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RURAL HOUSEHOLD DIVERSITY IN THE LELIEFONTEIN DISTRICT OF THE NORTHERN CAPE PROVINCE OF SOUTH AFRICA

by

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ABSTRACT

This study is undertaken in one of the historically "coloured reserves" of the Northern Cape Province called Leliefontein. The study is a response to the request by the Department of Agriculture, Northern Cape to improve their extension service. The study shows that there is a major dilemma for planners, extension officers or any development initiator to introduce development plans to the disadvantaged farming community. The lack of knowledge and an understanding of the large diversity amongst rural farming households is a possible root cause of this dilemma. The study addressed this particular issue.

The study hypothesis is: the behaviour of the rural farming households in Leliefontein area is diverse and is reflected by the way the households view agriculture and practice the farming activities they are involved in. The overall objective of the study is to compile an understanding about the diversity in farming households.

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The specific objectives are: to identify and explain the diversity of livelihood amongst households; to develop a typology consisting of diverse types situating agriculture's functional relevance; and to make recommendations for improved agricultural service per type by the Department of Agriculture, Northern Cape Province.

The methodology was carried out in the sequence of question formulation, data collection and data processing out of the sample size of 108 households. Data collection was through a structured questionnaire and unstructured interviews. Typology technique, which is the tool that can be used to group activity units according to their modes of operation and characteristics, was applied to the study area. The following were some of the factors used to construct a typology for the Leliefontein area: farming activities, rationality, life cycle of the household and decision making characteristics of a household. The findings of this qualitative analysis were controlled and confirmed by quantitative methods of discriminant analysis and logistic regression.

The seven types of households reflecting this diversity are: Autonomous Households; Livestock Holders; Irregular Income Earners; the Poorest; Regular Income Earners and Social Transfer Dependent types. These types display differences in decision-making pattern, the livestock keeping techniques and life strategies. Possible development trajectories which the different types can follow should an external stimulus (i.e. a developmental initiative) be injected, are also identified for use by extension activities.

Livestock farming is the main agricultural activity in the study area. The findings of the study however show that there exists substantial diversity among the communities, for example, livestock farming serve different functions in that community. Livestock is kept not only for economic reasons but also for social, religious and hedonistic reasons.

The study concludes that it is essential that the knowledge of rural diversity be integrated into planning and the extension service. Development should be regarded as a holistic procedure in which not only the agricultural extension receives focus but also other aspects that will facilitate the extension service, such as credit facilities and the human

development factor. The recommendations focus on guidance to agricultural extension officers on how to select and analyse target types in order to design a more effective support service to rural households.

DIVERSITEIT VAN LANDELIKE HUISHOUDINGS IN DIE LELIEFONTEIN DISTRIK VAN DIE NOORD KAAP PROVINSIE VAN SUID AFRIKA

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UITTREKSEL

Hierdie studie is onderneem in een van die voormalige"kleurling reservate" van die Noord-Kaap Provinsie, naamlik Leliefontein. Die doel van die studie is om te reageer op 'n versoek om hulp van die Landbou Department se kantoor in Springbok, Noord Kaap Provinsie vir die verbetering van die voorligtingsdiens. Volgens die navorsing bestaan daar 'n dilemma vir beplanners, voorligtingspersoneel en ontwikkelaars wat ontwikkelingsaksies ten opsigte van die histories benadeelde boerdery gemeenskap wil invoer. 'n Gebrek aan kennis oor die aard en diversiteit van landelike boerderyhuishoudings is moontlik die hoofoorsaak van hierdie probleemsituasie.

Die hipotese vir die studie is dus: die gedrag van die landelike boerderyhuishoudings is verskillend (divers) en word weerspieël deur die wyse waarop huishoudings boerdery benader, sowel as die manier waarop hulle boerderyaktiwiteite bedryf.

Die hoof doelwit van die navorsing is om 'n begrip van die diversiteit van boerderyhuishoudings in die Leliefontein omgewing te formuleer.

---

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Die bepaalde doelwitte is: identifisering en beskrywing van die diversiteit tussen huishoudings; die ontwikkeling van 'n tipologie om hierdie diversiteit te beskryf; en die maak van aanbevelings vir die verbetering van landbou voorligtingsdienste aan die verskillende tipes binne die tipologie.

Die metedologie is uitgevoer in volgorde van vraag formulering, dataversameling, en dataverwerking uit 'n steekproef van 108 huishoudings. Die dataversameling is met behulp van gestruktureerde vraelyse en ongestruktureerde gesprekke onderneem. Die tipologietegniek, 'n instrument wat gebruik word om aktiwiteite te groepeer volgens operasionele handelwyse en karaktertrekke, is aangewend vir die studie. Die volgende faktore is gebruik om die tipologie vir die Leliefontein area te bepaal: boerderyaktiwiteit, rasionaliteit binne besluitneming, die lewensiklus en besluit neming binne landelike huishouding. Die resultate van hierdie kwalitatieweanalise is gekontroleer en bevestig deur kwalitatieweanalasie metodes, naamlik deur diskriminasie analisie en logistieke regressies.

Die tipologie dui op sewe tipes huishouding groeperings: Onafhanklike Huishoudiens, Besitters van Veediere, Nie Gereelde Inkomste Verdieners, die Armstes; die Salaristrekkers; en die Sosiale Dienste Afhanklike tipe. Hierdie tipes vertoon verskille in die wyse van besluitneming, die tegnieke van vee bennutig, rasionaliteit en lewenswysestrategie. Die ontwikkelingstrajekte wat die verskillende tipes in die toekoms kan volg, sou 'n uitwendige stimulus (bv. 'n ontwikkelingsinisiatief) geïniseer word, word ook geskryf.

Veeboerdery is die hoofboerdery aktiwiteit in die studiegebied. Volgens die bevindings van die studie bestaan daar egter 'n duidelike diversiteit onder die landelike gemeenskappe van Leliefontein, byvoorbeeld, die aanhou van veediere is gerig op verskillende funksies in die gemeenskap. Diere word egter nie net vir ekonomiese redes aangehou nie, maar ook vir sosiale, godsdienstige en kulturele/ hedonistiese redes.

Dit is noodsaaklik dat die kennis oor diversiteit van landelike huishoudings geïntegreer word by die beplanning en besluitneming van die provinsiale landbouvoorligtingsdienste. Ontwikkeling moet beskou word as 'n holistiese prosedure waarin nie net op die landbouvoorligtingsdienste gefokus word nie, maar ook op die ander aspekte wat voorligtingsdienste sal ondersteun (bv. kreditfasiliteite en die menslike faktor). Met die aanbevelings word gepoog om leiding aan die voorligtingsbeampte te verskaf waarvolgens 'n teikengroep geidentifiseer en beskryf kan word en waar ondersteuningsdienste aan die landelike huishoudings beplan kan word.

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CHAPTER 1

INTRODUCTION AND PROBLEM STATEMENT

1.1 Introduction

The South African rural environment today is diverse and the agricultural systems are dualistic which is largely the result of a history dominated by phenomenon such as colonialism, racism, apartheid, cultural diversity, sexism, repressive practices as well as aspects such as economic deregulation, urbanization, natural resource endowments and environment changes (Van Rooyen, Nqgangweni, Groenewald and Fenyes, 1998; Kirsten, Van Zyl and Vink, 1998). The study will focus on the diversity in the rural environment of the historically disadvantaged area of Leliefontein, a previous "coloured reserve" in the Northern Cape Province of South Africa. This introductory chapter will provide the background to the study, a problem statement, study objectives and a study outline.

1.2 Background to the study

South Africa is classified as an upper middle income country, yet a vast proportion of its population still live in poverty and display a level of human development more often associated with low income countries (Whiteford, 1995). The income distribution is to an extend racially distorted and ranks as one of the most unequal in the world (Government Gazette, 1994). South Africa's Gini coefficient has twice (1975 and 1991) been estimated at 0.68, which ranks as the highest recorded anywhere in the world (Mohr, 1998). This is where a combination of wealth and abject poverty characterize the country.

The South African economy has been built on a particular natural resource base (mineral, water, and land) and systematically enforced racial division in every sphere. The legal and social denial of access to resources and opportunities for some population groups has kept control of resources in the hands of minority. For example, already in the Land Act

of 1913, rights to own, rent or even sharecrop land in South Africa depended upon a person's racial classification. Millions of black people were forced to leave their ancestral lands and resettle in what quickly became over-crowded and environmentally degraded homelands which became pools of cheap migrant labour for white-owned farms and mines (White Paper on Land Policy, 1997). Under the Native Trust and Land Act 1936, black people lost even the rights to purchase land in the reserves and were obliged to utilize land administered by tribal authorities appointed by the government. Tenural and fiscal measures that were adopted to allow the white population to consolidate their hold on the land have deprived the disadvantaged rural farmers of being successful (Stacey, Van Zyl and Kirsten, 1994). Rural areas were divided into bantustans or "homelands" and reserves for non-white South Africans and well-developed rural areas dominated by white-owned commercial farming (Kirsten,*et al*,1998) Towns and cities were divided into townships with inadequate basic infrastructure for blacks and well-resourced suburbs for whites. Government policy until late 1970's viewed these black towns as temporary as a natural movement back to the bantustans and reserves were expected over time.

There are 23 reserves in South Africa and 7 of them are found in Namakwaland district of Northern Cape Province. These rural areas are also known as "coloured reserves" (Krohne and Steyn, 1991). People classified as coloureds were gathered in the "reserves". These areas in the Northern Cape Province started as mission stations in the 17th century and offered a measure of protection to the indigenous people against the advance of *trekboere*. According to Krohne and Steyn (1991) the reserves are not merely the "coloured" equivalent of the "bantustans". The reserves are rather the product of a special form of colonialism in Namakwaland and not an initial part of the apartheid plan for the "bantustans". The coloured population, like blacks, however is also disadvantaged compared to the whites population. Racial and gender disparities in all spheres of life, as well as large differences in life circumstances along urban/non-urban divide, are therefore strong features of life in Northern Cape Province where coloureds are predominantly found (Statistics South Africa, (SSA), 1998).

In commerce and industry, conglomerates dominated by whites controlled large parts of the economy. In agriculture these inequalities were manifested in the extremely skewed access to farmland and support services as well as government support and protection offered to commercial farmers under the previous Agricultural Marketing Act of 1937, (adapted in 1968 then 1976) consequently opportunities to farming and competition in agricultural markets occurred along racial lines (Kirsten, et al, 1998). Segregation in education, health, welfare, transport and employment left the scars of inequality and economic inefficiency. South African society was confronted by serious problems in every sphere: economic, social, moral, legal, environmental and political. These scenarios provide for a very unique characterisation of rural communities. Some of these were head on attended to since the ANC government came to power after the first democratic election on 27th April 1994. In this context the Leliefontein area became a focus point in the Northern Cape Province.

1.2.1 Rural communities

According to the Rural Development Framework (RDF) (1997) of the South African goverment rural areas are defined as the sparsely populated areas in which people farm or depend on natural resources, including villages and small towns that are dispersed through these areas. In addition they include the large settlements in the former homelands, which depended for survival on migratory labour and remittances.

Most of South Africa's poor lives in rural areas. Of these, children younger than five years, youths and the elderly are particularly vulnerable to poverty; women more so than men (RDF, 1997). According to the Development Bank of Southern Africa (DBSA)(1994) seven of the nine provinces have more people in rural areas than urban areas. The proportion of poor people in rural areas is higher than in urban areas, and the depth of poverty is worse in the rural areas (May, 1995). Table 1.1 shows the distribution of poverty.

Table:1.1 Distribution of poverty in South Africa by rural/urban classification (1993)[1]

Location	Population distribution		Poverty share (%)		Poverty rate (%)	
	Number (million)	Share (%)	Poor	Ultra-poor	Poor	Ultra-poor
Rural	20.3	53.4	74.6	80.7	73.7	43.5
Urban	7.8	20.5	15.7	14.1	40.5	17.8
Metropolitan	9.9	26.1	9.8	5.3	19.7	5.8
All	38	100	100	100	52.8	28.8

Source:RDP: 1995 Key indicators of Poverty in South Africa.

Notes:

The poverty share refers to the percentage of all poor who live in a given area, for example, 74.6% of the poor in South Africa live in rural areas. The poverty rate refers to the percentage of people in a given area who are poor; e.g. 73.7% of the rural population is poor. According to RDF (1997), both qualitative and quantitative studies indicate about 40% of households in South Africa is poor. Here 40% of the total number of households (having 52.8% of the population) is defined as poor and 20% as ultra poor.

1.2.2 Some characteristics of South African rural households

In former black and coloured rural areas, many households are often situated in remote areas. The households are poor and characterized by big as well as small family sizes. Some households may include extended family members who may be grand children or parents. Most of the households have members who are migrant workers. A large proportion of the rural population consists of black women and particularly those of a working age outnumber men. A rural household of five members (three children and two parents) need to earn at least R9 000 per year in order for them to survive (Eckert, Kleynhans, Liebenberg, Van Vuuren, Uys, Muller and Hees, 1997), but there are those living below this threshold.

[1] This table was compiled before the data from 1996 census became available. The essential situation of rural domination in the poverty situation of the country however remains.

Some 30 to 50% of the rural population have insufficient food and are exposed to an imbalanced diet as a result of low income (Makhura and Kirsten, 1999). Poor rural households combine their resources in a variety of ways to enable them to maintain a minimum living standard (Ministry for Agriculture and Land Affairs, 1998). These livelihood strategies include agricultural production, off-farm wage labour, small and micro enterprise activities, claims against the state (pensions) and reliance on social networks. In most rural areas farming income contribute far less than non-farm income in the total income (Makhura, *et al,* 1999). Most of the farming activities are undertaken for subsistence rather than commercial purposes. This is confirmed by the selected findings of the rural survey (DSI, 1999a) and is reported as follows:

- Only 18% of the 902 156 households which had livestock were involved in the sale of livestock.
- While nearly 1.2 million households grew produce (including maize), only 3% were selling maize. The greater percentage sold other produce and grew maize mainly for subsistence purposes.

Inadequate attention to the problems encountered by occupants of rural households is the reason why about 50% of the current growth in urbanisation in developing countries consist of millions of small holder farmers and rural inhabitants (Eckert, *et al,* 1997). The economically active people in different households choose to seek a livelihood outside agriculture because of the higher opportunity cost of farm employment (Low, 1986a). In addition some are trying to escape the appalling conditions in the hope of finding a better life in the cities. Such urbanisation is associated with problems of squatting, unemployment, pollution and generally a low quality of life and even crime.

1.2.3 Farming characteristics

In general the small holder agricultural system in the rural areas is characterized by subsistence and agricultural development is constrained by limited access to important support services (Kirsten, Parker and Van Zyl, 1996). There are lack of resources and also an inability to utilize the existing resources fully. The one common factor associated

with farmers in the rural areas, apart from possibly having limited resources, is that they are highly risk averse (Spio, 1996). They diversify by planting more than one crop either as an intercrop or on different areas of land. If they are engaged in livestock farming they prefer to keep the types of animals that are resistant to bad conditions (Leliefontein Surveys, 1999).

The fact that there are different levels of farming in the rural areas of South Africa, is supported by empirical work done by various authors. Kirsten, *et al*, (1996) distinguished two groups of producers in one of the Kwa Zulu Natal Province rural areas as emerging farmers and subsistence farmers. The former group referred to those who produce exceeding subsistence requirement and the latter referred to those who are able to meet their basic household requirement. D' Haese, Van Rooyen, Van Huylenbroeck and D' Haese (1998) refer to the rural farmer stratification in South Africa and identify the following different groups of farmers in the Venda area of the Northern Province of South Africa : resource poor farmers, who are net food buyers that sell family labour to earn money for food; small holders who rely mainly on family labour for food production, cattle husbandry and marketing of their crops; small scale progressive farmers who own and operate their farms with assistance of own capital and hired labour; and large-scale commercial farmers. Different small holder farming groups operating within the rural households in various parts of South Africa are also described by Laurent, Van Rooyen, Madikizela, Bonnal and Carstens (1997) and Singini and Van Rooyen (1995). From these studies it is clear that no single type of small holder farmer exists in the rural areas. A clear need for a typology description and analysis can be stated.

1.3 Problem statement and hypothesis

The proportion of the people living in poverty in rural areas is higher than in urban areas, and the depth of poverty is worse in the rural areas (May 1995). Literature shows that seven out of nine provinces of South Africa have more people in rural areas than urban

areas. All strata of rural society are still engaged in agriculture, either directly or indirectly.

The literature teaches that whatever development initiatives do, as either relief or development planning, they will achieve much more if they build on the knowledge and the coping strategies of the poor. Researchers have to build a picture (together with the poor themselves) based on these factors (May, 1995; Perret, 1999; Laurent, 1988 and Guyer 1986). There is a need to generate information about rural households to inform policy designers or implementers.

The new political era in South Africa has come up with much consideration on subsistence agriculture and rural development. This is a complex sector, as it does not only include economic determinants but also non-economic determinants such as family, community and social cohesion or non-cohesion. Small farmer development is currently viewed as an important aspect of agricultural development in South Africa (White Paper on South African Land Policy, 1997; Ministry of Agriculture and Land Affairs, 1998). It is likely to be an important programme for growth with an equity strategy in South African agriculture (Van Rooyen, Ngqangweni and Njobe, 1994; Van Rooyen, *et al*, 1998).

Eckert and William (1995) state that a common mistake in earlier agricultural development programmes was to assume that small farmers were an undifferentiated group which could be accurately defined with mean and median. The determinants of farmer decision making do not only include households characteristics and land holdings but also the totality of physical, social, economic, biological and institutional setting in which the farmer operates. Therefore it is essential that this study consider a farm household and the environment in which it is operating. There is great variability existing among farmers that needs to be well understood so that support services, especially extension can be appropriately adapted. This view is confirmed by the many studies cited in the previous section.

This study will attempt to explore the following hypothesis: "the behaviour of the rural farming households is diverse and that this diversity is reflected by the way the households view agriculture and practice their farming activities. This diverse behaviour should thus be factored in as a substantial element in rural planning and development processes".

Fieldwork needs to be undertaken with the farmers as well as with the rural households to capture variations that exist among them. Such research should focus on situation analysis of agricultural activities and other rural activities. It has to capture diversity that exists since households will respond differently to external stimuli. The socio economic situation and the networks of the farmers need to be highlighted. In short, rural investigations should be built on local knowledge that recognise the inherent diversity prevailing in these environments (Laurent, *et al*, 1997).

The above approach was requested by the Department of Agriculture in the Northern Cape Province after a series of consultations with the University of Pretoria, the *Institut National de la Recherche Agronomque* (INRA), France and Agricultural Research Council (ARC) of South Africa. It is agreed that the extension officers of the department need to have a clear knowledge about their farmers. It is requested that the proposed research should come up with methodology for the identification of types of farming households and the farming activities (more emphasis is put on livestock farming in this study). The department aims to employ this knowledge to improve their extension service to the rural communities.

This approach leads to the basic research question: how should diversity in farming rural households be identified and described? And following on this: what are the different types of inputs required to design appropriate rural and agricultural strategies to serve diverse farming households? These issues are dealt with in the study.

1.4 Study objectives and study outline

In line with the above statements and hypothesis the overall objective of the study is to compile an understanding about and the methodology to identify and describe diversity in the farming households of the Leliefontein area so that it can be used systematically by the agricultural extension service in planning and in rural development initiatives.

The specific objectives are :

- To develop a methodology to identify and explain the diversity of rural livelihood amongst farming households;
- To identify and characterise the diverse behaviour of rural households in regard to decision making related to farming;
- To group similar household types together i.e. to develop a typology; and to
- make recommendations for improved agricultural service.

Study outline:

The background, problem statement and objectives of the study are discussed in the first chapter. In the second chapter an overview of the literature on rural and farming household behaviour is given in order to obtain a theoretical perspective on the concept of diversity. The description of the study area and target community follows in chapter three. The fourth chapter is a discussion of the methodology in which analytical methods to identify and verify rural diversity are described, i.e. typology analysis, discriminant analysis and logistic regression. Chapter five is stating the results and chapter six presents the summary, conclusions and recommendations of the study.

CHAPTER 2

AN OVERVIEW OF HOUSEHOLD BEHAVIOR

2.1 Introduction

Firstly the definition of a household is given then the concept of farm household is explained. The views on household economic theory given by classical and non-classical economists are thoroughly discussed and some important factors that should be considered when analysing behaviour of a farming household are described in this chapter. Such factors are time and life cycle of the household, rationality, technical issues and decision making in a household. Literature concur that the behaviour of families in the rural households results from a complex set of factors, some of which are not of economic nature. Finally the hypothesis for this study is revisited.

2.2 A farm household and its environment

De Jager, Van Wyk, Onduru and Vlaming (1998) argue that a household refers to a group of people who live in the same house or group of houses and share food regularly. According to the classical economists, production is a set of sequential activities that includes the extraction of material. It is based on a physical analysis of production activity. Classical economic theory focuses on a change in welfare as measured through a change in producer surplus. The neo-classical economic theory is based on individual preferences and initial endowments as determinants of price. Neo-classical economic theory focuses on a change in consumer surplus as a measure of change in welfare. The household can thus be viewed as a unit of production and consumption (Hunt, 1991).

According to RDF (1997) rural households are located in the following situations:

- All farms, large and small, outside urban areas, including the farming areas within the former homelands and in a freehold, large scale sector;
- All sparsely populated areas, not strictly agricultural;

- All wilderness and forest areas;
- Rural settlements whether the population benefit from the natural resources or not , so defined because of the general lack of services;
- Squatter camps away from towns;
- Small towns, villages and settlement in rural areas whether they now have linkages into the rural economy or not; this excludes mining towns, but includes those dependent on tourism.

Two special categories must be included:

- Displaced urban areas (with formal or informal housing) where most households have a worker travelling daily to an urban area (or mine) for work, often using subsidised transport.
- Rural clusters, where the main source of income is transfers, with some small dependency on the utilisation of natural resources, or on ties into a rural hinterland.

These areas were created by *apartheid*.

It is important to note that the work done by economists does not only consider individual behaviour but also household behaviour. Such work has been applied to the specific field of rural analysis and used to analyse rural household behaviour, and often only in a narrow context of the farm situation. But it is important that a broader approach is considered. Many economists stress that the farm household should consider a system comprising of the following: the household as a decision-making unit; the farm activities and the off-farm environment. All the factors interlink and interact. A farm household makes decisions with respect to allocating different quantities and qualities of land, labour, capital and management to household, farm and off-farm activities in accordance with a whole range of considerations in order to attain a family's goal (Wonterghem, D'Haese, Van Rooyen, Carstens, Madikizela Burger and Talbot, 1998). Therefore off-farm activities of the members of the household will affect the farm activities.

Mc Gregor, Rola-Rubzen and Murray-Prior (1999) present a conceptual framework of a farm household system as in Figure 2.1. This kind of modeling can be used to study the responses of agricultural households to outside stimuli. It stresses the fact that farm activities cannot be analysed in isolation but need to be referred to the overall set of elements, household members' strategies (even when some of them are not farming) and the external environment.

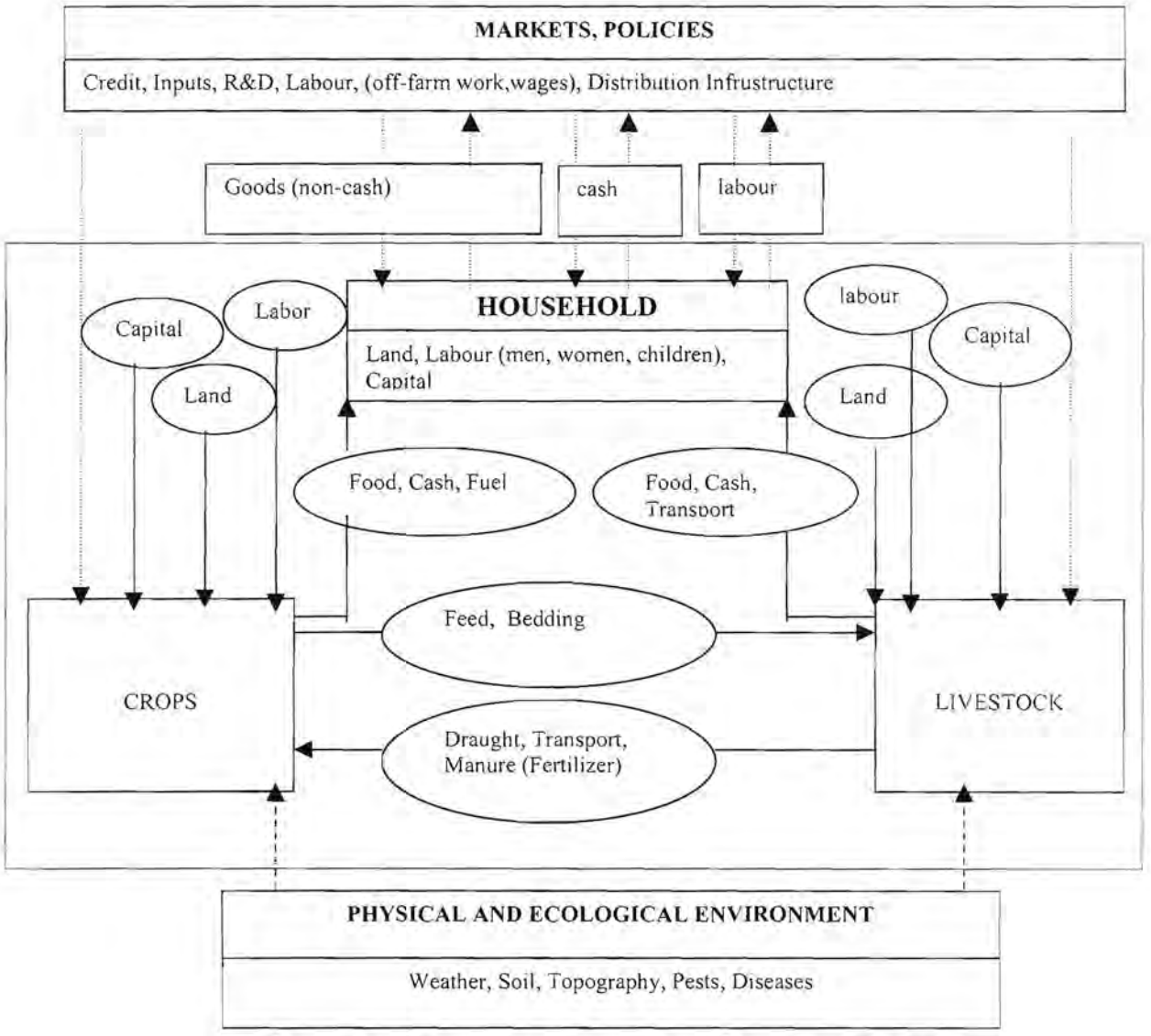

Figure 2.1:A conceptual framework of a farm household system
Source: Mc Gregor (1999)

2.3 Household economics theory

The new household economics theory relies on the work of Becker (1965). It recognises the fact that a household acts as a unified unit of production and consumption which aims to maximize utility subject to its production function, income and total time constraint. The theory of household economics relates differences in behaviour among households to differences in their characteristics and composition and, in particular, to the way these affect the relative time values of members within a household (Ellis, 1988).

Household economics entertain the theory that farm households do not strive to attain one goal (e.g. income maximisation) but rather multiple goals. Farm households are the producers of so-called Z goods (goods that directly enter the utility function, for example, leisure and nourishment). These Z goods use market inputs as well as home produced inputs and the time input of the household member. Households face various technical options for Z goods production and there is a need for members of households with access to lowest market wage to undertake domestic production for Z goods (Hunt, 1991; Low, 1986a).

Low (1986b) developed a farm household model for Southern African application from new household economic theory. Low argues that behaviour of a household member being economically rational will allocate household labour to its highest paying opportunity. Low notes that in Southern Africa such opportunity is frequently off-farm in the relatively well-developed non-agricultural labour market. This off-farm market dominates household work incentives and labour allocations. After migration to off-farm employment, the remaining labor in the rural household will be allocated first to production for home consumption, which is valued at retail food prices plus transportation cost to the household. And lastly, the remaining labour will be allocated to production for sales, which is valued at lower farm gate prices, unprocessed commodity prices minus transport to market.

Low's family labour employment model suggests that off-farm employment opportunities generally deplete the available labour supply of rural household for farming. Workers remaining on the farm are those with lowest opportunity costs defined by the external labour force market. The off-farm market favours adult men (e.g. mines and industries). Thus many rural household are *de facto* headed by women (or pensioners) for whom household child rearing responsibilities pre-empt extensive field labour in agriculture.

Low's family labour employment model can be subject to criticism because the reality is that in South Africa, the agricultural sector still represents 1,28 million jobs with 3,3 million workers in the rural areas (DSI, 1999b). In the remote rural areas the opportunity cost of a unit of family labour employed on the farm is likely to approximate the expected wage rate adjusted by the probability of employment (Mbowa and Nieuwoudt, 1999). Given this argument it can be reasoned that more and more rural residents will still be found to work or at least attempt to work in the rural areas and in the farming sector.

In addition to this criticism, one must note the role of the geographical constraints, which have been confirmed as contributing factors in household decisions or labour allocation. A study done on a stratified sample of sixty-four households in rural Northern Ghana, showed that locational characteristics of areas are important in explaining non-farm work (Abdulai and Delgado, 1999). There was a negative coefficient of the distance variable which suggested that there were higher costs of non-farm labour force participation for households living in remote places.

Another question is about the ability of the new household economics theory to accommodate a great diversity of farm household structure and situations. This was dealt with by Nakajima (1986) who extended the new household economics theory in the context of an agricultural household by developing several kinds of models depicting different agricultural household situations and deriving the subjective equilibrium conditions for each household type. Nakajima (1986) defines the household as an economic entity, which is a complex of farm firm, laborer's household and consumer's

household, whose behavioural principle is utility maximization. There are similarities and differences between the farm household and the other economic entities mentioned in Table 2.1 below.

Table: 2.1 Similarities and differences between farm household and other economic entities

Economic entity	Similarity	Difference
Farm firm	Farm firm and farm household carry out production activities.	• Farm household maximizes its own broader set of utility while farm firm is profit maximizer. • Farm household uses family labour and consumes portion of its production, farm firm does neither.
Labourer's household	• Labourer's household and farm household are based on utility-maximisation principles. • Use family labour as an independent variable.	While the farm households make decisions about how and what to produce to get a mixed income, labourer's household operates to obtain wage income.
Consumer's household	Consumer's household and farm household are based on utility maximisation principle.	Consumer's household is not engaged in production activity like farm household.

Source: Nakajima (1986)

According to Low (1986b) the Nakajima-type model displays the following limitations:

- It suggests that all farm outputs are sold. This is not the case with Southern African farm households as most of them are deficit producers who are forced to purchase part of their subsistence food requirement.
- Land is fixed at farm household level resulting in declining returns as more labour is applied on the family firm.

Nakajimas' work however shows that family farm differ from farm firms as these have different objectives, but approves an objective of utility maximisation for the farm household unlike the Chayanov model as is presented in Thorner (1986).

2.4 Other economic approaches to farm household analysis

Chayanov supports the fact that farm household and farm firm cannot be analysed in the same way. Chayanov differs with neo-classical economists like Low in the sense that he does not agree with the hypothesis of household economic theory, i.e. utility maximisation (Thorner, 1986). Chayanov's household model insists on the 'subjective' side of the decisions (the behaviour of a farm household member cannot be explained or understood only through the utility approach). His model seems to have a heuristic value (i.e. it uses experience and practical efforts to find answers to questions) to help explain the actual behaviour of farm household; it leads to some important and better understanding of what these "subjective"factors are.

Ellis (1988) says Chayanov's peasant model focuses on the subjective decision made by the household with respect to the amount of labour to commit to farm production in order to satisfy its consumption needs (Ellis, 1988). According to Thorner (1986) Chayanov's model states that the farm family production is different because family members will accept to work even if they get a very low payment for their work and such payment cannot be seen as a salary.

However there are some criticisms regarding Chayanov's model:

- Although it argues that family farms will be organised so that labour is employed as efficiently as possible, the implication of this is not considered in terms of the allocation of tasks between household members and the possibility that some of them may have a comparative advantage over others in certain tasks (Ellis, 1988).

- Lehman (1981) and Ellis (1988) refer to Chayanov's theory where it states that within peasant family farm, as labour performed increases, so does drudgery. However the family will persist in working until it is no longer worth it.
- Low (1986b) differs with Chayanov as he does not give an account of why the peasant farm does not hire in or hire out wage labour.

It is recognised that Chayanov's household model has predictive power concerning the impact of family size and composition as factors affecting the slope and position of the indifference curves. The demographic cycle of the peasant farm household as depicted by Chayanov (Ellis, 1988) is thus:

At first the household grows in size as children are born, the minimum consumption level is raised and the work contribution is low. As the children grow then their contribution increase. Ultimately children begin their own families and start to farm, therefore reducing the original family size again and lowering the minimum consumption level. Eventually the cycle goes back to the original family structure.

In addition to the importance of the stage of life cycle highlighted by Chayanov, empirical studies show the rural households behave differently in situations which may be seen as similar at a first approach. Moocke (1986) argues that households have diversified strategies which are influenced by the composition of households and also by the links between households and the level of wealth and professional background. Other factors which influence such behaviour can be level of education, professional skill, sociological characteristics which determine behaviour of people, cooperation or conflicts between households.

To summarise, the behaviour of the household can be addressed through the utility function whereby economic rationality is accepted. Utility maximisation also relies on the hypothesis that people behave according to "homo economicus". But, there are also other subjective factors that can address behaviour of the household. The attributes of family members affect the way they run their households, for example, skills and stage in demographic cycle of the household. This study will take note of some of these factors as they contribute in explaining the diversity that exists amongst the farming households.

2.5 Key points to analyse farming household behaviour

In the following paragraphs four main points referred to in the preceding sections which affect household behaviour are discussed in more detail. These are some of the main factors that need to be considered in order to make a thorough analysis of the farming household.

2.5.1 Time and the life cycle of the household

The way in which household size and composition changes with time should be built into any explanation of the observed differences in income and wealth between rural household (Low, 1986b). Life cycle affects household production behavior not only in terms of changes in the values of human time of household members over time, but also in terms of number of members in a household and their potential to contribute to production. As such, a household belonging to a certain type at a given time may shift to another type at a later stage (Laurent, *et.al.*, 1997). This could provide the basis for a particular development path or trajectory. Low (1986b) concludes that Chayanov (1966); Murray (1980) and Spiegel (1881) emphasize the fact that domestic development cycle has an influence on farm production. There are resource and production differences between households during different stages in the household life cycle.

There are four different stages that a farming household undergoes (Ellis, 1988):

Establishment stage is when the household starts to establish a farm, some transfer of resources to such a household may occur. In the ***expansion stage*** the household becomes more independent. In the ***consolidation stage*** a household realizes the expansion of farming to the fullest with the highest ideals of family development. ***Fission stage*** is evident when there is relinquishing of control of domestic resources from the parental to filial generation. ***Decline stage*** is characterized by the aging parents located within one of their children's households. During the last stage, resource of the aged can be mixed with the new household therefore contributing to a next expansion stage. This study should gather information to take cognisance of some of these stages.

2.5.2 Rationality

The hypotheses on rationality are central in the building of models. The economic rationality of the individual is about maximization of some known objective function. Peasant farmers are taken as being rational but being faced with a constrained profit maximization (Ellis, 1988). Theory of substantive rationality and assumptions of utility maximization does however not provide a sufficient base for explaining and predicting economic behavior (Simon, 1988). There are processes that people use to make bounded rational decisions. These processes are sensitive to the complexity of decision making contexts and learning processes. The study shall investigate what agriculture mean to different people: do farming activities have only economic functions or objectives? Does only economic rationality explain farm household behaviour?

2.5.3 Decision making in the household

Decision-making is an important process by which desired outcome are achieved (Anderson, 1992). May (1995) states that Mackintosh (1993) regards the orthodox model of the household as people who make decisions in pursuit of interest of the household. Within the household, individuals are therefore seen as jointly arriving at and agreeing on

decisions. If this is not the case then decisions for the household are unilaterally made by the household head, implying that claiming within the household is determined by household members accepting and in fact, freely choosing to subordinate their personal welfare in order to maximize the joint welfare of the family (May, 1995). Alternatively there is a form of unselfish benevolent decision making by a head who has been mandated to exercise this power. The orthodox model states that this does not result in a conflict.

Different authors point out that there are some flaws in the orthodox model and there is strong empirical evidence to prove that its assumptions are incorrect. There is friction that can arise as the result of changes in a household structure regarding allocation of resources. James (1992) as cited by May (1995), says that particular people within a household may be involved in recognized decision making whereas some members will be excluded. An example is shown by a situation where the father and the son make and implement decisions regarding the household thus excluding the father's wife and son's wife from effective decision making. Migrancy has an impact on decision making within a household in the sense that women, who are left to run the household in the absence of men, may not feel able to act totally independently of their husbands (May, 1995).

From an anthropologist perspective, Guyer (1986) indicates that there are problems with the household as a decision-making unit in the African context. There is not only a division of labour by sex and age but also a broader division of economic spheres. Men and women and sometimes children, separately control productive resources, take partly independent decisions, manage personal incomes, assume different responsibilities and favour different investment. The way they rely on each other's resources, labour and income is complex that it makes the outcome of household decisions difficult to predict and describe systematically. Again catastrophes resulting in the loss and destruction of productive assets in any case cause decision-making processes to veer away from previous trajectories (Ellis, 2000). Therefore the study will have to enquire about who makes decisions and in what manner in order to understand role players in the household.

2.5.4 Technical change

The preceding three points will contribute in explaining the diversity of situations encountered in the field. A theoretical model needs to be adapted to take care of the fact that the households have different behavior regarding technical choices. All households do not require the same extension service and technology transfer system. In agriculture it is necessary to account for diversity of farming and household behaviour in order to deal with technical change and innovation in an effective and responsible manner (Laurent, *et al*, 1997).

In a village with diverse farming activities a shift in production systems requires a consistent technical sequence to be followed. Diversity is viewed as a manifestation of the capacity of the agricultural system to adapt to and sustain different situations. Laurent, *et al*, (1997) conclude that there exist different technical solutions to cover diversity of production systems in order to deal with technical change and innovation in an effective and responsible way. For example, in most African countries livestock may not only represent a source of draft power, but have a range of functions.

The Figure 2.2 summarizes the factors that influence the household behaviour. They have been discussed in the above sections.

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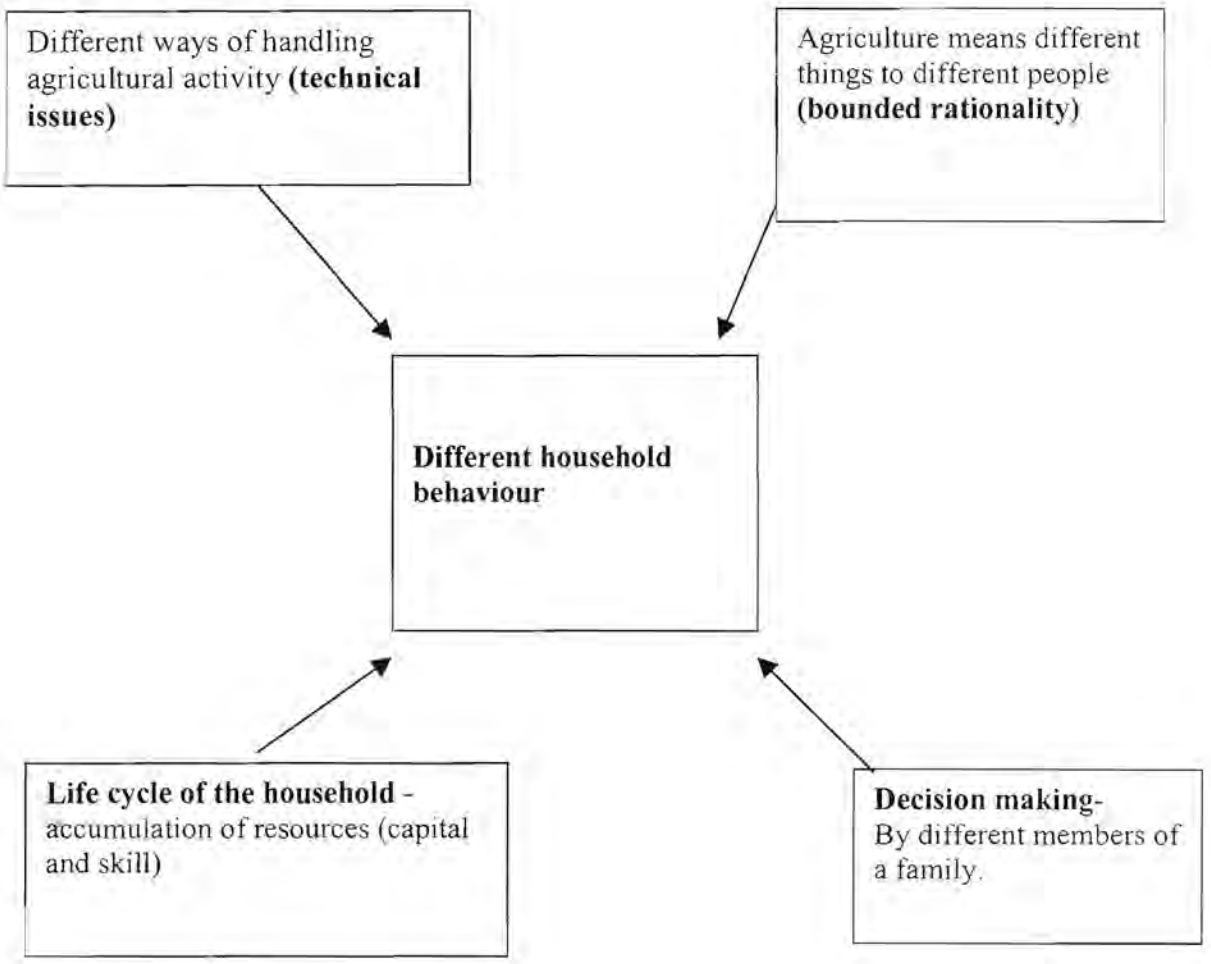

Figure 2.2 Factors influencing household behaviour

2.6 Conclusions

Understanding the behaviour of the household can provide a means of analyzing household reaction to different conditions and, hence, of predicting the consequences of technical and policy interventions (Mc Gregor, *et al*, 1999). Such understanding will give a holistic picture of rural household diversity, therefore providing a sound basis for improving the delivery of services to specific targeted types. From this view the study hypothesises that behaviour of the rural farming households is diverse and this diversity is reflected by the way households view agriculture and practice agricultural activities.

This means that the behaviour of the household is influenced by the objectives that the occupants of such households may have regarding their involvement in agriculture, for example, is it purely for economic reasons or something else such as religious purpose, or social status, etc? The way rural households perform their agricultural activities depends on the inputs being used, their technical skills, etc. which again will differ from household to household; the life cycle stages that the farming households are in, for example, the establishment stage, when occupants of the households are entering farming is also important. If diversity is recognised it implies that rural communities may respond differently towards any development support initiative. This again calls for restructuring and reorganisation of the intervention programmes and technical solutions used previously as a "catch all" to suit all groups, i.e. the reformulation of training programmes, extension activities, technology solutions, etc.

CHAPTER 3

DESCRIPTION OF THE STUDY AREA

3.1 Introduction

In this chapter a broad description of the study area which is then narrowed down to five villages of the Leliefontein sub district in the Northern Cape Province of South Africa is given and reasons for choosing these villages are explained. Features such as topography, climate, soils and vegetation are described and the historical background of Leliefontein as a reserve area as well as the farming pattern followed are briefly outlined. The institutional arrangements within the villages and agricultural extension service are discussed.

3.2 Description at provincial level

The Northern Cape Province has the smallest population (approximately 0.7 million people) but is the largest province in area (30%) of the country's land mass. It shares the western border with the Atlantic Ocean and it has climatic extremes: the lowest and highest temperature and the lowest rainfall. Although this province has the largest surface area, only 1,3% is regarded suitable for arable lands. Since water is a limiting factor, the only main agricultural area is along the Vaal and Orange Rivers where irrigation schemes provide water for farming.

The province's population density is approximately 2 persons per square kilometer. Most of the population is coloureds (53%), followed by Africans (30%) and Whites (17%). The population in the Northern Cape is typical of a country in transition between developed and developing status, with 33% of its inhabitants below the age of 15years and 5% above 65 years (SSA, 1997). The dependency ratio of the province is 0.6 which is less than the national dependency ratio of 0,7 which means that there are fewer dependants per person of working age. Northern Cape Province has six districts, namely

Namaqualand, Hantam Karoo, Kalahari, Diamond Fields, Upper Karoo and Green Kalahari.

Across the central and southern portions of Northern Cape there are rural centres that are largely supported by livestock farming. The northern and western sub-regions are identified by mining activities. Urban clustered settlements are along the main transport corridor traversing the province from east to west. These settlements are in a declining state due to a weak surrounding rural economic base. This province experiences out- and in-migration with the provinces of Free State, Western Cape and Gauteng as the main recipients of the former and towns such as Kimberley, Postmansberg and Colesberg the recipients of the latter. The economic growth potential of these places is the cause of the population shift.

The economic activities are limited and involve mining and quarrying, community catering, social and personal services, trade, agriculture and manufacturing. Agriculture and mining are the mainstay of the province but mining is declining gradually. The decline in these sectors has negative multiplier effects on other sectors. About 27000 formal jobs have been lost between 1990 and 1995. By October 1995 unemployment in the Northern Cape was 18% for economically active men and 41% for economically active women.

The informal sector of this province is a growing source of employment. Eighty-eight percent of the informal sector are workers for own account and are women (domestic workers are included as informal workers for own account). Northern Cape possibly represents the province with the greatest degree of uncertainty surrounding its long-term sustainability since its economic base is limited and people are largely dependent on pensions and occasional income (DBSA, 1994).

Education levels in Northern Cape are generally low. Approximately 79% of the adult population (aged 20 years and older) of this province did not have standard ten in 1995 (SSA, 1997).

3.3 Background at the district level

Leliefontein is a sub-district of Namakwaland which is a northwest district of the Northern Cape (Figure 3.1). Leliefontein is one of the reserves which lies the most southerly in relation to the other reserves of the Northern Cape. It consists of nine villages and lies north of Garies and southwest of Kamieskroon which are its nearest two towns. Leliefontein reserve, which was formerly under Leliefontein Administrative Council, is now part of a broader administrative unit. Up until December 2000 it was controlled by the Transitional Local Council, which reported to the provincial government. The study focuses on five villages of the Leliefontein sub district namely: Leliefontein, Nourivier, Paulshoek, Karkams and Spoegrivier (Figure 3.2). These villages are chosen as the stratified sample. Leliefontein and Karkams are on the same level of infrastructural development for example, electricity whereas the other three are on lower levels of development since they still lack basic infrastructure. Residents of the villages share the same tradition and farming practices, hence the extrapolation of the case study to compare with other villages is possible (Van der Poll, 1999). Some villages of the study area are characterised by underdevelopment, poverty, lack of self - sufficiency and isolation.

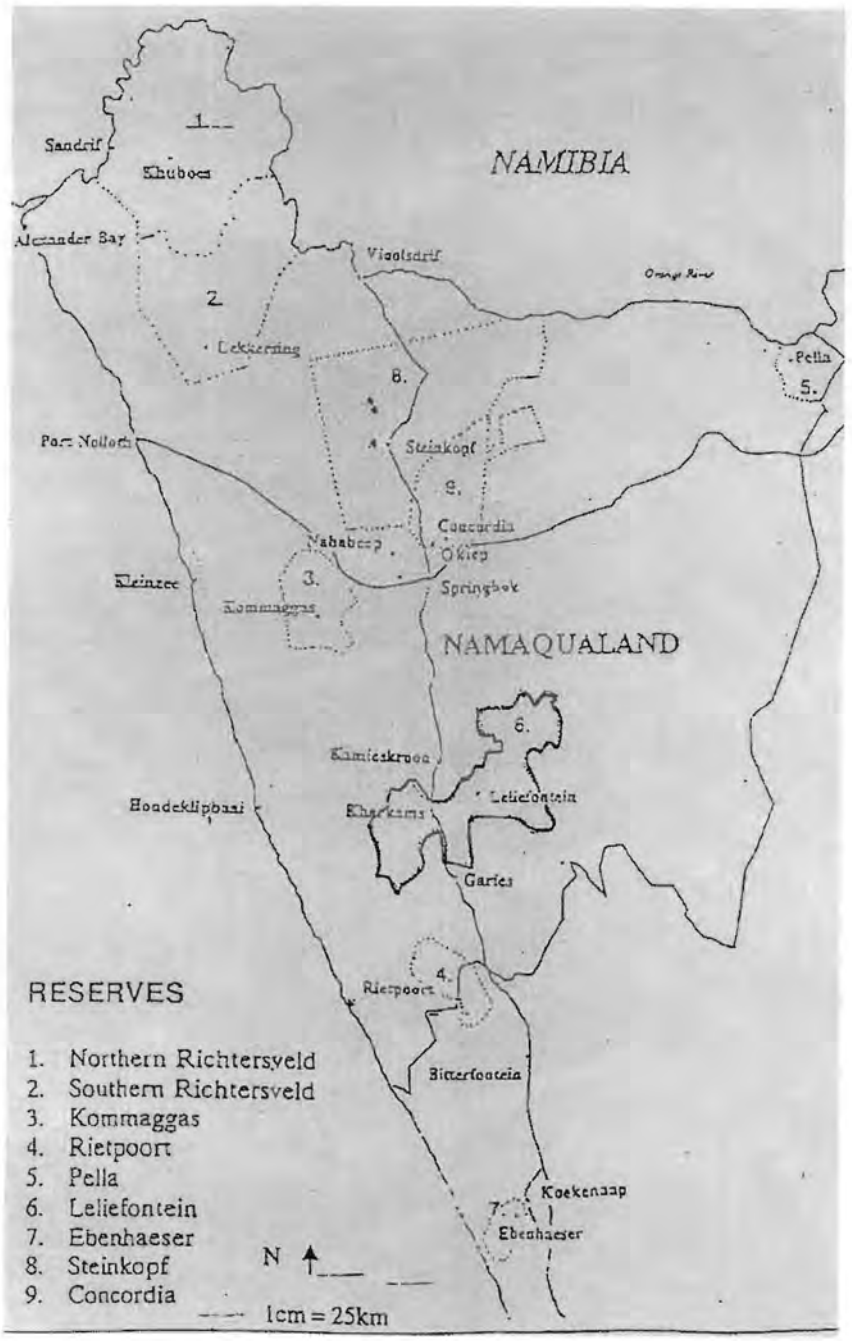

Figure: 3.1 The reserves of Northern Cape

Source: Krohne (1991)

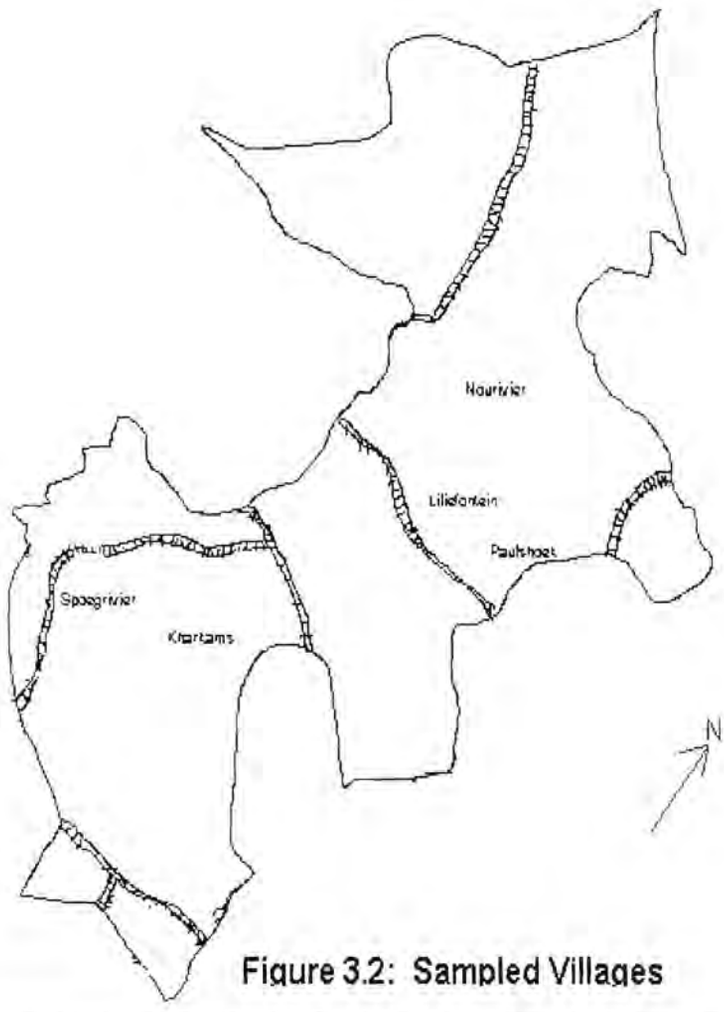

Figure 3.2: Sampled Villages

3.3.1 Topography and climate

Leliefontein district is approximately 200 000 ha in size. The largest part is in the Kamiesberg mountain, hence it has the highest altitude. It is characterised by warm, moderate summers and very cold winters but when compared to the other reserves it gets the highest rainfall. It lies on the border between summer and winter rainfall. Several rivulets drain Leliefontein which eventually end up into the Atlantic Ocean. Residents used to rely on water from permanent springs or self-dug holes in the riverbeds because of a relatively high water table in these locations. However, frequent droughts have

changed this pattern. In fact villages such as Nourivier, Paulshoek and Spoegrivier are seriously affected by drought.

3.3.2 Soils and vegetation

The soils are in poor condition with low agricultural potential. According to Acocks (1953) the following vegetation occurred in different parts of the study area::

- Mountain Renosterveld was found in Kamiesberg areas.
- False succulent Karoo was found in a rain shadow zone of Kamiesberg (Kliprand).
- Namaqualand Broken Veldt was found in the lower lying mountain areas.
- Succulent Karoo was found in the low-lying Sandveld area.

The vegetation is in deteriorating state. These areas are now invaded by non-edible, undesirable and poisonous vegetation, for example, *kraalbos* and *renosterbos*.

3.4 Historical background of reserve

In the reserves of Namaqualand coloured farmers were entitled to farm within the borders of these reserves which implied limited space for them. According to Krohne and Steyn (1991) the people of the reserves are proud of the fact that the land belongs to their community and therefore perceive privatisation as the expropriation of the land. Their surveys revealed that the respondents were reluctant to move since they maintained that they could take any job that was within the vicinity of where they lived. This shows that there are strong community ties amongst the respondents. The inhabitants of the reserves practice communal farming.

During 1980 the South African government began applying a development strategy which had as its goal the division of communal land into economic units for individual farmers to hire (Krohne, *et al*, 1991). Through this system many people however lost access to the communal lands they utilised for grazing and planting of wheat. Leliefontein was one of the reserves where this so-called "betterment planning" system was applied. There were 47 units that would accommodate not more than 150 people.

Many people were not in favour of this system as it left them dispossessed of land. According to Dunne (1988) the dispossession and deprivation of inhabitants' livelihood have led to a deterioration in their nutritional status and therefore increased illnesses associated with malnutrition. He wrote a letter dated 6th October 1986 to the Commision of Inquiry regarding Leliefontein Area stating: "...But I would urge that the commission explore all possible ways of protecting Leliefontein which will not impoverish those people who depend on it for survival".

This idea of "economic units" was never welcomed and after several court cases against the economic units the residents won the battle. Redelinghuis (1981) said that the residents maintained that they wanted communal farming yet that was seen as being backward and responsible for overgrazing. It was thought that with the economic units farmers could manage the lands better and more responsibly. However only few were allocated such units and the rest were left to continue using the communal lands. Even the systematic pattern of migratory grazing was completely destroyed. After several assessments of these units Krohne, *et al,* (1991) concluded that they were not viable. The system of communal farming was brought back into place.

The history of the area shows that for many households, farming is important. They struggled and went to court even if this could be considered irrational purely from an economic point of view.

Farming patterns:

The following farming patterns were observed.

Crops: Production of small grain crops is done on arable lands which are ploughed by donkeys or tractor. Crops that are grown are wheat, oats, rye and barley. Wheat is used for consumption and local sales depending on the amount of yield. Oats is used for making hay as feeds for livestock. There are vegetable gardens in some of the households in which carrot, spinach, potatoes and beans are planted. There are also fruit trees such as dates, pears, apricots and apples in the yards. These are produced mainly for home consumption.

Livestock: Stock farming is an important activity in the different villages. This tendency is shown by the fact that most of the households are engaged in this activity and are using common property resources (May, 1997). The residents keep mainly goats, sheep and some cattle and let them graze in the commonage or keep them at stock posts with a shepherd in control. Flock farming is regarded as their tradition and they have grown up with it (Van der Poll, 1999). The relationship between people and livestock is also regarded as a cultural value (Krohne, *et al*, 1991). More goats are kept than sheep since they have a better ability to survive most inhospitable environment and are relatively independent.

Donkeys and horses are kept in all the villages and the former are used for ploughing arable lands and pulling carts.

3.5 Institutional arrangements within villages

The Transitional Local Council (TLC) is responsible for allocating stands of different sizes. The residents of five villages are paying R122 per year (1999) for stands they are occupying. They are also paying R33 per year (1999) for an arable land area. The arable lands are not fenced they are owned only from the planting season until 14 days after harvesting when they will be opened to everyone. Access to rangeland is available to all citizens of a particular village. Institution of 'reserve' membership is referred to as *burgerskap* (Leliefontein Surveys, 1999). It means that all members of the reserve have the right to cultivate land and keep animals. This membership can be earned through an application, and an outsider marrying a reserve member also qualifies to apply.

According to May (1997) almost all stock farmers practice some form of ranging with the stock even if it is within the limits of a certain geographic area. Such stock farmers erect stock posts where water and pastures are sufficient. The exact locality of stock post may change depending on grazing needs of livestock. Some stockowners may have regular grazing areas that they use during "normal"[1] years.

[1] Years when the expected average amount of rainfall comes.

3.6 Extension service in the study area

The agricultural extension service of the Department of Agriculture, Northern Cape Province in the study area is a public good and it is given freely to the community. It is offered by the Regional Department of Agriculture in Springbok. There is one extension officer servicing Leliefontein sub district. He mainly works with the members of farmer associations but farmers who are not affiliated to such associations can also use his service.

The extension officer reaches out to the community through workshops and meetings since they are easier ways of gathering the farmers. He also pays visits to individual farmers. Consultation regarding crop farming is seasonal (e.g. during planting time of small grains) whereas with livestock it is throughout the year.

Some research and extension services are delivered by the Agricultural Research Council (ARC) - Infrutec Institute in Stellenbosch and also fish and tourist projects in Nourivier by ARC. The National Botanical Institute has a project in Paulshoek and an ostrich project in Spoegrivier is financed by Landbank.

The extension office in the study area has problems of identifying the different farmer needs and types and lack of knowledge about the farmers that it is serving. There is a lack of the knowledge about the farmers' operational environment hence the office has requested the ARC in collaboration with the University of Pretoria and INRA (France) to undertake the research into farmer types. The methodology used for this investigation is related to household analysis and is described in the next chapter.

CHAPTER 4

METHODOLOGY OF ANALYSIS

4.1 Introduction

The methodology to describe and analyse household diversity and different farmer types are discussed in this chapter. Typology development is the main focus for analysis in the study. Discriminant analysis and logistic regression procedures are incorporated to confirm the typology results. The characteristics, applications, limitations and advantages of typology analysis, discriminant analysis and logistic regression are discussed in this chapter.

The choice of the sampled villages is also explained followed by the discussion on the questions asked during both interviews. The chapter concludes to give the methodological sequence in which the three basic steps are described, namely, formulation of the question, processes of data collection and data processing with different analytical methods.

4.2 The analytical framework and methodology

4.2.1 Typology analysis

According to Bailey (1973) typology analysis is a multi-dimensional classification based on relations of contiguity or similarity. It is a tool that can be used to group and analyse activity units according to their main modes of operation and their characteristics (Perret, 1999). Typology aids in applying thinking to the diversity of observable conditions (Moore, 1995). Typologies seek to constitute a range of types which simplify reality whilst accounting for the main particularities which allow each type in a collection that is to be studied, to be classified and analysed (Perrot and Landais, 1993). It can give guidelines for initiating specific development operations as well as for focusing the total

project (Laurent, 1988). It also allow recommendations to be extrapolated and the development trajectory of a particular type to be predicted.

In this study the intention was to group together rural households which have similar needs and are likely to react similarly in farming activity, especially livestock farming. Factors discussed in chapter 2 (Figure 2.2) were considered when developing the typology for the Leliefontein area viz. farming activity rationality, life cycle of households and decision making characteristics. The main issue was not to compare the different types of households but rather to: (a) make comparisons between individual households which were considered sufficiently similar to allow them to be classified in the same type and (b) to analyse their functioning by using a single reference (Laurent, *et al*, 1997). It is important that the types that are formed are not just descriptive types but explanatory types. This can be achieved by giving more attention to the choice of attributes observed. Apart from livestock practices and strategies, crop farming was also assessed in this study. Livestock farming will however be emphasised as this represents the major farming activity in the Leliefontein area.

Building a typology involves full participation of all the stakeholders. The network of the researchers, extension officers and farmers functioning in the area ensure better data collection and interpretation. Methodological requirements of the technique are less stringent than in the case of an approach that necessitates to reason in greater detail the establishment of an information collection system (Perret, 1999).

The application of typology methodology to the study will be of great use in describing the diverse farming situation, making it possible for the extension officers to identify and understand different types of farming households and how they can appropriate their service and available technologies.

If a typology has not been built with the objective of implementing a specific technical action it can be of little assistance in advising or diagnostic actions, since within the same type of technical specification, a production system can still vary considerably (Laurent

and Centres, 1990). Another disadvantage of the typology is that results are valid only for a few years. It is good in giving an instant picture of farm diversity but cannot be a long-term tool destined for routine uses (Perrot, *et. al*, 1993). The typology needs to be revised on a continuous basis. Due to the long-term obsolescence of typology results, it is important that the possible future scenarios be suggested. Prediction can be drawn about the possible development path or trajectory that each household in a type may follow.

4.2.1.1 Different steps in typology development

The typology in the Leliefontein area was built with an objective to identify different types relevant for agriculture extension purposes. The procedure was the following: a preliminary survey was conducted to provide a general description of activities and households in the Leliefontein area; the data was processed and the results were tabulated. The second surveys were conducted in 108 households of five villages of Leliefontein area, questionnaires from those surveys were then browsed through and only the main traits of the each household were considered (See 4.3). Identified variables were determined by what was observed in the community. Such variables were structurally or technically related for example, source of income, level of income, productive activity, off-farm activity, size of herd or flock, shepherd systems, who is the decision maker, etc. At that stage rough identification of the types was made. If so required households were reallocated from one type to another until a proper classification was made and consistency between the types was achieved.

Those results were then taken back to the community, extension officers and other researchers for validation. The comments received were used to reclassify the households before the final typology was formed. The in-depth description of the types was then done and confirmed through interviews and discussions. The main characteristics or proxy variables of each type were highlighted by this description. In this study seven types of households were identified within the typology which was developed to describe diversity in the Leliefontein area.

4.2.2 Discriminant analysis

Originally, Discriminant Analysis (DA) was viewed as a tool for classifying an individual or project into one of a finite number (*K)* of groups (or population) on the basis of *p* observations obtained on the individual or object (Kotze, 1992). It can however be used to address more than simply the issue of classification, for example, it includes the study of group differences based on analysis of variable characteristics associated with individuals assigned to each group. DA is appropriate when the dependant variable is categorical (nominal or non-metric) and the independent variable is metric (Hair, Anderson, Tatham and Black, 1995). When an analysis identifies multiple groups it is termed Multiple Discriminant Analysis (MDA).

Its application and interpretation is much the same as in regression analysis, that is, the discriminant function is a linear combination of metric measurement for two or more independent variables and is used to describe or predict a single dependent variable (Hair, *et al*, 1995). The key difference is that discriminant analysis is appropriate for research problems in which the dependent variables are categorical whereas regression is utilised when the dependent variable is metric. Discriminant analysis is also comparable to reversing multivariable analysis of variance (MANOVA). Canonical Variate Analysis (CVA) is performed in the beginning of analysis and it addresses the problem of presenting the original p variables in a form that emphasizes differences among the groups (McNicol, Hirst, and Kempton, 1993). It forms a new set of uncorrelated variables, called the canonical variates, from linear combinations of the original variables.

According to Kotze (1992), the basic problem is to assign an observation, x, to one of two or more groups on the basis of its value x. It is to be distinguished from the problem of testing equality of means or covariance matrices.

4.2.2.1 Discriminant analysis procedure

The discriminant analysis on types within the typology was run by a computer analysis and the predictors (variables) were:

PropLSU =Number of livestock units

PropIrw =Proportion of Irregular income on total income (less agricultural income)[1]

PropSal = Proportion of salary income on total income (less agricultural income)

PropSoc = Proportion of social grants on total income (less agricultural income)

Proprem= Proportion of cash remittances on total income (less agricultural income)

The variables were summarised to check normality and assess whether data was skewed or not. Canonical Variate Analysis (CVA), better known as Linear Discriminant Analysis was used to find the factors which were mostly discriminating among the groups. In the analysis the Eigen vectors and roots were calculated and used to check which of the discriminant functions were significant. The discriminant scores for the households were computed.

The group means (centroids) were arrived at by averaging the discriminant scores for all the households within particular groups. The group means indicated the most typical location of any household from a particular group. The comparisons of the type means showed how far apart the types were along the dimension that was tested (Hair, *et. al*, 1995). The mean scores were calculated to see if the variables discriminated well among the groups and were plotted on a two–dimensional graph. The discriminant analysis is not limited to a single variate as is multiple regression, but creates multiple variates representing dimensions of discrimination among the types. The percentage of reallocation of some groups from original classification to new groups was checked. Correlation matrix between the variables and some scores was obtained for interpretation and the data tabulated to check the contribution of variables to specific types.

[1] Agricultural income was subtracted each time because generally its contribution was very low. That could be due to the drought that was experienced in 3 consecutive years.

4.2.3 Logistic regression

Logistic regression is a form of statistical modeling that is appropriate for categorical outcome variables. It describes the relationship between a categorical response variable and a set of explanatory variables. It can be applied to both dichotomous response and multi-level response. One of the advantages of logistic regression is that model interpretation is possible through odds ratios, which are functions of model parameters. The odds ratio considers the probability of an event occurring with the probability of it not occurring. It is preferred to use logistic regression to discriminant analysis since it does not rely strictly on meeting assumptions and it has straightforward statistical tests (Hair, *et al*, 1995).

4.2.3.1 Logistic regression procedure

The original typology classification had seven types that were regrouped to yield groups with bigger sample size. The main reason for using Logistic Regression is to try to check the percentage of correctness regarding classification. The largest type (Social Transfer Dependent) of 44 members (group 3) is not merged with other types as the sample is large enough and homogenous in the sense that all the members are depending on social grants from the government (See chapter 5 for details on types). Group 2 (with 29 households) is made up of the Autonomous type and the Regular Income Earners type who have the highest level of income. These two types are not completely similar, as the members of the former are either not working or self-employed. The members in the latter type are all employed in a non-farm sector. For both types there is regular circulation of money within the households. Group1 (with 35 households) is made of four smaller types, namely, Irregular Income Earners, Livestock Holders, Family Dependent and the Poorest. Although having different farming strategies these types of households have no or infrequent source of income.

All the variables were entered in the model and were run using the SPSS programme. Three models were developed: model 1 compared group 1 and group 2; model 2

compared group 2 and group 3 while model 3 compared group 3 and group 1. The output has the table showing the percentage of correctness that was achieved with classification. The classification was split in the number of households correctly grouped and the households that were predicted as belonging to other types.

4.3 Choice of sampled villages

Initially the study was undertaken in four villages in the Leliefontein area. After further discussion with the relevant extension officers it was decided that the fifth village, namely, Karkams should be added. That was done to cover more diversity of the area and have a more stratified sample. Those villages formed a stratified sample because they were on different levels of development and have different features (Table 4.1). Leliefontein and Karkams are for example, on the same level of infrastructural development. They both have electricity and clean piped water in their households. Nourivier, Spoegrivier and Paulshoek have underdeveloped infrastructure.

The number of households interviewed at Karkams, Leliefontein, Spoerivier, Nourivier and Paulshoek are 18, 24, 21, 23 and 22 respectively.

Table: 4.1 Classification of villages in the study area

Characteristics	Sandy lowlands with low rainfalls	Mountainous area with winter rainfall (Kamiesberg)	Mountainous area with summer rainfall (Klipland)
Infrastructure Better Infrastructure (electricity, roads)	Kharkams (n=18)	Leliefontein (n=24)	
Poor infrastructure	Spoegrivier (n=21)	Nourivier (n=23)	Paulshoek (n=22)

Source: Leliefontein Surveys in 1999

4.4 Developing the questionnaire

The questionnaire used during the preliminary interviews contained open-ended questions (Annex 1). Examples of the questions were: How did the head of the household get involved in farming?; Has the agricultural production improved compared to five years ago?; What are the reasons for farming?; Information was also obtained regarding the needs of the community and the household and the youths' perception of agriculture. The response contributed to the building of a close-ended questionnaire.
The questionnaire with the close-ended questions included the following: information on household demography, issues on education level and employment; ownership of a residential site; decision making on farming matters; arable lands (number and crop yields); livestock (size and type); a person responsible of taking care of livestock; agricultural expenditure; sources of income; information on relationship between the household and other households in or outside the area; dietary information (number of meals and meal components); mentioning of committees that support agriculture and the question of whether the agricultural needs of the communities are met. (Annex 2).

4.5 Methodological sequence of the research process.

Figure 4.1 summarises the methodological sequence that was followed. The sequence started with formulation of the questions. Firstly, there was a discussion with agricultural extension officers and agricultural economists on the focus of the study. The chosen samples were purposeful in the sense that they were chosen with an objective in mind, to identify different farming households for extension purposes. Key persons in all the villages supplied the list of the names of households' heads that could be interviewed.

The preliminary interviews were done with a sample size of 28 households and were aimed at trying to get a better understanding of the people in the villages. Those interviews were conducted using an open-ended questionnaire and the respondents were allowed to express their views freely, which allowed for flexibility and exposure of

certain issues. The data was then processed revealing that the response about livestock keeping yielded several functions for the same person.

The close-ended questionnaire was built with the inputs of all stakeholders. All the questions were formulated in the way that they were relevant to the purpose of survey. They were clear and put in the local terminology so that they could be well understood by both the interviewer and the respondents. The questions were explained to the interviewers to ensure that they understood them before starting with the interviews.

The author spent three weeks with the community in one of the villages in order to have a deeper understanding of the residents' lifestyle, usage of local concepts and general observation of their activities. Informal discussions were held with the community members.

The second part of methodological sequence was data collection from 108 households. This sample included some of the 28 households that were visited during the first round of interviews. The interviews were conducted in collaboration with the extension officers. There were two interviewers per one interviewee; one asking the questions and the other one recording the response. The heads of the families answered the pre-structured questions and were assured of the confidentiality of their answers. It was found that most of the time heads of the families were out at the stock post or at their fields, hence the interviewers tried to adapt their visits according to the interviewee's availability.

The third part of methodological sequence was data processing. The first typology was developed by qualitative analysis. This analysis is discussed in section 4.2.1. Thereafter the results were validated with the extension officers, other researchers and the community. The second or revised typology was developed according to their comments. Key variables were then selected and discriminant analysis was run with a computer. That resulted in some households being reclassified within types. The typology results were then presented to the agricultural extension officers

during a seminar. Comments and feedback were again accommodated in the final development of the typology.

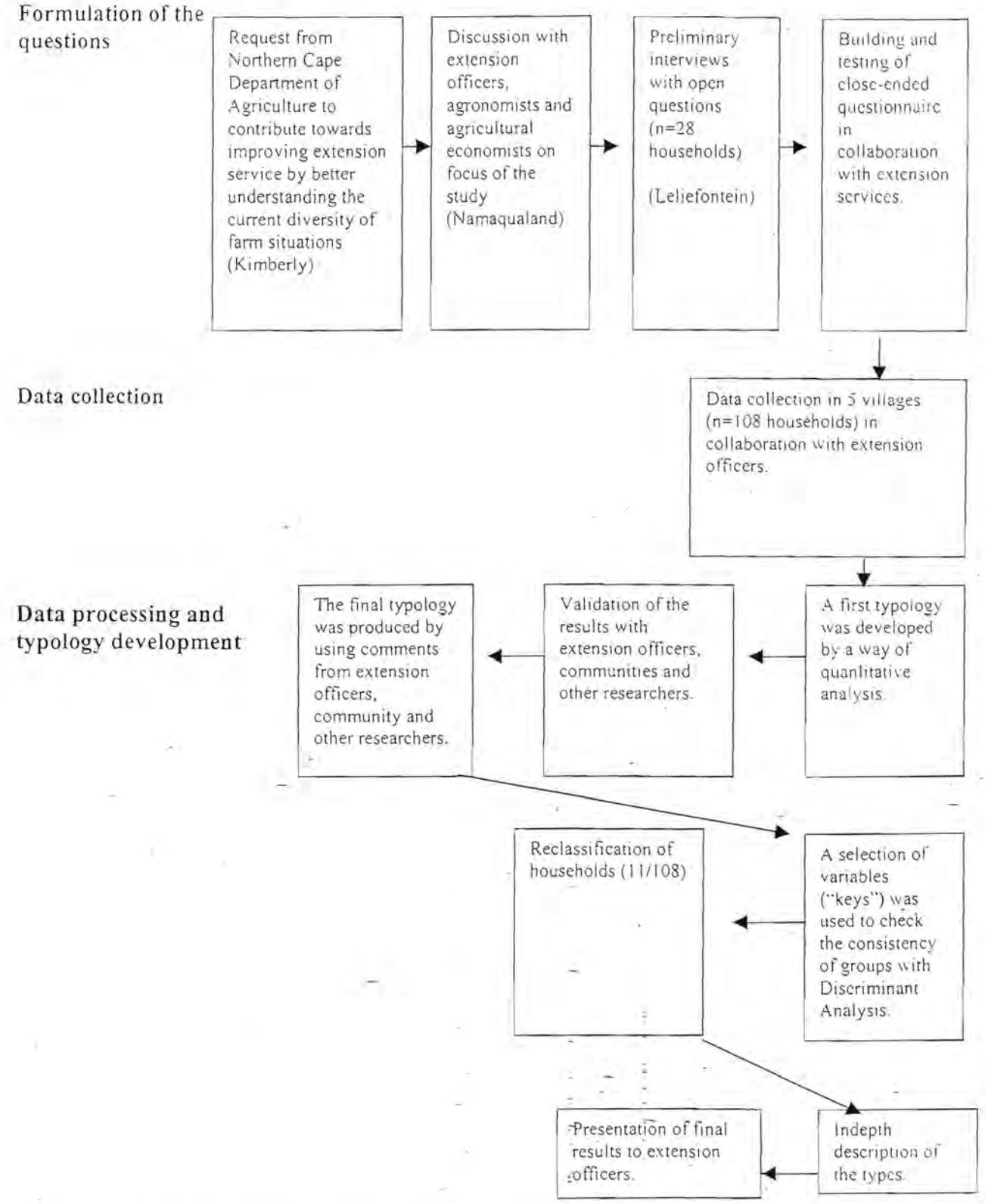

Figure 4.1 Methodological sequence of the research process

4.6 Conclusions

The various methodologies relevant in assisting and exploring the study hypothesis were described in this chapter. Typology analysis is useful in organizing the diverse farming situations into the types that can be described, and therefore fits well in the problem statement of this study. Discriminant analysis and logistic regression are used to confirm the relevance of the types within the typology. Discriminant analysis gives the statistical classification when given the key variables. It is also useful in reclassifying some types which is considered to be wrongly classified. Logistic regression provides the percentage of correctness, i.e. by how many percentages are the households correctly classified. By applying these various methodologies it was possible to address the problem statement and meet the objectives of the study. The results of these analyses are discussed in the chapter.

CHAPTER 5

ANALYSIS AND RESULTS

5.1 Introduction

This chapter will report on the analysis, major findings and results of the study. A synthesis from the data analysis will be drawn using the various techniques addressed in the previous chapter. The focus will be on developing a matrix describing the functional relevance of rural household activity in the Leliefontein area. This is followed by construction of a typology for rural households involved in farming in the area and testing the hypothesis that the behaviour of the rural farming households is diverse and is reflected by the way households view agriculture and practice agricultural activities. The implication of this diversity will be discussed in the next chapter (chapter 6).

The results of the preliminary interviews are tabulated and discussed in this chapter. The results of the typology analysis are given in detailed discussion followed by the descriptive statistical results. The calculated averages of variables are tabulated and discussed per type. The variables are divided into socio-economic factors, assets and management, consumption and income. The discriminant analysis and logistic regression results are presented.

5.2 Functional categorization of agricultural activities: developing a functional matrix

The following results were obtained from the preliminary interviews that were conducted with an open-ended questionnaire in which the interviewees were allowed to respond to the questions openly. The answers were given randomly i.e. without specifying whether the functions were economic, social, religious or hedonistic. They were arranged in a functional matrix (Laurent, *et al*, 1998), during analysis stage to reflect functional classification of agricultural activities (Table 5.1).

Table: 5.1 The different functions of livestock activity within the Leliefontein community (n=28 households)

	Professional agriculture	Social system	Family life
Economic function	• Focus on profits in a diversified farming system • To make an economic living	• Redistribution of resources, for an example, a gift of an animal to a visitor and/or a relative.	• Household consumption • Investment (saving) • Production
Social function	• It boosts their status • Employ people	• It is a tradition to keep livestock. • Social security when using common resources.	• Families are made independent since their needs can be satisfied.
Religious function		• Donkeys are still honoured by some families because of their biblical connotation.	
Hedonistic function (Hobby)			• In some financially stable families, women keep animals especially, lambs as pets.

Source: Leliefontein Surveys 1999

Table 5.1 is described as follows:

On the horizontal axis:-

- Professional agriculture refers to farming that is practiced in a commercial mode i.e. as an economic profession. The social system in this context refers to how livestock farming is perceived by the community. Family life refers to how livestock farming is experienced by the family (household).

On the vertical axis:-

- Economic function refers to benefits and items that can be associated with economic and commercial value. Social function yields intangible benefits and costs that are real, for example, better health. However such benefits do not lend themselves to monetary valuation (Gittinger, 1982). Religious function refers to the particular spiritual motivation of keeping livestock and hedonistic function refers to livestock as an object of pleasure and entertainment.

In the functional matrix:-

- The economic function for the category of professional agriculture describes livestock farming as a business with profit making as an objective that generates money for the household. It is therefore a professional activity. However, livestock farming is not the only source of income, but one of the several sources. In the social system, livestock farming is viewed as enabling the process of redistribution of resources, for example, an animal can be given away as a gift. At the family life level an economic function of livestock keeping is that animals form part of household consumable items. It can also be regarded as an investment because the family can sell an animal to access funds. An offspring can also be sold as production income.

- The social function of livestock to professional agriculture is that it boosts the status of these farmers. The larger the number of livestock the more respect is earned from the residents. A respect for the owners of large numbers of livestock was recorded by people with lesser numbers of livestock. The status from livestock composition and

size is related to its economic function. It is however not the same as so-called "cattle complex" myth. Van Rooyen, de Swart and Fraser (1981) and Randela (1999) argue that this myth is based on the incorrect assumption that black small-scale farmers are incapable of responding rationally to market signals. According to the myth farmers would not sell cattle because their economic concern was overlaid by mystical and ritual devotion to their stock and by the desire to accumulate cattle merely for prestige and wealth. This is clearly not the case in the Leliefontein situation. The status rather stem from the fact that the society see the owner of large number of livestock or owner of cattle as the sign that he or she can afford to maintain them and for example, hire more shepherds to cope with the work especially during lambing season. Large livestock numbers also empower owners as it gives them the option to command resources if so required by, for example, selling some of their animals. This is supported by Van der Poll, (1999). The livestock activity in this category result in hiring of shepherd.

In the social system livestock keeping is regarded as a tradition. That refers to the fact that the community grew up in families where livestock farming was practiced and saw that as an acceptable way of life. May (1997) stated that according to surveys, households of Leliefontein villages had interest in common property resources irrespective of their socio-economic status. Their livestock graze in the communal lands and give social security. Families who have livestock are made to feel independent since their needs are more easily satisfied.

- The religious function: Although the communities agree that donkeys accelerate overgrazing some feel that they should not be eliminated since they are honoured animals in a religious context. This refers to the biblical connotation that they have i.e. Matthew 21:2 entitled "The triumphant entry into Jerusalem" in which Jesus instructed that a donkey should be brought to Him so that He could ride on it while entering the city of Jerusalem.

- The hedonistic function: In some financially stable families, members, especially women, keep animals, for example, lambs, as a hobby. Such animals are given so much attention that they end up living like domesticated animals (pets). The financial stability of such households refer to the fact that such an animal keeper does not display intentions to sell an animal, even if in reality she/he may have to do so if it is necessary.

5.3 Building a typology

Diversity will be reflected if various types can be described within a particular typology. Description of the different types observed in the study area include households' strategies that the different types use and the possible trajectories (possible paths) that they may follow given some stimuli. Strategy in this context is the way in which the household is organised and coping. The way the factors such as life cycle of a household, rationality, decision making regarding farming and technical issues influence behaviour of different households is discussed in such a description (Figure 2.2). Each type will be named with a descriptive title to indicate its main features.

Type 1: ***Autonomous type (A) (7/108)***

This is the type of materially well off people who are operating as autonomous entities in a larger community (7 out of 108, or 6.5% of the sample). They generally live in brick-built houses that are well furnished and can be retired professionals, shop owners or people who come from well-off families. Their educational level spreads throughout the range of no educational training to post graduate level. The heads of the families are all men and their average age is 61 years. They have large numbers of livestock which are looked after by shepherds. Their livestock is made up of cattle, goats and sheep. They keep more sheep than other livestock, which is different with the other household types. This means that they are better equipped to cope with risks involved with sheep farming. The farming system for this type resembles that of commercial farmers. These households have financial autonomy. They have access to regular income that may either come from their businesses, previous employers or pensions. The average total income

of the group is R43 800 per year. They do not receive family support such as remittances. Farming contribution to the average total income is 16.6%. Decision-making is usually done by both the head and spouse and it is quick since both parents are at home. They have motorised transport means such as bakkies.

Strategy: They follow an autonomous strategy due to access to sufficient funds. They also enjoy social status. They hire labourers and view farming as an important economic entity i.e. as a profession.

Possible development trajectory: If the issue of land ownership can be cleared and extension support is provided, this type is likely to expand to commercial farming activities. There is the possibility that farming by this type will depend on succession since the heads are now becoming aged and are pensioners.

Type 2: ***Livestock Holders (Lk) (12/108)***

This type (12 out of 108 or 11.1% of the sample) consists of livestock owners or family members (can be the sons or even grandsons) who look after the livestock. The type wants to make a living and if possible a profession out of livestock farming. They are middle-aged people who had previously worked (could be pensioners or those who took voluntary packages from work, and are new entrants in the livestock farming). They have an average age of 54 years. Such livestock holders bought a small numbers of livestock with the intention of increasing the stock they hold. Some may have low income because of recent problems they encountered, for example, drought or even due to the fact that they have just started with livestock farming.

This type keeps more goats than sheep. This is the trend that is generally followed in the community since keeping more goats than sheep means better protection against production risk. Goats have a better ability to survive an inhospitable environment and are relatively independent (Leliefontein surveys, 1999).

The maximum and minimum total income in this type varies between R48 000 and R2400 per annum respectively (the average income is R20 500 per annum). Farming contribution to the total income is 3,9% on average. Decision-making is divided since the heads are mostly out at the stock post. This implies that men decide more readily on farming issues while women decide on household issues.

Strategy: The members of this type (Lk) are engaged in an investment strategy towards professional farming with the aim of making livestock holding a successful business. Their full time engagement with no specific hired labourers shows their determination.

Possible development trajectory: There is the possibility for this type (Lk) to move to Type 1(A) should financial resources be available. However members of this type can also move to Type 5 (social transfer dependents) if they get to a stage of depending more on social grants, i.e. when ageing.

Type 3: ***Regular Income Earners (S) (22/108)***

This type (22 out of 108 or 20.4% of the sample) consists of the professional and other skilled people who are receiving regular income. They can either be living in their homes or be away and coming home during weekends, month-ends or fortnightly. For this type there is extra money that can be put into building the livestock flock or herd. They keep cattle, goats and sheep. The number of sheep is more than that of other animals, and this could be for the same reason as for the Autonomous group (Type 1).

Their annual average total income is R26 900. Farming contributes 7.9% to the total income on average. This type consists of people who do not depend on financial transfers from family members or social groups. The average age is 53 years and the educational level ranges from no educational training to post matriculation. Those who come home everyday can readily decide on anything that concerns farming whereas for the heads who works away, the decision will be made when they are back home. The

members of this type can either hire a shepherd or ask some people to keep their livestock for them.

Strategy: The members of this type are engaged in an investment strategy towards farming with the aim of making livestock holding a successful business, however they are not always directly involved as they are participating in full time jobs. Livestock farming rather complement their external income. They employ both hired labour and family labour.

Possible development trajectories: This type may move towards Type 1 (Autonomous) as the heads retire or be part-time as a new type of small-scale commercial farmers in the future.

Type 4: ***Irregular Income Earner (Iw) (11/108)***

The people in this type (11 out of 108 or 10.2% of the sample) are engaged in temporary jobs and have unreliable income. The responses of the members of this type show that they depend on livestock farming as a security and that they are not prepared to take permanent jobs that will keep them away from livestock farming. They will rather engage in piece jobs. They may be the middle aged livestock holders or the young family members of the livestock holders who are looking after the animals themselves. Once members of this type get involved in piece jobs they group their livestock together under the responsibility of one shepherd who will be paid for, while they are working. Another possibility is asking a neighbouring shepherd to take care of the livestock without paying him. They keep almost the same number of livestock as the livestock holder type, and also have more goats than sheep. The minimum and maximum ages are 26 and 63 respectively. The educational level varies from primary school to standard nine.

Their annual average total income is R15 600. They have family support. The contribution of farming to the total income is 10.8% on average.

Strategy: They adopt a 'booster' strategy in the sense that they engage themselves in part time jobs to supplement or boost their farming income. They either utilise own labour or hire it out.

Trajectories: There is a possibility for the members to move to Type 6, (Family Dependent type) and Type 7, (Poorest), when temporary job opportunities cease. There is also the possibility that they may move to Type 2, (Livestock Holders), should they decide to generate more income from livestock farming.

Type 5: ***Social Transfer Dependents (St) (44/108)***

This type (44 out 108 or 40,7% of the sample) is made up of the people who are mostly handicapped, pensioners or are receiving some form of government's grant. It is the largest and the oldest type. The ages of the members range from 43 to 88 years. Thirty-six out of forty four of the households'' heads have educational training in the range 0 to standard 5. There are 23% of households being headed by women.

Their annual average total income amounts to R21 800 per household. Members of this type get income mainly through social transfers from the government and in the form of remittances. The contribution of farming to the total income per year is 2.4% on average. Most of those who are old and owning livestock accumulated their animals when they were younger. They follow the trend of keeping more goats than sheep. The person responsible for taking care of livestock can be the owner himself, shepherd who may be either a family or a hired person.

Strategy: They are dependent on social grants and keep livestock for household consumption or to generate funds when needed (animal sales within the village). They utilise family labour.

Possible development trajectory: Movement of this type depends on the succession process for these households whose heads are pensioners. Due to patrimonial rights new

households heads can start afresh and invest in livestock and therefore belong to Type 2, (Livestock Holders).

Type 6: ***Family Dependent type (Fd) (5/108)***

The households in this type (5 out of 108 or 4.6% of the sample) are having irregular financial support from relatives and other people. The contribution of farming to the total income is 1.9% on average. Thirty percent of the total income is derived from family support (remittances). They also receive other support in kind. Their average age is 58 and their level of education is below matriculation. Three out of the five households are headed by women.

The members of this type have medium sized herds (average livestock unit is 13). Some of the livestock also belong to relatives. The person who takes care of the animals can be a member of the household, a hired shepherd or the livestock owner. Decision-making on resource allocation does not come from within the households only but also from outside, especially from people sending money to the household.

Strategy: They use a dependency strategy to secure remittance (money and food). They depend on other people (especially relatives) to offer them money and food. Decision making is mainly from people from outside. For example, the members of the family who work away from home send money to a household for ploughing the lands. Such family members who make provision for farming activities are the ones who decide whether to plough or not. The members of this type use own labour.

Possible development trajectory: This type could move to Type 5, (Social Transfer Dependent) as the heads get pensioned or to Type 3, (Regular Income Earners) as job opportunities arise.

Type 7: ***Poorest type (P) (7/108)***

This type (7 out of 108 or 6.5% of the sample) consists of the poorest families who may either be small or big (with more than three adults in the house) and who live in poor housing structures. These households are headed by men who have low levels of education. Their annual average total income of R2 500 is far less than the acceptable minimum annual income of R9 000 for a rural household (Eckert, *et al.* 1997). There is limited flow of income for example, as cash remittances and government grants. Farming contributes 14.3% of the total income on average.

The households of this type are not completely isolated. In a sense there is still a spirit of togetherness amongst the households in the villages in as far as working together is concerned. Livestock numbers varies from nothing to a few animals. The members of Type 7 do not have cattle but do have small numbers of sheep than goats.

Strategy: This type has survival strategy. The members of the type posses limited food or money and display an inactive involvement in farming activities. They supply labour to other households.

Possible development trajectory: If job opportunity becomes available, there can be a possible movement towards Type 6, (Family Dependent) for example, if an employed family member sends remittance to the household and to Type 4 (Irregular Income Earners) if a member of such household get a job.

The following figure displays summarised development trajectories discussed above:

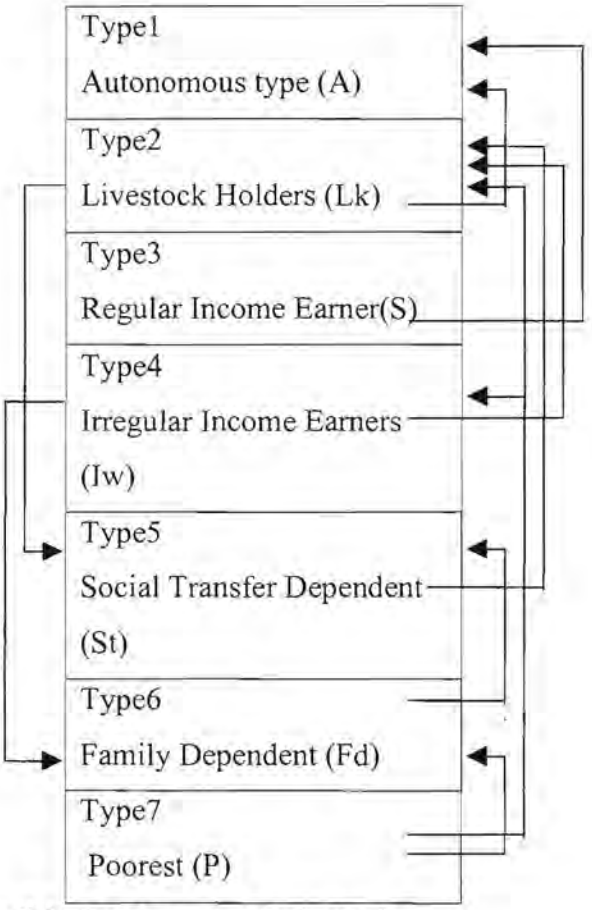

Figure 5.1 Possible development trajectories

Source: Leliefontein survey, 1999

The following factors viz. decision-making regarding farming; technical issues; life cycle of a household and rationality influence behaviour of different households (Figure 2.2). These are some of the factors that can induce change in movement of the types. The change in one of the factors may move a type to become another type.

The factors differ per type for example, decision making regarding farming in one type is not the same as the other types, for example, the Autonomous type has decision making done by both the head and the spouse whereas in the Livestock Holders type is mainly by the heads (Table 5.4). The way different types conduct their livestock farming is different, for example, Irregular Income Earner type apply shared livestock keeping

technique and the Livestock Holder type uses an individual livestock keeping technique (Table 5.2).

Average ages of the heads of the households categorises the stages of such household i.e. if they are all pensioners for example it gives a clue that such farming households are due to leave farming and therefore is likely to transfer their livestock to the next generation. The objectives for keeping livestock for each type differs, for example, the Livestock Holder type wants to make an economic living out of farming (i.e. professional agriculture) whereas the Poorest type members keep few livestock for household consumption (i.e. family life/social function).

5.4 Descriptive statistics

The typology consisting of seven types of rural farming households are summarised in Table 5.2 and a statistical description is given in Tables 5.3, 5.4 and 5.5. Table 5.4 presents the decision makers in the households regarding farming. Table 5.5 shows the sources of income described in Annex 3 for different types. In Table 5.2. The first row is the names of the types; the second row is the gender of the head, the third row is main attributes of the types; the fourth row is technical mode regarding livestock keeping, the fifth row is size of livestock herd, the sixth row is average total income per year, the seventh row is average agricultural income and the eighth row is agricultural income as percentage of total income per year.

Table: 5.2 Summary of types of farming households

Types	"The Autonomous" (A) (n = 7) 6.5%	"The Livestock Holders" (Lk) (n=12) 11.1%	"The Irregular Income Earners" (Iw) (n=11) 10.2%	"The Regular Income Earner" (S) (n=22) 20.4%	"The Family Dependants" (Fd) (n=5) 4.6%	"The Social Transfer Dependants"(St) (n=44) 40.7%	"The Poorest" (P) (n=7) 6.5%
Main attributes of the types	Various sources of income. Highest income group of the area; brick built houses; own transport (for example. bakkies).	Want to make a living out of livestock keeping; entry into livestock farming after a previous job outside agriculture and outside the area	Temporary jobs and unreliable income; they can be very poor; they are reluctant to seek jobs far from the area.	Regular income from non-agricultural activities include households with migrant workers visiting home regularly; can save money to build the herd.	Receives regular family support (cash and inkind) .Relatives usually interfere in the households' decision making.	Households depending on welfare grants. Mainly pensioners. Few handicapped persons getting health allowance.	Income per capita is low (AVE=R615/year). They cannot afford to plough arable land even if they have access.
Gender of the household heads	7 males 0 females	9 males 3 females.	11 males 0 females	21 males 1 female	2 males 3 females	10 males 34 females	7 males 0 females
Livestock management practices	•Salaried shepherd	•Individual livestock keeping	•Shared livestock keeping	•Family livestock keeping or •Shepherd •Individual livestock keeping			•Reduced livestock activity
Livestock size	Large herd Ave of 50 LSU[1]	Medium size herds Ave of 14 LSU	Medium size herds Ave of 14 LSU	Medium size herds Ave of 11.8 LSU	Medium size herds Ave of 13 LSU	Medium size herds Ave of 11.5 LSU	Small herds Ave=5.5 LSU
Ave tot income/year	R43 800	R20 500	R15 500	R26 900	R27 300	R21 800	R2 500
Ave Agric. Income/y	R8 700	R830	R1 800	R2 300	R520	R520	R420
Agric. income as %of tot. income/y	16.6	3.9	10.8	7.9	1.9	2.4	14.3

[1] 1 Large livestock = 5 small livestock

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Table: 5.3: Variables considered in the typology analysis

Types	A[1]	Fd[2]	Iw[3]	Lk[4]	P[5]	S[6]	St[7]
N	**7**	**5**	**11**	**12**	**7**	**22**	44
The variables							
NB. Values are averages							
Socio-economic factors							
1. Average Age of the head (yrs)	61	58	50	54	46	53	65
2. Education level reached by household head (Primary=0; secondary=1)♣	0.57	0.40	0.27	0.08	0.14	0.32	0.18
3. Gender (head) (male=1; female=0)	1	0.4	1	0.75	1	0.95	0.77
4. Number of persons in a household	4	5.2	5.1	6	4.1	4.3	4.7
Assets/ technology/ management							
5. Arable lands (y=1; n=0)	1	0.6	1	0.42	0.71	0.73	0.61
6. Have they been ploughed for the past 3 years (Y=1; N=0)	0.71	0.4	0.55	0.33	0.43	0.55	0.48
7. Did you use tractor (y=1; n=0)	0.71	0.4	0.18	0.25	0.43	0.36	0.27
8. Own tractor (y=1; n=0)	0.29	0.0	0.09	0.0	0.2	0.32	0.05
9. Storage facility (y=1; n=0)	0.86	0.2	0.55	0.33	0.29	0.45	0.50
10. Poultry (y=1; n=0)	0.43	0.60	0.55	0.83	0.57	0.45	0.55
11. Garden (y=1; n=0)	0	0	0.09	0.08	0.29	0.05	0.09
12. Incidences of livestock loss♦ (events)	0.14	0.60	0.36	0.58	0.14	0.36	0.43
13. Agriculture needs: are they addressed (y=1; n=0)	0.86	0.60	0.55	0.58	0.57	0.64	0.27
14. Livestock size (LSU)▲	50	13	14	14	5.5	11.8	11.5

♣ Primary level refers to Standard five and less whereas secondary is Standard 6 up to post matric.
♦ Counts of the reported losses that may have occurred due to different reasons.
▲ LSU (livestock unit): 1 large livestock=5 small livestock

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Table 5.3 continued:

Type N	A[1] 7	Fd[2] 5	Iw[3] 11	Lk[4] 12	P[5] 7	S[6] 22	St[7] 44
The variables							
Consumption							
15. Food in short supply (y=1; n=0)	0.7	0.4	0.63	0.41	0.57	0.59	0.59
16. Meals per day. 3times=1; < than 3=0	0.71	0.8	0.82	0.92	0.57	0.86	0.84
Responsibilities							
17. Who works in the fields? Family labour=0; hired labour =1	0.71	0.4	0.55	0.25	0.29	0.63	0.39
18. Who decides on crops to be grown? Family head : y=1; n =0	1	0.60	0.91	0.17	0.86	0.41	0.34
19. Who takes care of livestock? Shepherd: y=1; no =0	1	1	1	1	0.86	0.91	0.82
20. Whose transport does one use for taking products to market? own= 0; hired, somebody else =1	0.29	1	0.64	0.67	0.71	0.55	0.73
21. Who decides on use of rangeland, Shepherd or someone other than family member=1; family member=0	0.43	0.4	0.36	0	0.29	0.32	0.23
22. Private kraal, y=1; n=0	0.86	0.6	1	1	0.43	0.63	0.59
23. Communal kraal, y=1; n=0	0.14	0.4	0	0	0.43	0.36	0.20

Key: 1=Autonomous (A); 2= Family Dependent(Fd) 3= Irregular Income Earners (Iw); 4= Livestock Holders(Lk); 5=The Poorest(P); 6=The Regular Income Earner(S), and 7= Social Transfer Dependent (St).

Table: 5.4 Decision-making regarding farming by the family members

	Type	[1]A	[2]Fd	[3]Iw	[4]Lk	[5]P	[6]S	[7]St
Decision maker								
Head			+	+	+			
Head & spouse		+					+	+
Head & son/daughter			+	+		+		+
Mainly from outsiders			+					

Key: 1=Autonomous, 2=Family Dependent, 3=Irregular Income Earners, 4=Livestock Holders, 5=The Poorest, 6=The Regular Income Earner and 7=Social Transfer Dependent.

+ represents a decision-maker.

Table: 5.5 Sources of income for different types in the typology

The variables	Types [1]A	[2]Fd	[3]Iw	[4]Lk	[5]P	[6]S	[7]St
(R/Y)	N 7	5	11	12	7	22	44
Tot. ave. income	43 818	27 344	15 598	20 573	2 573	26 917	21 806
Agricultural expenditure	14 036	2 825	3 484	1 900	1 624	3 365	1 678
Irregular income	428	1 440	4 960	1 217	1 217	1 370	740
Remittances (y=1; n=0)	0	1	0.36	0.50	0.43	0.64	0.75
Regular income	1 771	1 440	0	3 700	0	14 938	153
Social transfer	7 965	5 352	2 180	7 800	0	2 296	10 318
Agricultural income	8 737	526	1 884	829	429	2 311	528
Outstanding credits (y=1; n=0)	0.57	0.29	0.67	0.50	0.71	0.77	0.66
Saving money? (y=1; n=0)	0.43	0	0.27	0.33	0.29	0.50	0.14

Key: 1=Autonomous (A), 2=Family Dependent (Fd), 3=Irregular Income Earners (Iw), 4=Livestock Holders (Lk), 5=The Poorest (P), 6=The Regular Income Earner (S) and 7=Social Transfer Dependent (St).

Description of variables: The further description of variables per type is done for the purpose of trying to compare the means/ averages of the variable of the types. This will expose the differences and similarities between the types. The information from which these variables originate is that which was collected during the surveys.

Socio-economic variables:

The oldest types, Autonomous and Social Transfer Dependent have mean ages of 61 and 65 years respectively. The Poorest type reflects a youngest average age i.e. 46 years. Autonomous is the one with the highest percentage (57%) of the members with secondary level education. Generally, the percentages of all other types are very low, which could possibly mean that many people achieved education up to primary level training. The Family Dependent type is the only one with high percentages of female heads, 60%. Across all types the average number of persons in the households ranges from 4 to 6.

Regarding accumulated assets, technology application and management, consumption pattern and decision making the results are as follows:

All the members of Autonomous and Irregular Income Earners have arable lands and the Livestock Holder type has the lowest percentage (42%) of arable lands. Autonomous type had 71% of their land ploughed for the past three years using tractors and 29% of its members own tractors. It is only about half of the Irregular Income Earner type (55%) who had ploughed the lands within the past three years. Only 18% of this type used tractors with 9% owning such tractors.

Autonomous type has 100% of the parents being responsible for decision on crops to be grown and 71% of hired labour working in the fields. Livestock holders has only 17% of parents deciding on crops to be grown and 25% of utilisation of hired labour. This could mean that this type is devoting most of its time to livestock. Regular income earner and Social transfer dependent types have low participation of parents in deciding which crops

to grow. Less than 10% of members in all the types (excluding poorest) have gardens on either residential site or arable lands.

The Autonomous type has the largest average number of LSU (50) and the Poorest type has the smallest average number of 5.5 LSU. The people who take care of livestock can be shepherds or members of family. For many of the types their livestock are taken care of by shepherds, as shown by the positive response to questioning which ranges from 82% to 100%. Decision on the use of rangeland is more frequently from the family members who are livestock owners than from shepherds and other people. In the Autonomous type, for example, 43% of such decisions come from people other than the family members whereas for Livestock Holders it comes solely from family members. Table 5.4 displays the persons who have most influence regarding farming in each type.

All the livestock owners of Irregular Income Earners group and Livestock Holders have private kraals. The Poorest has the lowest percentage of private kraals (43%) and the highest percentage of communal kraals (43%). There is a least incidence (14%) of livestock loss for the Autonomous type but highest (58%) for the Livestock Holders type. The response about meeting agricultural needs shows that 86% of Autonomous members are satisfied whereas only 27% of members of poorest are satisfied. This trend could be due to the fact that the visits by the people concerned (e.g. extension officers) are skewed towards the Autonomous type. The Autonomous and Regular Income Earners have lower percentages of poultry, 43% and 45% respectively, whereas livestock holders have 83%. In contrast, Livestock Holders claim highest percentage of food shortage, 41% which is almost similar to the figure for the Family Dependent type i.e. 40%. On average, the members of the types who enjoy three meals per day ranges from 71% to 92% excluding Poorest where the lowest i.e. 57% occur.

According to Table 5.5 the Autonomous type has the highest average income of R43 000 and Poorest has the lowest average income of R2 500 per year. The Autonomous type has the highest agricultural expenditure of R14 000 per year whereas all the types have spent between R3 000 and R1 600 annually. Irregular Income Earners type has the

highest irregular income earned. All members of Family dependent type receive remittances but the Autonomous none. The Regular Income Earner type receives an average of R15 000 of regular income whereas the Poorest and Irregular Income Earners have none. The Social Transfer Dependent type receives the highest average of social grants and the Poorest none. Outstanding credit refers to bank loans, furniture purchases, food purchases from local shops and other small loans. As a result of this a clear comparison cannot be drawn from such information. Fifty percent 50% of the Regular Income Earners save money, followed by 43% of members of Autonomous type and no savings in the Family Dependent type.

5.5 Discriminant analysis and results

Discriminant analysis was used to assess whether the classification of particular household in particular types was acceptable and therefore whether a significant degree of diversity between household can be accepted. The summarised results of discriminant analysis are discussed in this section. Detailed discriminant analysis results are given in Annex 4. The results are displayed on a two-dimensional graph (Figure 5.2). The mean scores of the types are plotted on the graph. The mean score for each type shows position of the type i.e. how diverse the types are.

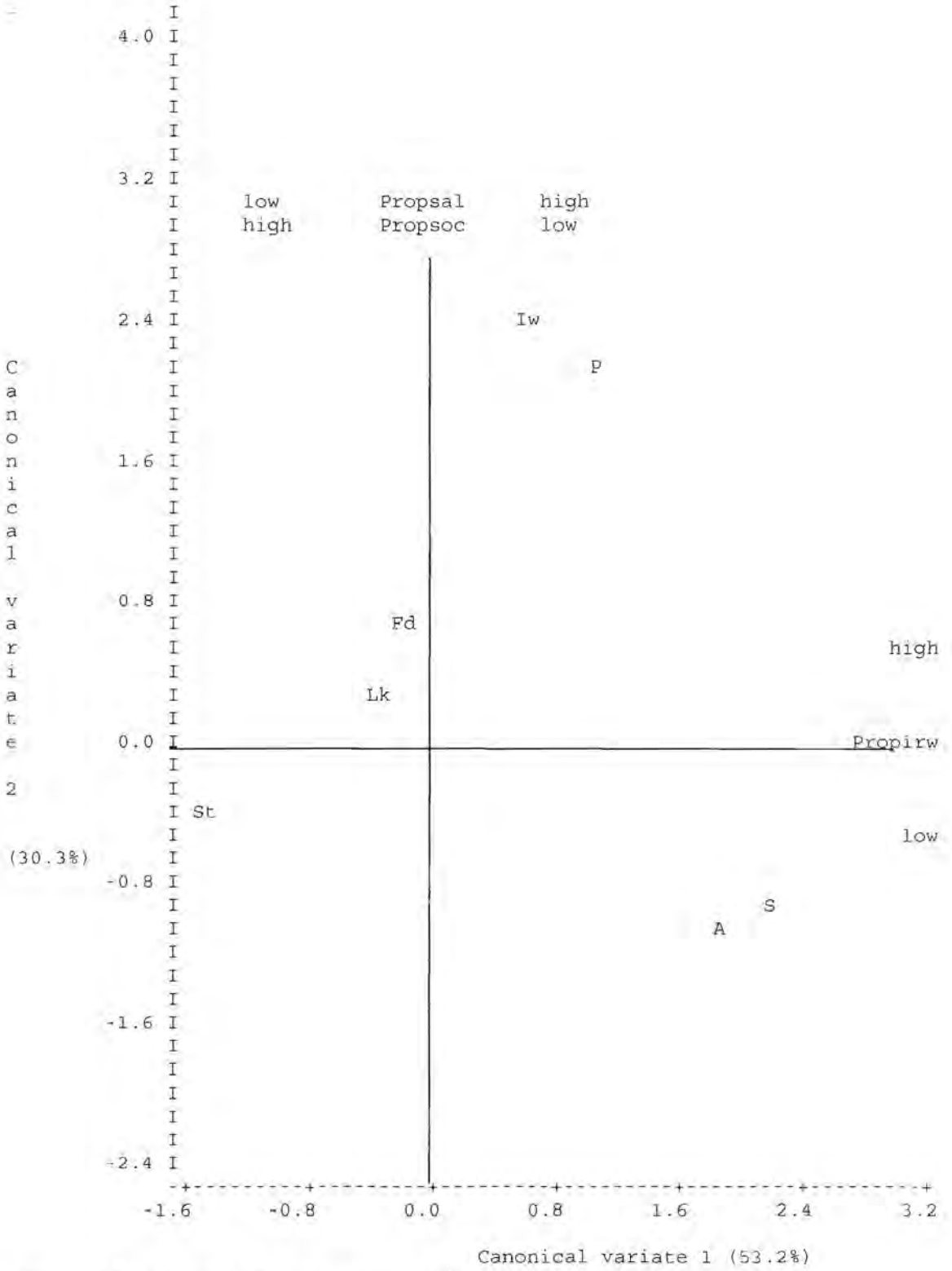

Figure 5.2 Graph of mean scores of types

Key: A=Autonomous; Fd= Family dependent; Iw=Irregular Income Earners; Lk= Livestock Holder; P=Poorest; S=Regular Income Earners and St=Social Transfer Dependents.

5.5.1 Interpretation of the discriminant analysis results

In the analysis the canonical variate 1 (CV1) accounted for 53,2% and canonical variate 2 (CV2) for 30,3% of the variation in the data. Plots are usually prepared for the first two or three discriminant function assuming that they are statistically significant and also a valid predictive function (Hair, *et al*, 1995). In this analysis the latent roots of only the first two CVs are greater than one. The graph displays the types' mean scores of CV1 and CV2. This two-dimensional graphic representation accounted for 83,6% of the variation in the data and is therefore acceptable. The mean scores for each type show its position in reduced discriminant space.

There are seven types positioned in four quadrants, namely: Autonomous (A) together with Regular Income Earner (S); Social Transfer Dependents (St), together with Livestock Holder (Lk) and Family Dependents (Fd) and Irregular Income Earner (Iw) with Poorest (P). Types A and S are closest together and furthest away from the average of all the types (with standardization, the average of all types is zero). Its quadrant can be called "affluent gradient" since they form the richer stratum of the community. Type St is further away from overall mean. Types Fd and Lk are closer to an overall mean than types Iw and P. The latter types are far apart from types A and S since they are not similar.

It is possible to interpret relevant variables in determining relative positions of types. The types having the highest mean on the respective predictor are away from the types with the lowest mean scores. CV1 (x-axis) discriminates mostly among types A and S, Iw and P, Lk and Fd and St. To find the variables most responsible for the classification of these groupings the scores are correlated with the variates. From the correlation matrix it can be seen that the 'propsoc[2]' coefficient of variation (r) is –0.89 and 'propsal'(r=0.85) discriminate between the types to the right and those to the left of the zero line on CV1. A and S have above average 'propsal[3]' while for type St it is below

[2] proportion of social transfers
[3] proportion of regular income

average. Type Lk and Fd are close to the zero line and just under average. Since the variate 'propsoc' is negatively correlated, the reverse is true.
CV2 (y-axis) discriminate mostly between types Iw and P and A and S. The coefficient variation (r) for 'propIw'[4] is 0.80. For A and S this is below average and above average for Iw and P. Thus for the lower, right-hand quandrant (A and S) the 'propsal' is above average, whereas'propsoc' and 'propIw' are below average.

There are 25 households that have been reallocated to new types. The reallocation was done automatically by the Genstat computer program. This means 23% regrouping and 77% of original grouping, which shows good statistical classification.

This analysis confirms the typology result that there are significant diverse types of farming households.

5.6 Logistic regression results and interpretation

The logistic regression results are used to confirm the classification of the types statistically. The main reason for using logistic regression is to check the percentage of correctness regarding classification. The logistic regression compares the groups in a model. Group 3 is made up of the Social Transfer Dependent type. Group 2 is made up of the Autonomous type and the Regular Income Earners type. Group 1 is made of four types, namely, Livestock Holders, Irregular Income Earners, Family Dependent and the Poorest.

Model 1 compares group 1 and group 2; model 2 compares group 2 and group 3 while model 3 compares group 3 and group 1. The independent variables included are temporary wage or irregular income, fixed salary or regular income, remittances, social grants and total number of livestock unit. Table 5.6, Table 5.7, Table 5.8 and Table 5.9 present an output of logistic regression.

[4] proportion of irregular income

Table: 5.6 Logistic regression results

Models	Overall percent correctness(%)	Observed (%)		Predicted (%)	
I	90.6	1	94.1	1	6.0
		2	86.7	2	14.0
II	95.9	2	93.1	2	6.90
		3	97.7	3	2.30
III	86.1	1	82.9	1	17.0
		3	88.6	3	11.4

Table 5.6 shows the percentage correctness among the classification of households in the groups. Model I, model II and model III yielded 90.6, 95.9 and 86.1 overall percentage correctness respectively. Ninety four percent of the households classified are observed as belonging to group 1 and 6 percent of households are predicted as belonging to group 2. Eighty six percent (86%) of the households classified are observed as belonging to group 2 and 14% are predicted as belonging to group 1. In model II 93% of the households classified are observed as belonging to group 2 while 6.9 percent of households are predicted as belonging to group 3. Ninety eight percent of households classified are observed as belonging to group 3 whereas 2.3% of households are predicted as belonging to group 2. In model III 83% of households classified are observed as belonging to group1 and 17% are predicted as belonging to group 3. The correctly observed households belonging to group 3 make 88.6% whereas those predicted as belonging to group1 make 11.4%.

Table 5.7, Table 5.8 and Table 5.9 depict the variables in the logistic regression equation. The columns that will be highly considered are B (coefficient of estimates), Sig. (level of significance) and Exp (B) (odds ratio). The estimated coefficients are measures of the changes in the ratio of the probabilities termed the odds ratio. Hair, *et.al* (1995) explain this as follows: a positive coefficient increases the probability, while a negative value decreases the predicted probability. A coefficient of zero equates to the value of 1 resulting in no change in the odds. The level of significance is set at 10%.

Table 5.7 Model I

Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
TEMPW	-9.2E-05	.0001	.4399	1	.5072	.0000	.9999
FSALARY	.0003	6.251E-05	16.1791	1	**.0001**	.4003	1.0003
REMMIT	-1.2417	.8943	1.9278	1	.1650	.0000	.2889
SOCGRA	-.0001	.0001	1.6173	1	.2035	.0000	.9999
TOTLU	.0587	.0305	3.7116	1	**.0540**	.1391	1.0605
Constant	-.3010	1.3107	.0528	1	.8183		

Key: TEMPW=temporary wage, FSALARY= fixed salary, REMMIT=remmittances SOCGRA= social grants and TOTLU= total number of livestock unit

In model I the variables fixed salary or regular income and the total number of livestock units are significant. It is group 2 (Autonomous type and Regular Income Earners) that has more of such variable than for group 1 (Livestock Keepers, Irregular Income Earners type, Family Dependent and the Poorest). There is an increased probability of the two variables occurring for the former types.

Table: 5.8 Model II

Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
TEMPW	-6.5E-05	.0004	.0259	1	.8723	.0000	.9999
FSALARY	-.0008	.0003	10.5088	1	**.0012**	-.2945	.9992
REMMIT	-.4007	1.2836	.0974	1	.7549	.0000	.6699
SOCGRA	-6.6E-05	6.108E-05	1.1777	1	.2778	.0000	.9999
TOTLU	-.0453	.0240	3.5611	1	**.0591**	-.1262	.9557
Constant	5.1473	2.2129	5.4104	1	.0200		

Key: TEMPW=temporary wage, FSALARY= fixed salary, REMMIT=remmittances SOCGRA= social grants and TOTLU= total number of livestock unit

In model II the significant variables are fixed salary and total number of livestock unit. There is a reduced probability of them occurring in group 3 (Social Transfer Dependent type) but there is an increased chance of their occurrence in group 2 (Autonomous type and Regular Income Earners type).

Table:5.9 Model III

Variables in the Equation

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
TEMPW	-.0003	.0002	2.4646	1	.1164	-.0654	.9997
FSALARY	-.0003	.0002	3.2512	1	**.0714**	-.1074	.9997
REMMIT	-.8569	.6313	1.8425	1	.1747	.0000	.4245
SOCGRA	.0003	7.145E-05	14.1880	1	**.0002**	.3352	1.0003
TOTLU	-.0402	.0256	2.4621	1	.1166	-.0653	.9606
Constant	.5384	1.0694	.2535	1	.6146		

Key: TEMPW=temporary wage, FSALARY= fixed salary, REMMIT=remmittances SOCGRA= social grants and TOTLU= total number of livestock unit.

Model III has fixed salary and social grants as significant variables. The fixed salary variable has a lower predicted probability of occurrence for group 1 (Livestock Keepers, Irregular Income Earners type, Family Dependent and the Poorest). Group 3 (Social Transfer Dependent type) has a social grant variable with a high chance of occurrence.

The output for logistic regression shows the models with high overall percent correctness in classification. The output shows the percentage of correctness regarding the classification of the types. The higher the overall percent correctness the better the classification.

5.7 Conclusions

The study results have proven the hypothesis: that behaviour of the rural farming households is diverse and that this diversity is reflected by the way households view agriculture and practice agricultural activities. The typology results yielded seven types of farming households. These types tried to reveal as many representative strata as possible within the communities. Each type has a strong differentiating variable. The factors such as decision-making regarding farming; technical issues; time and life cycle of a household and rationality are found to be influencing behaviour of different farming households.

Statistically the types' sizes for Autonomous, Family Dependent and the Poorest are regarded as being very small. This characteristic can make the classification of types less reliable but nevertheless the Canonical Variate Analysis results in discriminant analysis have given a meaningful grouping of the seven different types. The discriminant results confirm that diversity in the target area is significantly represented by the classification of households into different types. The discriminant analysis also shows that 72% of the households were correctly classified.

The output for Logistic Regression shows the types with high overall percent correctness in classification. This analysis tries to compare the correctness of groupings. The output shows the percentage of correctness regarding the classification of the types. The higher the overall percent correctness the better the classification.

Both qualitative analyses confirm these typology results positively.

CHAPTER 6

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter gives an overview of the study, the major findings, conclusions and suggested recommendations.

6.1 Overview

The study focuses on the rural household in an agricultural environment in previously disadvantaged areas and attempts to develop a hypothesis and appropriate methodologies to guide future analysis and planning in the poor rural developing areas of South Africa. The study commences by giving a broad picture of the South African history prior to the 1994 election as it relates to this environment and positioning of farming oriented rural households. Some of the major imbalances that existed in the South African society and led to the unique characterisation of the communities are discussed. It continues to highlight various theoretical and conceptual issues of rural communities from a local and international perspective: who are the people living there; the extent of poverty and their way of life. From this description a hypothesis on rural diversity and methodology to describe and analyse such diversity is formulated. Findings, conclusions and recommendations are drawn from this analysis.

Currently agriculture in previously disadvantaged areas (also referred to as subsistence small holder agriculture) is considered to be an important sector that needs to be developed to generate rural employment, growth and wealth and combat rural poverty. Empirical analyses done with regard to rural communities show that there is stratification in rural farming. The diverse characteristics of small scale farming, has a complicated impact on this sector hence there is a need to generate clear information about this diversity for use by development support institutions. From these observations the study attempted to describe diversity in a scientific and empirical manner to assist in rural development planning.

The determinants of farmer decision making do not only include households' characteristics and land holdings but also the totality of physical, social, economic, biological and institutional settings in which farmers operate. The variability that exists amongst farmers need to be well understood in order that support services, especially extension be adapted accordingly.

Fieldwork needs to be undertaken with the farmers in order to capture variations that exist amongst them. Household members should also be involved in such a fieldwork. Such a study should focus on an integrated situation analysis of both agricultural activities and other rural activities. In short, rural investigations should be holistic, systematic and should be build on local knowledge thereby recognising the diversity prevailing in these environments (Laurent, *et al*, 1999). The above approach was adopted by the Department of Agriculture in the Northern Cape Province in its request to the Agricultural Research Council and the University of Pretoria to do a study and develop a representative typology in the Leliefontein area.

There is thus a clear need to generate much more particular information about rural households to inform policy designers or implementers. Extension officers need to have clear knowledge about their farmers and their operational environment. Each farming household can however not be treated solely due to the high cost of such an individualistic approach. A more economic approach is to group households in terms of a set of characteristics which will allow households to be grouped together as separate types within a representation typology.

This study hypothesises that the behaviour of the rural farming households is diverse; that this diversity is reflected by the way households view agriculture and practice agricultural activities; and that such differences should be accounted for in agricultural development planning efforts. The overall objective of the study is to compile an understanding about the diversity in the farming households so that it can be used in planning and development initiatives.

The study follows theoretical perspective that a farm household should be considered as a system comprising of the following interlinked and interactive sub systems: the household as a decision-making unit; farm activities; and the off-farm activities. Household economics theory entertains the theory that farm households do not strive to attain one goal but rather multiple goals. They are producers of goods that directly enter the utility function, for example, leisure. These goods use market inputs as well as home produced inputs and the time of the household member.

Low (1986a) developed a household model from new household economic theory. The model approves the fact that household members make decisions regarding labour according to a model where they maximize utility for their time. However there are economists who differ with him.

Chayanov believes that household members have other objectives than utility maximization (Thorner, 1986). There are factors that affect behaviour of the farming household. The main factors that need to be considered when analysing such behaviour are decision making in the household, rationality, technical change and time and life cycle of a household.

The factors that cause diversity amongst the rural households are clearly not only of economic nature but also non-economic nature.

The study area is located in Leliefontein sub district in the Northern Cape Province. Historically it is a reserve area for the coloured community and is presently controlled by the Transitional Local Council which reports to the Provincial Government. The study area is populated by rural communities who are engaged in both crop (small grains) and livestock farming. Farming is done on communal lands. In 1984 communal farming was disturbed by the division of communal lands into so-called economic units for individual farmers to hire. The system was however stopped due to community objections. The members of the reserve have 'reserve' membership that gives them a right to cultivate

land and keep animals. The study area is served by the extension service of the Regional Department of Agriculture of the Northern Cape Province in the town, Springbok.

The sequences of processes required to study diversity are outlined as follows: firstly, the formulation of questions by stakeholders; secondly, data collection by the researchers in collaboration with agricultural extension officers and thirdly; data processing done in two ways, viz. qualitatively, using the typology development technique then statistical analyses by discriminant analysis and logistic regression. The statistical analysis is employed to assess and confirm the descriptive typology results.

6.2 Major findings

6.2.1 The existence of diversity

The study identifies and describes the diversity in social, economic and production systems of the rural farming communities of Leliefontein. This information gives a profile of household characteristics that expose different types within the community. The differences cannot be ignored as they detect specific constraints and opportunities faced by each type.

An important finding supports the observation that an agricultural production activity can serve different functions in a rural farming household. The information is important in both planning and extension activities aimed at assisting rural communities with agricultural development.

6.2.2 A typology of diversity

A representative typology consisting of 7 types of farming households in Leliefontein area is identified. The types are Autonomous type; Livestock Holders; Family Dependents; Irregular Income Earners; Regular Income Earners; Social Transfer Dependents and the Poorest. All these types function differently i.e. the way they

combine their resources during farm production differs. The typology formed is based on the agricultural functioning of the rural households and provides a useful context for local farming activities, especially for those concerned with improving agriculture.

6.2.3 Decision making

According to the study it is found that the decision making regarding farming is done mainly by the household head and spouse or generally by the owner of the livestock. It is interesting to note that the shepherds are the ones who least decide on major issues regarding livestock farming. For example, they can decide on where to take the animal for grazing (choice of pastures) but not on which medicines to buy or when to sell, etc.

6.2.4 Development trajectories

The findings provide a base for possible development paths or trajectories for particular types within the typology. Development is dynamic hence the typology results are expected to change over time. The movement of a type from one type to another is influenced by different stimuli, such as the provision of inputs like credit; support service; appropriate extension; land availability; change in a life cycle of a household; etc. The possible paths that the households may follow given some stimuli are displayed.

Classification of different farming households shows that factors such as decision making regarding farming; technical issues; time and life cycle of a household and rationality are considered to influence the behaviour of such households. All these factors differ per type for example, decision making regarding farming in one type is not the same as for the other types, for example, Autonomous type has decision making done by both the head and the spouse whereas in Livestock Holders type is mainly by the heads only. The way different types conduct their livestock farming is also different, for example Irregular Income Earner type shared livestock keeping with and the Livestock Holder type uses individual livestock keeping technique.

Average ages of the heads of the households give the stages of such household i.e. if they are all pensioners for example it gives a clue that such farming households are due to leave farming therefore transfer their livestock to the next generation.

6.2.5 Development strategies

The hypothesis of diversity in agriculturally orientated rural households is proved to be correct and the farming households in Leliefontein area can be classified into types. This has some implication for policy and strategies. The following are suggested development strategies that can be considered by development initiators:

- The development strategies should recognise diversity in rural communities. Such differentiated strategies should furthermore encompass participation, mobilization and capacity development of the involved communities and intended beneficiaries. This will enhance the development of appropriate strategies for different farming household types and consequently the sustainability and value added to the development process.

- It should be noted that as farming does not occur in isolation, its development has to occur in an integrated development context directed by sound policies and support mechanisms. For effective farming to take place there has to be infrastructural development and essential services, for example, health service.

- The institutional support system is very important and it includes credit support systems, extension service, input supply and human capital development. The support service should not be rendered through a single dimensional approach; i.e. an introduction of extension service needs other support like credit availability and human capital development for the success of the process.

- The extension efforts will be effective once there is adequate knowledge about diversity i.e. the typology of farmers who are to be served and their environments. Good planning and favourable government policies make extension service more

efficient. Access to several elements has to be promoted as a coherent part of the support programme.

6.2.6 Particular considerations for extension officers

From the above findings it becomes possible for the agricultural extension officers to acquire the following information:

- Extension officers would like to know who to target whenever giving service especially when the decision makers regarding farming activities are be identified.

- With the knowledge of diversity in a community, and member responsibilities, extension officers, in particular, can understand how practical training can be formulated for improving different activities of people.

- Knowledge of the agricultural resource base of different households is important, for example, composition of the livestock held and types of crops grown. Such information suggests that technical advice is different for different types within a particular typology.

6.3 Conclusions

The way agricultural households respond to the outward stimuli, such as, the availability of land, labour and capital is different. The way they combine resources to maximize utility differs. Such utility is not necessarily of economic nature, it can be non-economic too. The results of the study give clear evidence that such diversity exists. The hypothesis researched in this study argues that the diversity reflected in rural society calls for a holistic but focused rural planning and development strategy with types within a typology as the major focus for extension service.

The sources of income for the communities in the Leliefontein areas show a tendency towards dependency on social grants from the government. The largest group of households, which is dependent on social grants, is mainly women-headed. There are even worst situations where no income sources exist. The level of human resource capital is low, this is shown by the descriptive statistics showing low percentage of household heads with standard six up to post matric. There are few or no institutional structures that can be activated in order to improve the positions of different types of households in the communities. Credit schemes, organized research and extension schemes as well as clear land-ownership rights are of vital importance but are either missing or weakly developed.

Investing in a development, research and extension system, the education of the rural population and access by farmers to inputs such as fertilizers and livestock medicines at reasonable prices will make a difference in the output and performance of most households. Access strategies however should be structured to meet the diversity in an area.

Another interesting aspect is the fact that the distribution of resources in these communities has an extra-household and an intra-household component. It is common for communities to have links with both family members in the far-away places and also within the communities.

6.4 Recommendations

The major recommendation from this study is that the diversity in the rural situation should be analyzed and discussed in terms of planning parameter and guidelines. The use of typology analysis was found useful to assist in this more holistic but focussed approach of development planning. This section focuses on how to integrate the knowledge of diversity into planning and extension activities in the Leliefontein area.

6.4.1 Selection of target groups

The study has identified seven representative types of rural farming households. Extension officers and development planners can thus decide on particular plans of action, that is, prioritizing planning and extension action. Economical allocation of support service requires the identification of specific target groups or areas so that scarce resources are put to best use. Regarding planning and it is of vital importance that the extension officers meet with the farmers as well as the shepherds. If this cannot be attained then a meeting with firstly the farmers and then the shepherds should be organized to ensure that vital information is diffused to both levels.

The following strategic choices are proposed for extension officers to consider when deciding on a plan of action:

Strategy 1: Progressive types with large number of livestock should be considered for technological innovation programmes. The progressive types in this case are the Autonomous and the Regular Income Earners. They are the potential adopters of new technologies and systems and they are the people who are capable of adopting an innovation earlier than the other. They have access to resources, including reasonable capital and they are likely to take risks.

Strategy 2: Types experiencing an intense lack of resources, for example, the Poorest and some Family Dependents need to be given special attention since they are the most vulnerable types. The kind of intervention should be that of assisting these households to become food secure. That can be achieved by promoting projects such as vegetable gardens. However, these types are generally not a priority for extension service in the sense that they are slow adapters of technological innovation as they are risk averse types and normally the laggards. It will be difficult for them to adopt and carry out the recommendations.

6.4.2 Recommendations for agricultural development support

In order to be in a position to successfully focus on target groups the following recommendations regarding planning and development support in Leliefontein area need to be considered:

(i) Agricultural extension

Agricultural extension in Leliefontein needs to be reviewed urgently in terms of effectiveness and relevance of its messages:

- Reorientation training of agricultural extension staff to recognise and describe household diversity in an area and to plan accordingly can be done in organised sessions in which particular needs will be addressed by well-informed people.
- Extension officers must listen to and learn from the farmers. By listening and learning the extension officers will find out why farmers adopt some technologies and not others.
- Training of the extension officers should be done regularly in order to keep up with the changing recommendations and developments in research and technology.

(ii) Human resource development

Since human resource development is a dynamic process it can be adapted according to the needs of the community. According to the study there is a need to focus on farm production rather than formal education. The descriptive statistics shows that most of the household heads have no education or a very low level of education and are headed by more men and fewer women.

It is recommended that the extension office in charge organises a basic agricultural production training programme for the farming households. The syllabus should be sufficiently flexible so that it can be adapted to the local conditions. It should cover the basic crop and livestock production, methods of conservation and land use. Although

more men than women head most of the households, the policy of education and training should especially consider women.

(iii) Credit support schemes

Lack of savings mobilisation is evident in the study area. Few households save money. Formal financial institutes are situated far away from the rural communities.
Communities should be encouraged to get involved in savings mobilisation, form saving clubs and associations. According to De Klerk (1999) the Land Bank intends to set its satellites offices closer to the rural communities. One of the Land Bank services will be to introduce a "Step Up Loan Ladder" when lending money. This is incremental micro-loans in which timeous repayment allows the client to borrow progressively more after each loan. These loans fall within a range of R250 to R18 000. Other formal banks should be encouraged to follow suit.

(iv) Technology development pathway

The technology development pathway needs to be decided by the extension officers together with the farmers. The traditional approach to research and extension failed to increase agricultural production for the resource poor farmers because it used to come up with inappropriate and inaccessible technology.

Researchers and extension officers should take cognisance of tacit knowledge of the farmers. This will ensure that the developed technology will be adopted easily and the feedback from the farmers for further research will be possible.

Farmers should be made to actively participate in the extension process while the extension officers' role becomes that of an adviser rather than a teacher, in that farmers are moving along the development path, starting with their traditional technology. They do not make a radical change in their farming system since that requires improving their technology skills.

(v) Feed back to strategic management levels in the Department of Agriculture, Northern Cape Province

It is important that the findings of the research work be communicated to the various structures in the Department of Agriculture so that such information can contribute to the information bank on previously disadvantaged farmers. There is a lack of basic information on subsistence farming, for example, the status and profile of disadvantaged farmers as well as issues of diversity within farming households. It would especially be important to make persons at the strategic policy level aware of the study results and recommendations.

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ANNEX 1

TYPOLOGY QUESTIONARE/ TYPOLOGIE VRAELYS

1. How did you get involved in farming?
   Hoe het u met boerdery betrokke geraak?

2. Compared to five years ago has your agricultural production improved =(1), remained the same = (2) or deteriorated =(3)?
   In vergelyking met die vyf jare gelede, het u boerdery:

   Uitgebrei =(1)

   Dieselfde gebly =(2)

   Of kleiner geword =(3)

3. Do you think that agricultural situation is better somewhere else? Would you like to move and/or farm there?
   Dink u dat boerdery beter is by ander plekke? Indien so, sou u daarheen wou verhuis om daar te boer?

4. Have you moved from another place?
   Het u van 'n ander plek tot hier verhuis?

5. How do you see farming for different people? Is it of any value to you? (income wise)
   Size:
   Ownership:
   Consumption or sales

Hoe sien u boerdery vir verskillende mense? Het dit enige waarde vir u? (in terme van inkomste) en ten opsigte van:

Grootte van die grond

Eienaarskap

Vergebruik

Of inkomste uit produkte verkoop

6. How do young people see agriculture?
   What will encourage them into it?
   How can they become involved?

   Wat is die jong mense se siening van boerdery?

   Wat sal hulle aanmoedig om toe te tree?

   Hoe dink u kan hulle betrokke raak?

7. What are your reasons for farming?. (Is it for an example, food security?)
   Wat het u laat besluit om te boer? (bv. Voedselsekuriteit)

8. What are the benefits, problems and possible solutions in farming?
   Wat is die voordele, probleme en moontlik oplossings in boerdery?

voordele	*Probleme*	*Moontlik oplossings*

9. Will you survive without farming?
Kan u 'n bestaan maak sonder boerdery?

10. State your three (3) major agricultural needs
Noem die drie hoof boerdery behoeftes

11. State the three (3) major community needs.
Noem die drie hoof gemeeenskap behoeftes.

12. State your three (3) major household needs.
Noem die drie hoof huihouding behoeftes

13. Compared to five years ago has the quality of your household: improved (=1), remained the same (=2) or deteriorated (=3)?
In vergelyking met vyf jare gelede, het die toestand (kwaliteit) van jou huisehouding:
Verbeter =(1)

Selde gebly =(2)

Versleg =(3)

ANNEX 2

LELIEFONTEIN SOCIO-ECONOMIC SURVEY

Interviewer's names	1 ..... 2 .....
Date	
Village	
Actual location of residence	
Interviewee reference number	
Questionnaire field number	
Questionnaire office number	

A DEMOGRAPHIC INFORMATION

A.1 HOUSEHOLD CHARACTERISTICS

	Relation to head of household	Age	Gender (m/f)	Marital status	Highest educational qualific.	Employment status	Occupation	Field of employment	Time at home
A1.1									
A1.2									
A1.3									
A1.4									
A1.5									
A1.6									
A1.7									
A1.8									
A1.9									
A1.10									
A1.11									
A1.12									

1 = head (husband/wife)
2 = spouse of head

3 = children younger than 16 years
4 = children older than 16 years
5 = other

1 = no educational training
2 = standard 5 or less
3 = standard 6 to standard 9
4 = matric
5 = post-matric

A2. Are you born into this community or are you here because of marriage or immigration?

LAND AND AGRICULTURE

RESIDENTIAL SITE

B1 Do you own this residential site?

1	yes	2	no

B2 If yes,

B2.1 What form of ownership does your household have over the residential site?

Certificate of occupation	
Private ownership (title deeds)	
Other Specify	

B2.2 Is the household in possession of a written document proving ownership of the residential site?

1	yes	2	no

B2 If no,

How did your household access the homestead where you stay?

.....

.....

B4 What is the size of the residential site? (square meters)

B5 Do you have a garden on your residential site?

1	yes	2	no

B6 What is its size? (square meters)

B7 Do you grow crops or vegetables in your garden? Which types? When are they available?

B7.1 Who takes care of these crops or vegetables?

Head (husband/wife)	1
Spouse	2
Children younger than 16 years	3
Children older than 16 years	4
Other	5

B8 How many fruit trees do you have on your residential site? Which types? When are the fruit available.

B9 What is the main constraint in crop farming?

B10 Do you work on any communal gardening scheme?

B11 Which of the following micro-livestock do you keep and indicate numbers owned?

	Type	Who is the owner?	Number owned	People taking care of them*	How much produced each year
B11.1	Broiler				
B11.2	Layers				
B11.3	Dual-purpose chickens				
B11.4	Pigeons				
B11.5	Geese				
B11.6	Ducks				
B11.7	Turkeys				
B11.8	Rabbits				
B11.9	Pigs				
B11.10	Other (specify)				

*Refers to the following table

Head (husband/wife)	1
Spouse	2
Children younger than 16 years	3
Children older than 16 years	4
Other	5

ARABLE LAND

B12 Who get access to the land, is it the head or the whole family?

B13 Do you have access to one or more arable fields?

1	Yes	2	no

B14 If yes,

How many fields do you have access to? (indicate numbers)

B15 What is the size of each of the fields?

		Area (indicate units)
B13.1	Field 1	
B13.2	Field 2	
B13.3	Field 3	

B16 How is access to land granted, is it through the village committee or the district council?

B17 Who decides on the crops to be grown?

Head (husband/wife)	1
Spouse	2
Children younger than 16 years	3
Children older than 16 years	4
Other	5

B18 Did you grow any crops on your arable lands during any of the past three seasons?

1	yes	2	no

B18.1 If yes, which ones?

Type	Yields

B18.2 If no, why not

.....

.....

B18.3 Who had access to or used the stubble for grazing after crops were harvested?

B18.4 How did you plough? (Donkeys, own or hired tractor)

B18.5 How were the fields harvested? (By hand, animal or tractor driven harvester)

B19 Who works in the fields?

Head (husband/wife)	1
Spouse	2
Children younger than 16 years	3
Children older than 16 years	4
Other	5

RANGE LAND

B20 Who should have access to range land?

Head (husband/wife)	1
Spouse	2
Children younger than 16 years	3
Children older than 16 years	4
Other	5

B21 Do you have access to range land?

1	yes	2	no

B22 How did you obtain access to range land? Is it through the village committee, Transitional Local Council or district council?

B23 Who decides on the use of range land?

Head (husband/wife)	1
Spouse	2
Children younger than 16 years	3
Children older than 16 years	4
Other	5

B24 What do you use access to range land for? (tick where applicable)

	Uses	Yes = 1 No = 2	Who does that task*
B24.1	Collect plant materials for animal feeding		
B24.2	Collect fire wood		
B24.3	Collect wood for building		
B24.4	Collect wood for fencing		
B24.5	Collect bush for kraal and other enclosures		
B24.6	Collect plants and animals for food		
B24.7	Collect plants for medicinal purpose		
B24.8	Collect plants and animals for sales to the outsiders		

B24.9	Collect reeds (matjiesgoed) to make Matjies		
B24.10	Other (specify)		

*Refers to the following table

Head (husband/wife)	1
Spouse	2
Children younger than 16 years	3
Children older than 16 years	4
Other	5

B25 Which of the following livestock do you keep? (indicate the numbers owned)

	Type	Number owned by an interviewee	Livestock owned by the other* family member among livestock kept		Total number of livestock owned
				How many	
Cattle	Cows				
	Bulls				
	Other				
Sheep	Ewes				
	Ram				
	Other				
Goats					
Horses					
Donkeys					
Other (specify)					

B26 Other people owning livestock that is kept together with the household's livestock*

	Relation to head of household	Age	Gender (m/f)	Marital status	Highest educ. Qualific.	Employ-ment status	Occu-pation	Field of employ-ment	Household link
B26.1									
B26.2									
B26.3									
B26.4									

*Here we intend to understand which households are linked to the household of the interviewee, for an example, livestock of a married daughter who lives in the other household.

B27 Who decides on when to slaughter or sell the animal?

Head (husband/wife)	1
Spouse	2
Children younger than 16 years	3
Children older than 16 years	4
Other	5

B28 Who is taking care of the livestock?

SOMER /SUMMER			
Participants (are they relatives)	Payment (in cash or kind – clothes, food, accommodation	Task	Time (Regular full time, regular part time, casual, give help from time to time

WINTER			
Participants (are they relatives)	Payment (in cash or in kind)	Task	Time (regular full time, regular part time, casual, give help from time to time)

B29 If the person who takes care of the livestock is absent who replaces him?

B30 Did you sell any of your livestock during the year?

Type	Age of livestock	To whom	For which use 1 = meat 2 = reproduction 3 = exchange

B31 Which transport do you use when taking products to the market?

Donkey cart	1
Bakkie	2
Car	3
Bicycle	4
On foot	5
Hired transport (specify)	6

B32 Do you have storage facility? (for an example, for seeds or feeds)

B33 Do you have livestock kraal? Is it privately or communally owned?

B34 What is the main constraint in livestock farming?

C INCOME

C1 What are the sources of income available to your household?

C1.1 State the amount you receive from every source per month or year.

External sources

	Source			Amount	M	Y
C1.1	Remmitances		cash			
			kind			
C1.2	Welfare	Pension				
		Allowances for children				
		Allowances for health				
C1.3	Migrant workers					
C1.4	Transferences					

C1.5	Off farm salaries and wages			
C1.6	Other			

C2 People sending money to the household. Please fill the following table.

	Relation to the head of household	Age	Gender (m/f)	Marital status	Highest Educ. Qual.	Employ-ment status	Occupa-tion	Field of employ-ment	Household link
C2.1									
C2.2									
C2.3									
C2.4									

C3 LOCAL SOURCES OF INCOME: AGRICULTURE

	Sources	Amount	M	Y	Type
	Agriculture: Crop sales				
	Agriculture: Crops (in kind)				
	Agriculture: Animal sales				
	Agriculture: Animals (in kind)				
	Agric: Selling the skin of the slaughtered animal				
	Agric.: Exchange of agricultural products				
	Other				
	On farm payment: (commercial or not) Working on the fields				
	Taking care of livestock				

C4 Will you accept other employment within agriculture or outside?

D EXPENDITURE

D1 Who decides on the money to be used for agricultural purposes? Complete the following table:

	Agricultural activity	Who decides on the money to be used	How much? Amount/month
D1.1	Buying medicines		
D1.2	Buying feeds		
D1.3	Buying seeds		
D1.4	Buying pesticides		
D1.5	Buying fertilizers		
D1.6	Erecting fence		
D1.7	Buying of animals		
D1.8	Hiring tractor for ploughing		
D1.9	Transport cost		
D1.10	Hiring of shepherd		
D1.11	Hiring of field workers		

D2 In which times of the year is money in short supply?

D3 Do you save money? How much per month?

D4 Do you have any other financial support?

1	yes	2	no

If yes, what are the arrangements?

D5 Do you have any credit outstanding

1	yes	2	no

E DIEET INLIGTING /DIETARY INFORMATION

E1 Does your household always have enough food to eat?

1	yes	2	no

E2 If no,

E2.1 Give reasons

.....
.....
.....

E3 Are there particular times of the year during which food is in short supply?

1	yes	2	no

E4 If yes, indicate period or season

.....

E5 Are there particular times of the year during which food is abundant?

1	yes	2	no

E6 If yes, indicate period or season. (for example, is it before or after pay day)

.....

E7 Please indicate how many meals does your household usually have a day.

E8 What are the main meal components? (Is it bread, fruit, vegetables or meat)

E9 Indicate where these vegetables are most often obtained and who is responsible for each activity?

		WHO	WHERE
E9.1	Collected in fields or range lands		
E9.2	Grown in own vegetable garden		
E9.3	Bought from a vegetable producing neighbour /friend		
E9.4	Bought from hawkers		
E9.5	Bought from local shop		
E9.6	Bought outside community		
E9.7	Other (specify		

E10 Where is the meat obtained from?

E10.1	At feast	
E10.2	Slaughtering of own animals	
E10.3	Consumption of animals that have died of natural causes	
E10.4	Buying from animal producing neighbours/friend	
E10.5	Buying from local shop	
E10.6	Buying from hawkers	
E10.7	Buying from outside community (eg. town or butcher)	
E10.8	Other, specify	

E11 What is the cost of the food that is bought outside the farm?

	Kind of food	Amount per month	
E11.1	Vegetables		
E11.2	Meat		
E11.3	Cereals		
E11.4			
E11.5			
E11.6			

F GENERAL

F1 Who takes care of the children during the day? (If it is not the member of the household, fill in the table below).

F2 Other people taking care of the children in the household

	Relation to the head of household	Age	Gender (m/f)	Marital status	Highest Educ. Qual.	Employ-ment status	Occupa-tion	Field of employ-ment	House-hold link
F2.1									
F2.2									
F2.3									
F2.4									

F3 Who decides on who must attend the farmers' day meetings?

F4 Is there any structure that support agriculture in the village? (For an example, extension officers, agricultural sub-committee or researchers helping with decision making)

F4.1 Are your agricultural needs adequately met by these people?

ANNEX 3

Description of Variables

Income

The income is divided into various groups:

- Social grants are the money from the government and that includes, pension; health allowance and children allowance.

- Family support includes all the money that is received from the relatives but does not include salary from the head of the family who is a migrant worker. This include everything that is received in kind

- Income from agricultural sales of crops; animal; skins and other agricultural products.

- Regular income

  According to this study regular income is taken as a continuous income that comes in every month of the year, it can be low or high[1]. That is income from full time employment and/or self employment. It includes salaries from non-farm and agricultural jobs; salaries of head of family who is a migrant worker and income from trade for an example, shop.

- Irregular income

  This is an income that does not come in every month. It includes money gained from part time employment; few days jobs; and other self employed jobs that are done from time to time as opportunity arises and not throughout a year.

[1] The data collected does not specify whether employment is secured or not. The extent of contracts is not known.

ANNEX 4

Discriminant Analysis Results

The following is an output of the Discriminant analysis :

Identifier	Minimum	Mean	Maximum	Values	Missing	
number	101.0	325.2	606.0	108	0	
proplsu	0.00	15.47	105.00	108	0	Skew
proplrw	0.0000	0.1466	1.0000	108	0	Skew
propsal	0.0000	0.2152	1.0000	108	0	Skew
propsoc	0.0000	0.4550	1.0000	108	0	
proprem	0.0000	0.1155	1.0000	108	0	Skew

Identifier	Values	Missing	Levels
type	108	0	7

```
===============   Linear  Discriminant Analysis on Colonies

*****  Canonical variate analysis  *****

***  Latent Roots  ***

             1          2          3          4          5
        2.4210     1.3807     0.4809     0.2447     0.0228

***  Percentage variation  ***

             1          2          3          4          5
         53.21      30.34      10.57       5.38       0.50

***  Trace  ***

       4.550

 *****  Discriminant analysis  *****

                ***  Latent Vectors, Roots, and Trace from CVA  ***

               CVA_Lrv['Vectors']
```

	1	2	3	4	5
PCAN					
proplsu	0.015	0.004	-0.064	0.022	-0.003
proplrw	-0.521	0.231	0.374	0.638	-6.935
propsal	1.592	-4.886	1.690	1.063	-5.080
propsoc	-3.557	-4.146	0.660	1.040	-5.191
proprem	-1.373	-1.782	2.437	5.949	-4.450

CVA_Lrv['Roots']

1	2.4210
2	1.3807
3	0.4809
4	0.2447
5	0.0228

CVA_Lrv['Trace'] 4.550

*** Adjustments applied to columns of scores ***

CVA_Adjs

	1	2	3	4	5
1	1.277	3.050	-0.013	-1.822	5.032

*** Discriminant scores for the group means ***

M_Scores

Pg['labels']	1	2	3	4	5
A	1.8490	-1.0880	-2.1979	0.3617	-0.0555
Fd	-0.2641	0.7160	0.5289	1.8386	0.3133
Iw	0.5849	2.4419	-0.5252	-0.4160	0.1508
Lk	-0.4176	0.2449	0.1835	0.4740	-0.3112
P	1.0636	2.1678	0.5031	-0.1042	-0.2051
S	2.1520	-0.9686	0.6082	-0.1857	0.0459
St	-1.5417	-0.4461	-0.0133	-0.1823	0.0301

*** Discriminant scores for the units ***

	U_Scores				
	1	2	3	4	5
1	1.0950	3.1945	-0.1999	-1.3561	1.3804
2	-1.2687	0.3618	0.5521	-0.9161	-0.7397
3	0.0695	1.6212	0.4687	-0.8146	2.9808
4	-1.6243	-0.5112	0.4193	0.5712	-0.0176
5	-1.2494	-0.1553	0.4198	1.3659	0.0773
6	1.8156	0.5495	0.5565	0.1331	-0.6506
7	2.0143	0.7054	0.5874	-1.0200	0.7493
8	2.8716	-0.8621	-0.0946	-0.3009	-0.4390
9	2.1987	-0.9233	-1.6858	0.2161	-0.4177
10	-1.4944	-0.6608	-1.2413	0.5848	-0.1614
11	0.1790	1.8288	1.6820	2.7383	-0.1044
12	1.8342	0.3891	1.1645	-0.5146	-0.7241
13	-0.6886	-1.3242	0.9655	-0.7752	-0.1249
14	-1.5095	-0.4820	-0.0659	0.7380	-0.0402
15	-2.0049	-1.0258	-0.5145	-0.3827	-0.2132
16	-2.0472	-1.0366	-0.3358	-0.4442	-0.2049
17	-0.2437	1.5634	-0.5058	-0.6827	-1.2405
18	3.0357	-1.7929	0.9744	-0.5177	-0.0809
19	-2.1529	-1.0634	0.1111	-0.5979	-0.1841
20	3.0145	-1.7982	1.0638	-0.5485	-0.0767
21	1.3553	-0.9533	1.3292	0.5083	0.0653
22	-2.1741	-1.0688	0.2005	-0.6286	-0.1799
23	-1.9401	-0.6813	0.3532	-0.7267	-0.3303
24	-2.2798	-1.0957	0.6474	-0.7823	-0.1592
25	-1.8243	-0.8153	-0.2763	0.0376	-0.1422
26	-1.8119	-0.5347	0.5239	-0.4145	-0.2748
27	0.9690	2.7086	-0.3773	0.5236	1.0054
28	1.9679	-0.1983	-0.0410	-0.7145	1.4216
29	-1.1209	0.4008	0.9783	0.2183	-0.3816
30	-1.4392	0.0085	0.1937	-0.7498	-0.6076
31	3.0252	-1.4093	0.4041	-0.4416	0.2692
32	0.8893	3.3151	-0.2006	-0.9907	-1.9288
33	0.4844	0.4725	0.8579	1.3084	-0.1756

34	-2.2297	-1.0540	0.6120	-0.6818	-0.1503
35	-1.8033	-0.6725	0.4717	0.1999	-0.0573
36	-0.9151	-0.2313	-1.9729	1.6975	-0.0926
37	1.0222	3.3489	-0.7624	-0.7974	-1.9549
38	-1.0053	0.3496	0.8952	0.0765	1.1579
39	-1.5897	-0.2914	0.5193	-0.9841	0.8479
40	-1.0991	-0.5426	-3.2220	0.4496	0.0681
41	-1.8726	-0.8276	-0.0720	-0.0326	-0.1327
42	-1.6324	-0.3461	0.6630	0.0083	-0.2071
43	0.6176	2.7180	0.4952	0.5399	-1.1941
44	-1.9089	-0.8368	0.0813	-0.0853	-0.1255
45	0.9467	3.3297	-0.4432	-0.9072	-1.9401
46	2.5030	-1.1568	0.8684	0.5472	0.0334
47	0.7624	3.2828	0.3357	-1.1751	-1.9039
48	-1.9445	-1.0104	-0.7699	-0.2949	-0.2251
49	0.4662	2.3095	0.8180	1.6689	-0.6869
50	-2.1216	-0.9448	0.6579	-0.4369	-0.1224
51	-1.8231	-0.7914	-0.1383	0.0619	-0.1272
52	-1.6734	-0.6394	-0.0774	0.3887	-0.0829
53	3.4495	-1.6876	-0.7750	0.0839	-0.1622
54	3.2381	-1.7414	0.1189	-0.2235	-0.1207
55	0.8077	3.2943	0.1442	-1.1092	-1.9128
56	2.8695	-1.8351	1.6767	-0.7593	-0.0482
57	-0.0959	1.2685	2.4239	4.1265	0.5823
58	-0.8902	-0.7423	-5.2263	1.2377	-0.4324
59	-1.0472	0.3370	0.4666	-1.0207	1.5858
60	-0.4505	0.8442	-0.6689	1.0420	-0.5181
61	-1.3028	-0.6733	-2.7015	0.3201	-0.0414
62	0.3086	1.6598	-0.9929	-1.0381	3.1431
63	0.0249	1.2992	1.9131	4.3022	0.5585
64	1.0775	3.1314	-0.5079	-0.7460	0.4414
65	3.0780	-1.7821	0.7956	-0.4563	-0.0892
66	2.9475	-1.7333	0.4352	-0.3474	-0.1085
67	1.4829	-1.3158	0.0785	0.0513	-0.0979
68	2.9390	-1.8174	1.3830	-0.6583	-0.0618
69	4.0718	-1.5293	-3.4054	0.9885	-0.2846
70	-0.9997	0.5999	0.1941	-0.5856	-0.7768
71	0.7215	-1.3688	0.7674	-0.3929	-0.0924
72	-0.9963	0.5604	0.8448	0.1830	-0.4660
73	-2.0985	-1.0496	-0.1187	-0.5189	-0.1948

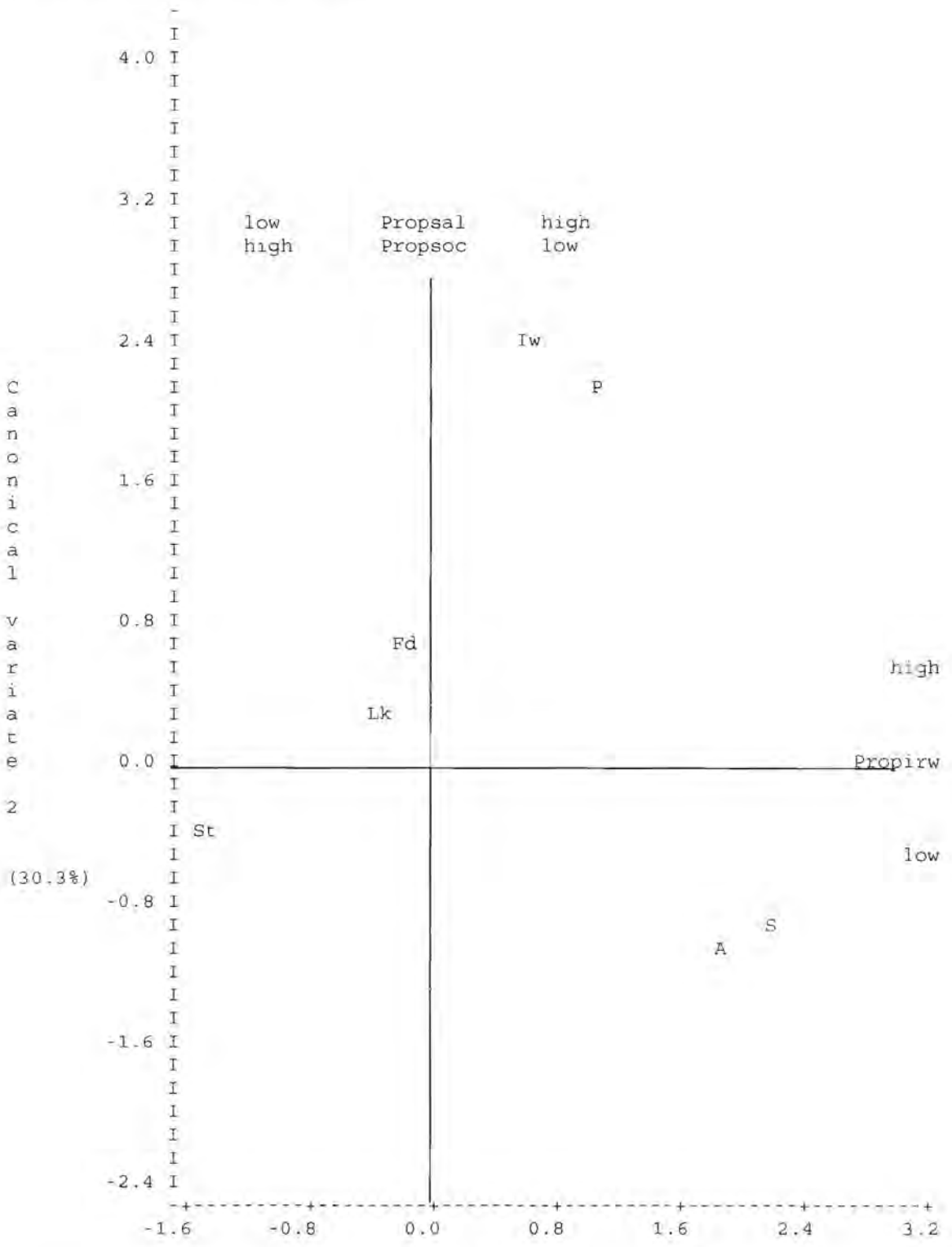
74	-1.5371	-0.3048	-0.3963	-0.5069	-0.4967
75	3.0508	-1.7890	0.9105	-0.4958	-0.0838
76	-2.2284	-1.0827	0.4304	-0.7077	-0.1693
77	-2.1287	-1.0573	0.0090	-0.5628	-0.1889
78	-1.2733	-1.0160	0.7512	-0.3349	-0.0939
79	-2.1750	-0.9822	0.7327	-0.5467	-0.1236
80	0.8259	3.2990	0.0676	-1.0829	-1.9163
81	0.7828	3.0267	0.2846	-0.5220	-0.7760
82	-0.7236	0.6356	-0.0077	-1.0791	1.9618
83	-1.6965	-0.5260	0.0508	-0.7419	0.4919
84	-0.8450	0.6261	0.3974	-1.1732	1.5705
85	0.2921	-1.0562	0.3180	0.1405	-0.0705
86	-1.3563	-0.5010	-1.6604	-0.1293	0.3131
87	-2.0925	-1.0481	-0.1442	-0.5101	-0.1960
88	0.5934	0.0954	0.0140	0.7542	-0.3146
89	-1.5174	-0.1708	0.4799	-0.1963	-0.3582
90	1.0486	3.2993	-0.5906	-0.9755	-0.8694
91	0.4327	1.5643	-1.5257	0.3531	2.4941
92	2.7592	-1.3995	0.8347	0.0267	0.0450
93	1.4314	3.0896	-0.6642	-1.5984	5.0017
94	1.2664	-1.1269	1.4556	0.1298	0.0315
95	-1.7651	-0.7062	0.0459	0.2138	-0.0929
96	1.1826	-1.1497	-1.4432	0.5125	-0.1783
97	-1.5608	-0.4950	0.1512	0.6634	-0.0301
98	4.4555	-1.4318	-5.0270	1.5462	-0.3601
99	-1.0689	-0.0425	0.0641	1.6924	0.0851
100	0.2303	1.3515	1.0448	4.6008	0.5181
101	0.0245	1.2186	-0.1593	1.4660	1.6290
102	2.9091	-1.8019	1.4385	-0.6465	-0.0557
103	-0.5505	0.7864	-1.2767	-0.4171	-0.1412
104	-1.9233	-1.0051	-0.8593	-0.2642	-0.2293
105	-0.9011	0.3139	-0.9369	-0.4895	0.4270
106	-0.8838	0.4819	-0.2560	-0.0093	-0.2012
107	2.1014	-1.6371	0.5469	-0.4431	-0.1129
108	-0.9395	0.1025	0.1998	1.9880	0.1323

*** Original grouping, and new allocation of units ***

type	Iw	St	S	St	St
Allocate	Iw	St	Iw	St	Lk
type	S	S	S	A	St
Allocate	S	S	S	A	St
type	Fd	S	St	St	Lk
Allocate	Fd	S	St	St	St
type	St	Iw	S	St	P
Allocate	St	Iw	S	St	S
type	S	St	St	St	St
Allocate	S	St	St	St	St
type	St	Iw	A	St	Lk
Allocate	St	Iw	S	Lk	St
type	S	P	Fd	St	St
Allocate	S	P	Fd	St	St
type	St	Iw	St	St	St
Allocate	Lk	Iw	St	St	A
type	Lk	St	P	St	Lk
Allocate	St	St	P	St	Iw
type	S	P	St	Iw	St
Allocate	S	P	St	P	St
type	St	St	S	A	Iw
Allocate	St	St	S	S	P
type	S	P	A	St	Lk
Allocate	S	Fd	A	St	Lk
type	St	Iw	Lk	Iw	S
Allocate	St	Iw	Fd	Iw	S

type	S	S	S	A	St
Allocate	S	S	S	A	Lk
type	Lk	St	A	St	S
Allocate	S	Lk	St	St	S
type	St	Lk	St	St	P
Allocate	St	St	St	St	P
type	Lk	St	St	St	S
Allocate	P	St	St	St	Lk
type	St	St	S	St	Iw
Allocate	St	St	Lk	St	Iw
type	Iw	S	P	S	St
Allocate	Iw	S	Iw	S	St
type	S	St	A	Fd	Lk
Allocate	A	St	A	Fd	Fd
type	Fd	S	Iw	Lk	St
Allocate	Fd	S	Lk	St	St
type	St	Lk	Fd		
Allocate	Lk	S	Fd		

Plot of mean scores of Types



Obtain the correlation matrix between the variables and some scores for easier interpretation

*** Correlation matrix ***

proplsu	1.000					
proplrw	-0.176	1.000				
propsal	0.207	-0.242	1.000			
propsoc	0.005	-0.426	-0.565	1.000		
proprem	-0.090	-0.080	-0.222	-0.209	1.000	
USCORE[1]	0.239	0.160	0.846	-0.892	-0.070	1.000
USCORE[2]	-0.192	**0.803**	-0.520	-0.383	0.243	0.000
1.000						
USCORE[3]	-0.901	0.003	0.085	-0.204	0.334	0.000
0.000						

	proplsu	proplrw	propsal	propsoc
proprem	USCORE[1]	USCORE[2]		

USCORE[3]	1.000

	USCORE[3]

---------- Tabulate data to find low and high values

type	proplsu	proplrw	propsal	propsoc	proprem
A	53.80	0.0159	0.6049	0.3361	0.0000
Fd	15.12	0.0898	0.0470	0.3178	0.4860
Iw	16.24	0.5239	0.0000	0.1506	0.0939
Lk	13.98	0.1898	0.1125	0.4772	0.2105
P	5.86	0.5294	0.1429	0.0000	0.1849
S	13.58	0.0612	0.7254	0.1000	0.0713
St	12.09	0.0496	0.0105	0.8095	0.0823
Mean	15.47	0.1466	0.2152	0.4550	0.1155