. of farmers	%
No	29	58	21	55,3
Yes	8	16	3	7,9
Uncertain	13	26	14	36,8
Total	50	100	38	100,0

A "yes" or "uncertain" response in Table 32 may be interpreted as an indication of political insecurity or uncertainty. Table 32 shows that 21 Cedarville farmers and 17 Swartberg farmers express the feeling of

political insecurity. However, of these farmers only 5 Cedarville farmers and 2 Swartberg farmers feel that this uncertainty has a negative effect on their farming practices by discouraging them from investments in more land, improvements or in planting permanent crops. The remainder of the farmers' attitudes can be summed up by the statement: "One can only carry on regardless."

On the whole the perceptions of farmers in the two sub-areas regarding their future are very similar. None of the observed differences were found to be significant when applying the chi-square test. This appears to indicate that political insecurity does not play a statistically significant role in influencing results based on Von Thünen's theory. The reason for this could lie in the attitudes of farmers who, although uncertain of the future, do not allow this to affect their farming practices.

3. Marketing Patterns:

Von Thünen assumed initially that there was only one major market in the isolated state for which all produce was designed and from which farmers could obtain inputs such as manure used for fertilizer. Later Von Thünen relaxed the assumption of a single urban market when he introduced the notion of a subsidiary market and showed how this would modify his initial results.

In East Griqualand the major urban market is the Durban-Pietermaritzburg complex. However, in testing the hypotheses at the regional scale no correlation was found between distance from the major urban market and intensity of farming or farm size. When the hypotheses were tested at the local scale a correlation was found in the Swartberg sub-area but not in the Cedarville sub-area. Could these results be explained by the patterns of marketing in the two sub-areas. Is a role played by marketing centres other than Cedarville and Swartberg? To what extent do the marketing patterns of the two sub-areas differ?

The major types of produce found in East Griqualand are beef, mutton, wool, milk and cash crops. Cattle and sheep are marketed at local stock sales or are sent directly to the markets, usually by rail. From the local stock sale it is the buyers responsibility to transport the stock to their destination, which will obviously affect the price he is prepared to pay for the stock. The buyers normally rail stock to their destination. Wool and cash crops are also transported by rail to the

markets. Railheads are, therefore, important marketing points and stock sales are held at a number of these railheads, namely: Cedarville, New Amalfi, Franklin and Swartberg. Railheads are also used for receiving goods from where they are transported to the farm. The only product in the study area which is not transported by rail is milk. Milk is transported from the farm by road to collecting depots and from there transported by road to the market. Three marketing points are therefore of importance in the study area, namely: marketing centres for stock, railheads and collecting depots for milk. A comparison will be made of the use of these in the sub-areas in order to establish whether there is any significant difference in uniformity in the use of marketing points as the use of a variety of marketing points by farmers in the sub-areas may influence expected results based on Von Thünen's theoretical patterns.

(a) Marketing centres for stock:

The results summarized in Table 33 show that the majority of farmers market their stock at the two major local marketing centres, that is, Cedarville and Swartberg. In the Cedarville sub-area 77,6 percent of the farmers market their cattle at Cedarville and in the Swartberg sub-area 84,2 percent of farmers market their cattle at Swartberg. This difference is not significant at the 5 percent level when tested by means of the chi-square test which indicates that there is not a significant difference in the degree of uniformity with which farmers use the major local marketing centres for marketing cattle in the two sub-areas.

Where the marketing of sheep is concerned, 63,8 percent of Cedarville farmers and 89,2 percent of Swartberg farmers market at Cedarville and Swartberg respectively. A higher proportion of Cedarville farmers market their sheep at centres other than the major local centre than is the case with Swartberg farmers. For example, 14,9 percent of farmers who market sheep from Cedarville market them at Cato Ridge and 21,3 percent market sheep in the Transkei or to local butchers. In the Swartberg sub-area the corresponding percentages are 8,1 percent and 2,7 percent. The Swartberg sub-area shows greater uniformity than the Cedarville sub-area in the use of marketing centres for sheep. The difference between the sub-areas in the use of marketing centres for sheep was tested using chi-square and was found to be significant at the 5 percent level which indicates that the degree of uniformity in the use of marketing centres for sheep is significantly higher in the Swartberg sub-area. This may be a factor explaining why the results in the Swartberg sub-area conform to a greater extent to expected results based on Von Thünen's theory.

Table 33: Marketing patterns for cattle and sheep in the sub-areas.

	Cedarville		Swartberg	
Marketing Centres	No. of farmers	%	No. of farmers	%
Cattle	using centre		using centre	
Cato Ridge	3	6,1	2	5,3
Cedarville	38	77,6	-	-
Swartberg	-	-	32	84,2
Other (Transkei, local butchers)	8	16,3	4	10,5
Total	49	100,0	38	100,0
Sheep				
Cato Ridge	7	14,9	3	8,1
Cedarville	30	63,8	-	-
Swartberg	-	-	33	89,2
Other (Transkei, local butchers)	10	21,3	1	2,7
Total	47	100,0	37	100,0

(b) Railheads:

The results shown in Table 34 indicate that the majority of farmers use the railheads closest to them in order to transport produce. Only 2 Cedarville farmers and 1 Swartberg farmer use a railhead other than that closest to them. In the Cedarville sub-area five railheads are used with the majority of farmers (68 percent) using the Cedarville station. There is a certain amount of overlap with 1 Cedarville farmer and 2 Swartberg farmers using the New Amalfi station as New Amalfi is situated between Cedarville and Swartberg (Figure 6). In the Swartberg sub-area, four railheads are used with the majority of farmers (84,2 percent) using the Swartberg station. This difference between the sub-areas in terms of the use of railheads can be accepted as being statistically significant at the 5 percent level using the chi-square test. The result of chi-square indicates that there is a significant difference in the use of railheads in the sub-areas. A greater percentage of Swartberg farmers use one railhead as opposed to the Cedarville farmers where there is less uniformity in the use of railheads. The greater uniformity in the use of railheads in Swartberg may have contributed to the better conformity of results in the Swartberg sub-area to the expected results based on Von Thünen's theory.

Table 34: The use of railheads in the sub-areas.

Railhead	Cedarville				Swartberg			
	No. of farmers	% closest to railhead	No. of farmers using railhead	% closest to railhead	No. of farmers	% closest to railhead	No. of farmers using railhead	% closest to railhead
Cedarville	33	66	34	68	-	-	-	-
Franklin	-	-	-	-	2	5,3	3	7,9
Houstonshope	-	-	-	-	1	2,6	1	2,6
Llewellyn	-	-	-	-	1	2,6	-	-
Matatiele	7	14	5	10	-	-	-	-
New Amalfi	1	2	1	2	2	5,3	2	5,3
Saamloop	6	12	6	12	-	-	-	-
Swartberg	-	-	-	-	32	84,2	32	84,2
Wembley	3	6	4	8	-	-	-	-
Total	50	100	50	100	38	100,0	38	100,0

(c) Collecting depots for milk:

Table 35 summarizes the use of collecting depots for milk. Of the farmers in the sample who produce milk, 87,1 percent of Cedarville farmers market their milk at National Co-operative Dairies in Cedarville and 86,6 percent of Swartberg farmers market their milk at Nestle's in Franklin. In both sub-areas there is one depot to which a majority of the farmers send their milk and this gives a high degree of uniformity in the marketing of milk. The degree of uniformity in the marketing of milk does not differ significantly between the two sub-areas according to the chi-square test at the 5 percent level. The result of chi-square indicates that the role played by the marketing patterns of milk in influencing the results of Spearman's rank order correlation coefficient cannot be very large.

Table 35: Marketing patterns for milk in the sub-areas.

Depot	Cedarville		Swartberg	
	No. of farmers marketing at depot	%	No. of farmers marketing at depot	%
NCD Cedarville	27	87,1	-	-
NCD Kokstad	-	-	1	6,7
Nestle's Franklin	1	3,2	13	86,6
Other	3	9,7	1	6,7
Total	31	100,0	15	100,0

D. Summary of Results:

Based on Von Thünen's theory four hypotheses were formulated and tested. The first two concerned the relationship between distance from the market, farm size and intensity of farming at the regional scale of analysis. The third and fourth hypotheses concerned the same relationship at the local scale of analysis. No statistical relationship was found at the regional scale of analysis and it was concluded that, as farms in East Griqualand are all far from the market, the relatively small increase in distance from one part of the study area to another makes little difference to the farm size or intensity of farming. At the local scale of analysis it was found that the relationship exists in the Swartberg sub-area but not in the Cedarville sub-area. In the Swartberg sub-area it was shown that there is a general trend of increasing farm size and decreasing intensity of farming with increasing distance from local marketing points. Following on from the results of the hypotheses, a comparison was made of the two sub-areas in order to provide possible reasons for the difference in results in the two sub-areas. The comparison involved a consideration of selected factors - chosen on the basis of the literature survey and the assumptions outlined by Von Thünen - which could possibly modify the expected results based on Von Thünen's theory. The comparison showed that the two sub-areas differ significantly in respect of four factors. (The chi-square test was used to test the significance of the difference in each case). The four factors are:

- the main types of farming practised.
- the physical environment of the farming unit.
- the educational level of the farmers.
- the use of marketing points, specifically the use of marketing centres for sheep and the use of railheads for receiving or sending-off goods.

The comparison showed that the Swartberg sub-area is more uniform in respect of the types of farming practised, the physical environment and the use of marketing points. The comparison also showed that the Swartberg sub-area has a significantly higher percentage of farmers with tertiary education. The results indicate that the four factors listed above may modify the relationship between distance from the market, farm size and intensity of farming which is expected from Von Thünen's theory. However, further research is needed to establish if, and to what extent, the factors do affect the relationship.

CHAPTER SIX

CONCLUSION

The thesis constitutes a pilot survey, the aim of which is to examine the spatial aspects of farming activity in East Griqualand. One factor, that is, distance from the market was isolated for special reference and Von Thünen's theory, which focuses on the influence of distance from the market on the spatial distribution of farming, was selected as an analytical framework.

Von Thünen's theory can be seen as comprising two separate theories, that is, the location theory and the intensity theory. The location theory states that farming types are distributed in a particular pattern around an urban centre and that the nature of this pattern is dictated by the sensitivity of each type of farming to distance from the market. For example, dairy products, which are perishable and expensive to transport, are very sensitive to the factor of distance and will therefore locate as close as possible to the market. To illustrate the principles of his theory Von Thünen drew a model which consists of concentric zones of production around an urban market. Not only the type of farming but also the intensity of farming changes from one zone to the next with the most intensive land-uses being situated closest to the market. The pattern of decreasing intensity with increasing distance from the market is known as the intensity theory. Given a single type of farming, the closer the farmer is to the market, the greater will be his savings on transport costs and the more money he will have available to invest as inputs into his land. The increased investment or inputs into his land should result in a greater output and a farmer close to the market should therefore be able to obtain a greater income per hectare from his land than one further away from the market.

Closely linked to the idea of decreasing intensity with increasing distance from the market is the idea of a distributional pattern of farm sizes around an urban centre. The more intensively a farmer farms his land, the greater his income should be and the smaller the farm he should need to maintain a given standard of living. In other words, whereas intensity decreases with distance from the market, farm size should increase with distance from the market.

Farm size has been noted as a factor worth of study as it is linked to the problem of an economic size unit. If a farm is too small a farmer may not be able to make a living on the farm and this could put the farm in danger of over-exploitation by, for example, over-stocking. Many factors determine the extent to which a farm can be considered as a viable economic unit. Other factors such as the physical environment, the type of farming practised, the living requirements of the farmer and his managerial ability may affect what size of farm will constitute an economic unit. If the intensity theory holds, distance from the market should also be an important factor to take into consideration when determining the extent to which the size of a farm constitutes an economic unit. The aim of the thesis was therefore narrowed down to an investigation of the influence of distance from the market on farm size and the intensity of farming in selected areas in East Griqualand.

The influence of distance from the market can be studied at different levels and two levels were chosen for the purposes of the thesis. The two levels were distance from the main market which constitutes the Durban-Pietermaritzburg complex and distance from local marketing points such as railheads, stock sales and collecting depots for milk. In other words, the influence of distance from the market was studied at the regional level and the local level.

Distance from the market is not the only factor which influences farm size. Other factors were chosen on the basis of the literature survey in Chapter Two and the assumptions outlined by Von Thünen as being factors which could possibly modify the expected relationship between distance from the market, farm size and intensity of farming. These factors were:-

- Characteristics of the farming unit which included the type of farming practised and the physical characteristics.
- Characteristics of the farmer which included his age, educational level and perceptions of political insecurity in East Griqualand.
- Marketing patterns.

In order to investigate the influence of distance from the market and marketing points, on farm size and intensity of farming, four hypotheses were drawn up in Chapter Four. The hypotheses postulated that farm size

increases and intensity of farming decreases as distance from the marketing centre increases. The hypotheses were tested at the regional and local levels in two sub-areas, Swartberg and Cedarville. Spearman's rank order correlation coefficient was used to test the hypotheses as it is a non-parametric test suited to the data for the main variables which were not all normally distributed. At the regional scale of analysis the hypotheses were rejected at the 5 percent significance level. At the local level of analysis the hypotheses were rejected in the Cedarville sub-area and accepted in the Swartberg sub-area at the 5 percent significance level. This raised the question: Why are the expected relationships outlined by the hypotheses found in the Swartberg sub-area but not in the Cedarville sub-area? Further research is needed to answer this question. However, it was felt that a comparison of the two sub-areas would indicate significant differences which could provide pointers to further research by identifying specific factors which may have modified the expected relationship between distance from marketing centres, farm size and intensity of farming. The sub-areas were compared in terms of the selected factors outlined on page 110. The chi-square test was used to test the significance of observed differences at the 5 percent level.

The comparison of the sub-areas revealed that the Swartberg sub-area was more homogeneous in terms of the type of farming practised, the physical environment and the marketing centres used by farmers. It was also found that Swartberg had a significantly higher incidence of farmers with tertiary education. Further research should attempt to examine the extent to which these factors do modify the expected pattern of farm size and intensity of farming in relation to distance from the market based on Von Thünen's theory.

Many authors have attempted to deny the present relevance of Von Thünen's theory. However, the results in the Swartberg sub-area confirm that distance from marketing centres at the local level of analysis is still a factor which influences farming activity given that the area under consideration conforms to a large extent to the assumptions of uniformity regarding physical factors, transportation of produce and the use of a marketing centre which were outlined by Von Thünen. In Swartberg the trends of increasing farm size and decreasing intensity with increasing distance from the market are clear and the statistical relationship between the variables significant at the 5 percent level. The results in the Swartberg sub-area therefore support the idea, based on Von Thünen's theory, that distance from marketing centres has an influence on the size of a farming unit.

Farm size has been identified as a problem of South Africa agriculture as a farm that is too small may not constitute a viable economic unit (Marais, 1970; Du Plessis, 1972). The following statement, which stresses the serious light in which the problem of farm size is viewed appears in the Second Report of the Commission of Inquiry into Agriculture:

"The problem of uneconomic farming units is, because of its economic, biological and sociological implications, undermining agriculture in the Republic of South Africa and is certainly one of the greatest single problems in present day South African agriculture" (Marais, 1970).

The Second Report of the Commission of Inquiry into Agriculture goes on to state that a lot of thought has been given to the question of what yardstick should be used to ascertain the extent to which a farming unit constitutes a viable economic size (Marais, 1970). Economic viability does not only depend on the physical size of the farming unit but also on other factors such as climatic conditions, soil fertility, living requirements and the managerial ability of the farmer. This thesis has shown that distance from the market is also a factor which influences the size of a farming unit and should therefore be taken into consideration when determining the size at which a farm can be considered economically viable.

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APPENDIX A

QUESTIONNAIRE

RHODES UNIVERSITY
DEPARTMENT OF GEOGRAPHY

RESEARCH SURVEY OF FARMING IN EAST GRIQUALAND

This questionnaire forms part of a Masters Thesis on farming in East Griqualand. All information received will be treated as STRICTLY CONFIDENTIAL.

General (For Official Use Only)

1. Code

2. Person Interviewed Owner
Manager

NB: A Farming Unit = all land farmed as one unit and for which one set of books is kept.

1. Identity of Holder:

- | | |
|-----------------------------|--|
| Private Farmer | |
| Partnership with Individual | |
| Private Company | |
| Other (specify) | |

2. Area farmed as one unit (including leased land) ha/morgen
.....

3. Distance from farm - gate to town:

	<u>Town</u>	<u>Distance (km)</u>
(a) Distance from farm to nearest town.		
(b) Distance from farm to town where business is done.		

4. Distance from farm-gate to station/siding:

	<u>Station/Siding</u>	<u>Distance (km)</u>
(a) Distance from farm to nearest station/siding.		
(b) Distance from farm to station/siding used for receiving or sending-off goods.		

5. Land-Use for tax year 80/81:

	<u>Category</u>	<u>ha/morgen</u>
1. <u>Cash Crops:</u>		
(a) Irrigated		
(b) Dryland		

	<u>Category</u>		<u>ha/morgen</u>
2.	Pasture (planted):		
	(a) Irrigated		
	(b) Dryland		
3.	Plantation/Forest		
6.	<u>Stock Farming for Tax Year 80/81</u>		

	<u>Category</u>		<u>Head</u>
1.	<u>Cattle:</u>		
	(a) Dairy		
	(b) Beef		
2.	<u>Sheep:</u>		
	(a) Mutton		
	(b) Wool		

7. Gross Farm Income:

What was your total gross farm income for the tax year 80/81 to the nearest thousand (in Rands)?

8. Contribution to Total Gross Farm Income for Tax Year 80/81:

<u>Category</u>	<u>% of Total Gross Farm Income</u>
Beef	
Dairy	
Mutton	
Wool	
Cash Crops	
Other (specify)	

9. Carrying Capacity:

What do you estimate is the carrying capacity of your farm?

..... ha/morgen per L.S.U.

10. Produce sold for Tax Year 80/81:

(a) <u>Category</u>	<u>Number of Head</u>	<u>Weight</u>
Beef Cattle		
Mutton Sheep		

(b) <u>Category</u>	<u>Amount</u>
Woolkg
Milklitres

(c) Other (specify type and amount)

11. Marketing:

(a) What proportion of your stock i.e. sheep and cattle, did you market at the following places in the Tax Year 80/81:

<u>Place</u>	<u>Type of Stock</u>	<u>%</u>
Cedarville Stock Sale	Beef Cattle	
	Mutton Sheep	

(v)

Swartberg Stock Sale		Beef Cattle	
		Mutton Sheep	
Cato Ridge		Beef Cattle	
		Mutton Sheep	
Other (specify place, type of stock and percentage).			

(b) What proportion of your milk did you market at the following places in the Tax Year 80/81:

<u>Place</u>	<u>%</u>
NCD Cedarville	
NCD Kokstad	
Kokstad Milk Depot	
Matatiele Milk Depot	
Other (specify place and percentage).	

12. Age: - Cross appropriate block:

Under 20	<input type="checkbox"/>
20 - 29	<input type="checkbox"/>
30 - 39	<input type="checkbox"/>
40 - 49	<input type="checkbox"/>
50 - 59	<input type="checkbox"/>
60 - 69	<input type="checkbox"/>
70 and over	<input type="checkbox"/>

13. Education: - Put cross in block containing highest academic qualification received.

Primary	<input type="checkbox"/>
Secondary	<input type="checkbox"/>
University/College	<input type="checkbox"/>

14. Does proximity to Black states result in any problems for you as a farmer?

Yes

No

15. If "yes" has been answered to previous question, state the major problems and how they influence your farming practices.

16. Do you see a future for individual white farmers in East Griqualand?

Yes

No

Uncertain

17. If your answer was "no" to above question, give reasons:

18. Do you think East Griqualand will be incorporated into Transkei?

Yes

No

Uncertain

19. If your answer to the previous question is "yes" state if and how this may affect your farming practices.