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A Climate Dependent Comparative Productivity Study of Communal and Commercial Livestock Farming Systems in Namaqualand South Africa

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A Climate Dependent Comparative Productivity Study of Communal and Commercial Livestock Farming Systems in Namaqualand South Africa

By

Ayele Solomon

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ABSTRACT

A Climate Dependent Comparative Productivity Study of Communal and Commercial Livestock Farming Systems in Namaqualand South Africa

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Ayele Solomon

A dual economy exists between commercial and communal livestock farming in the semi-desert succulent karoo agroecological zone (AEZ) of South Africa and Namibia. Individually owned commercial farms are interspersed with pockets of communally held reserves comprised of the former 'Coloured Rural Areas' (CRAs). Generally, communal areas stock sheep and goats at double the density of commercial farms, and thus have lower levels of vegetative cover on inherently more marginal land (fewer natural drainage areas, and more rocky or mountainous rangeland) compared to commercial farms. This study explores the relationship between Stocking Density (SD) and productivity to determine how close to an economic carrying capacity the two Livestock Farming Systems (LFS) are under Good, Average, and Poor (GAP) veld condition years as conceptualized by the farmer. To compare the relative efficiency and profitability of the two forms of livestock farming, total net returns, and net returns on a per animal and per hectare basis are calculated. The findings are related to the Quality of Life (QOL) found on these two LFS. Policy recommendations (on livestock management and land reform) aimed at improving welfare on communal farms are discussed. Finally, the study creates a typology of communal and commercial livestock farmers based on the survey responses of seven communal farmers and one neighboring commercial farmer.

TO MY PARENTS

SARA AND SOLOMON

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Fremont, California
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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATIONS

AEZ-Agroecological Zone

CRA-Coloured Rural Areas

FP_A-Factor Productivity of Animals

FP_L-Factor Productivity of Land

FSR-Farming Systems Research

GAP-Good, Average, Poor Veld Condition Years

LE-Land Evaluation

LFS-Livestock Farming Systems

QOL-Quality of Life

SD-Stocking Density

TFP-Total Factor Productivity

WTP-Willingness To Pay

CHAPTER 1: PROBLEM STATEMENT

1.1 PROBLEM BACKGROUND

Namaqualand is a semi-desert district in the Northern Cape Province of South Africa. The scenery of endless plains covered with succulent shrubs, is interrupted by hills and valleys, comprising the Kamiesberg mountains. This view is interrupted by the occasional herd of sheep and goats, and some roaming donkeys. This landscape is transformed once a year, around August, when the succulents bloom and a carpet of flowers appears-drawing tourists from around the world.

It is the largest district in the Northern Cape province, and consists of fourteen small urban settlements, seven former Coloured Rural Areas[1] (CRA), and large amounts of white owned commercial farmland and mining company holdings. Stocking Density (SD) of sheep and goats on commercial land is generally around the Department of Agriculture's recommended sustainable levels while the SD on communal areas is twice as high.

As a result, the land on the former 'reserve' areas are severely degraded relative to commercial lands.[2] Dualism between the communal and commercial economy is reflected by the large discrepancies in Quality of Life (QOL). This is defined as income, land quality (measured by the diameter of rocks, soil quality, the presence of natural rainwater catchment and drainage areas, and the level of vegetative cover present), and land holding size per family. For the purpose of

this analysis, the above parameters; income, land quality, and quantity are a measure of QOL.

Seven communal farmers in this study come from the former 'reserve' area of Paulshoek which is one of nine sub-divisions in the Leliefontein 'reserve' found in southern Namaqualand. Paulshoek is situated in the southeast corner of Leliefontein (see figure 1.1 and 5.3). Eight hundred people from 140 families (largely of old and very young inhabitants) live on the 220 sq. km (22,000 ha) area of Paulshoek.

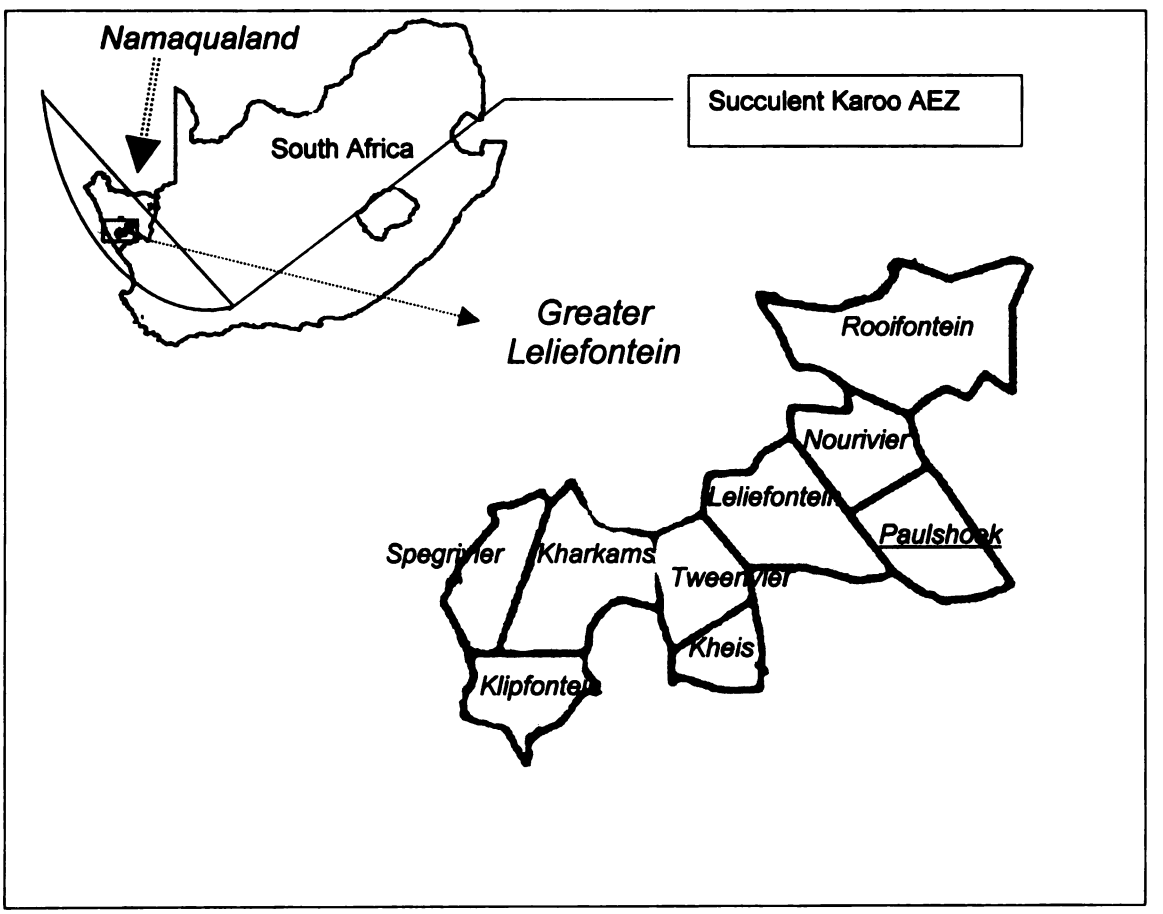

Figure 1-1 Namaqualand and Leliefontein

A case study approach was undertaken, and seven farmers from Paulshoek were selected for analysis.

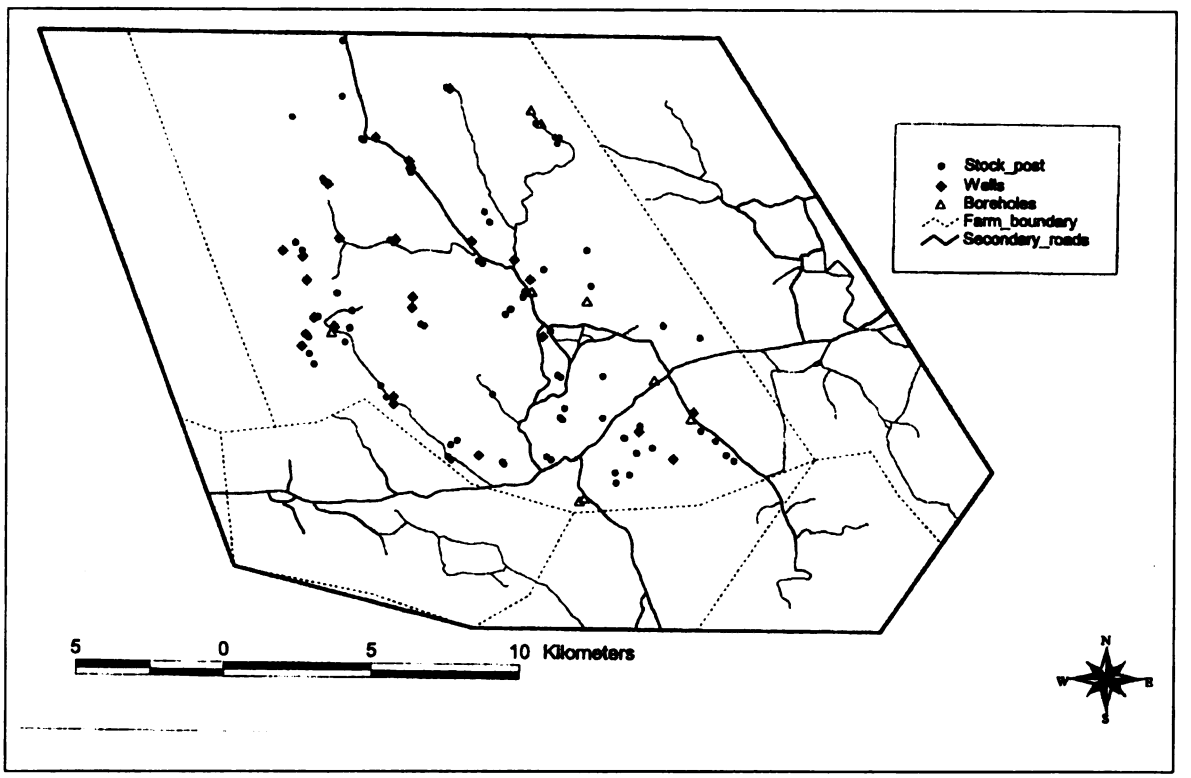

Figure 1-2 Paulshoek

Paulshoek lies 50 km east of the small town of Garies and 80 km south of the District capital, Springbok (see figure 5.3). The economically active citizens who have moved out of Paulshoek send remittances back to relatives. Government funded welfare and pensions also contribute significantly to the economy on the former 'reserve'. Democratic local government structures were weak before the local government elections of October 1995; the area is now administered by the Leliefontein Transitional Council.

A Local Development Forum was established in 1995 and consists of all the organizations and structures of the community. Recently, residents organized the Paulshoek Development Forum, or *Paulshoek Ontwikkelings Forum* (POF) to promote and manage the development of Paulshoek.

The geographic isolation coupled with limited livelihood opportunities make Namaqualand, and the Northern Cape Province in general, one of the least developed areas of South Africa. Various measures of wealth used by Leibbrandt and Woolard (1999) consistently rank the Northern Cape as the second poorest province after the Eastern Cape.

The South Africa National Botanical Institute (NBI) held consultative workshops throughout the county (1997 to 1998) to assess the level of land degradation as part of a process toward compiling an National Action Plan (NAP) to combat desertification that is based on local level input. The results indicate that 25 percent of the Magisterial Districts are severely degraded (among them is the district of Namaqualand), and that communal areas are 1.85 times more densely stocked, on average, than commercial farms.

According to Snyman (1998), "Stocking rate is the variable input directly controlled by the stock farmer and has the greatest effect on: 1) the limitation of environmental risks (Synman and Fouche 1991, 1993 cited in ibid.); 2) the long term vegetation composition (Van den Berg et al., 1975 cited in ibid.); 3) animal performance (Danckwerts and King, 1984 cited in ibid.); and 4) economic advantages for the farmers."

Northern Cape is the second richest province in mineral wealth after Gauteng, but its standard of living is far lower than Gauteng (which include Johannesburg and Pretoria) since most of the wealth is not reinvested in the province (Krohne and Steyn, 1990). The QOL on the former CRAs is arguably one of the worst found in South Africa. Fishing (on the Atlantic coast) and mining are major sectors of employment in Namaqualand, but they have been in decline.

1.2 THE FORMER 'RESERVES' AND PAULSHOEK TODAY

The current situation on these rural pockets of poverty is described by Catling and Saaiman (Lipton et al, 1996) as, "Underdeveloped and overcrowded, the CRAs are characterized by declining agricultural productivity, high levels of unemployment and deepening poverty (Gilfellan et al, 1995 cited in ibid.). Most of the farming is done on a part time basis by middle aged or elderly males...deep rifts and opposing factions often hold back social progress (Land Development Unit 1992, cited in ibid.)."

As in most former 'reserve' areas, there are few private enterprises or civic institutions in Paulshoek. There are two small shops that sell necessity food items and soft drinks, a recently built community center, and an elementary school. Some residents live in modern constructed houses while others live in informal structures made from corrugated steel, or in traditional *matjieshuts* (reed huts)[3]. There is no refrigeration, very few telephones, and no electricity in the village. As a result of limited opportunities, most residents rely on remittances,

welfare payments, or government pensions (including two of the livestock farmers interviewed for this study).

A minimal amount of crop production in the form of barley, wheat, oats and rye takes place on the former 'reserves' in the years when rainfall permits. But the primary form of independent livelihood in these remote and arid 'rural camps' is the keeping of sheep and goats. Communal livestock farming has few financial costs for the farmer. Communal farmers have no access to credit so they have no debt, they usually are not taxed, and they don't pay for water, land, and infrastructure.

There are approximately 30 active livestock farmers in Paulshoek (the number fluctuates as farmers drop-in and out from owning herds-see Appendix C). Seven communal farmers (numbered 1001-1007) are compared to one neighboring commercial farmer (No.1008) who primarily keeps sheep on 5200 ha. Livestock farming is a male-dominated livelihood in Namaqualand, so the pronoun 'he' is used for all the farmers in this study since all the farmers interviewed are male[4].

The sole commercial farmer in this study inherited 3400 ha of his farm and he leases the remainder. He lives on the farm with his family in a modern house with a telephone, electricity and other amenities not found on the neighboring communal residences. He is not considered wealthy by commercial farmers' standards, and his land holdings are below average for a commercial farmer in this part of Namaqualand. At the same time, Paulshoek is one of the poorest of the nine communal areas in Leliefontein.

The commercial farmer (No.1008) practices rotational grazing by using fences to create grazing camps. In Paulshoek, veld is an open access resource. The commercial farmer gives his sheep supplemental feed, and dips and vaccinates routinely. The communal farmers also give fodder in the form of supplemental feed, and provide veterinary services, but they are constrained by a lack of information (market and livestock management), land, and capital.

Paulshoek farmers graze their animals in a classic open access system that is characterized as being non-exclusive and rival. All the benefits to keeping livestock go to the farmers while the environmental costs are borne by the entire community.

Figure 1-3 A Paulshoek Livestock Farmer at his Stockpost

Previously functioning mechanisms of community oversights which regulated the use of veld (e.g. identification of rest periods) have broken-down during the post-apartheid administrative restructuring of the former 'reserves'. Now there is no incentive for any one farmer to reduce herd size.

Currently there are about 2000 sheep and goats kept in Paulshoek, but this number has fluctuated between 2000 and 4000 since 1995 (see Appendix C and figure 3.3) with a mean of 3906 between 1971 and 1995. The present number of 2000 sheep and goats represents double the SD of the commercial farmer (No.1008) who currently stocks at about 300 small-stock (on 5200 ha), but on average this figure is approximately 520; the recommended SD of 10 ha per animal.

The overstocking in Paulshoek has led to overgrazing compared to commercial farms (see figure 1.5). This has led to a decrease in the volume of palatable shrubs, and also a reduction in the size of palatable shrub species. As a result, the number of invading, and unpalatable toxic shrubs, namely *Gelania Africana*, have increased in Paulshoek while there has been a shift from perennial to annual plants (Todd and Hoffman, 1999a). Rohde et al (Swallow, 1999) find plant-cover regeneration to be higher on the less densely stocked commercial farms, compared to communal farms.

The lack of electricity in Paulshoek also puts pressure on the veld; it was found that each household spends an average of 4.5 hours per day collecting firewood (from shrubs since this AEZ does not support trees) for cooking and heating. Also, the temperature drops rapidly at night in this arid environment and

firewood is the only heat source. In addition to subjecting the residents to the travail of wood collection, it is also destructive. This activity strips 1.5 tons of wood per family per year (Solomon, 1999).

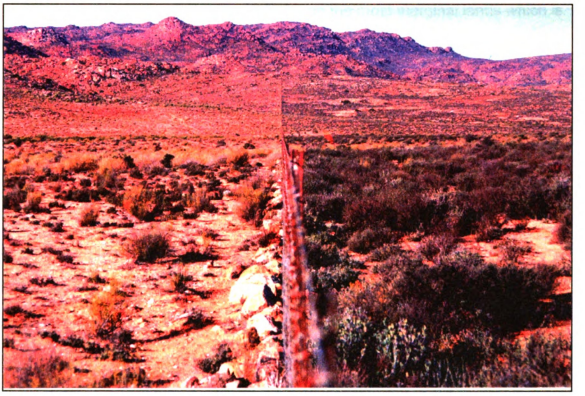

Figure 1-4 Paulshoek and a Commercial Farm Fenceline

A fence-line photograph of Paulshoek and a commercial farm taken by the author in July of 1998 shows the relative degradation between the communal and commercial farms.

The unsustainability of livestock farming can be gleaned from the reductions in small-stock carrying capacity in Namaqualand. Recommended SD has gone down by half from 1974 to 1984 (Department of Agriculture, Springbok

cited in Dunne, 1988). Dean and Macdonald (1994) found that between 1911 and 1981, seven of eight districts in the succulent karoo AEZ experienced a 50 percent or greater decrease in SD. In 1800 farms in karoo lands could be stocked at about 4.5 sheep per ha, but today the recommended carrying capacity has dropped to 1 sheep per 10 ha on the most marginal lands which is 12 times less than 1800 SD (Shearing, 1994).

1.3. NAMAQUALAND HISTORY TO THE MID 20TH CENTURY

Human populations in the karoo including Namaqualand can be traced back 3 million years (Smith in Dean and Milton, 1999). Nama speaking Khoi people practiced pastoralism in Namaqualand for 2000 years until European and 'baster' trekboer and hunters began moving into the area in the 18th Century. This was later encouraged by the colonial authorities through 'loan farms' (Smith, 1992). Thus before the beginning of copper mining in the late 19th century and the subsequent transformation of agriculture to include agronomic production, livestock farming was the only livelihood option in Namaqualand.

In 1847 the boundary of the Cape Colony was extended to the Orange River and trekboers were given Crown lands to farm. Also beginning in the mid 19th Century, the Rhenish Mission Society of Germany emerged in the area. Displaced local inhabitants moved around these missions which became havens from attacking trekboers. At this time the missions solicited 'Tickets of Occupation' from the colonial government for protection against further encroachment from trekboers.

'Tickets of occupation' restricted access to the mission stations (and areas around them called 'zones of occupation') through a system of *burgherskap*, or citizenship. Tickets of occupation for a mission reserve were available only to indigenous people and 'bastards' of aboriginal descent (Sharp, 1984)[5]. Act 29 of the1909 Mission Stations and Communal Reserves Act put the 'zones of occupation' under secular control.

Once someone entered a reserve, they were forever classified according to origin. Thus a measure introduced to protect natives became a system of racial classification. This was institutionalized in the 1950's with the National Party's apartheid policy which classified populations on the reserves as 'coloured'. Through the creation of enclosed 'reserves', and a reduction in available rangeland, arable farms developed as native populations moved from nomadic to sedentary crop farming.

Beginning in the 19th Century, missions converted the indigenous pastoral Khoi inhabitants to Christianity. During this period, the population of mixed (European and Khoi) persons grew, and it is these Afrikaans speaking descendents that inhabit the 'reserves' today. As a result of apartheid policy, CRA densities increased as the area of land under the 'reserve' continued to shrink through the 20th Century (Smith, 1992). Today, herd densities on commercial farms are half of those on the former 'reserves' where the land is severely degraded.

Namaqualand initially had flexible racial association, and then through historical and political processes, adopted features of racial and economic

separation that characterizes the dual economy and society today. There was relative flexibility between 'reserves' and commercial farms during the late 19th century to the early 20th century; white trekboers could settle on the reserves and would be identified as 'aboriginal' or mixed as they lived and intermarried on the reserves (Sharp and West, 1994). There was no formal cash economy among whites or 'coloureds', and culture revolved around livestock and the church. *Burgherskaps* could gain individual title to land outside reserves if they could gain acceptance as a Boer. During this period it was not uncommon for trekboer and *burgherskap* to enter into mutually benefiting plowing and grazing agreements in a system of *bywonership*.

The fluid divisions between communal and commercial areas ended when the state began awarding land to mining companies and grazing licenses, on easy terms, to European farmers through the Land Settlement Act 12 of 1912 and Land Settlement Act 21 of 1956. When the unsurveyed 'zones of occupation' were redrawn during apartheid, it is alleged that these mission areas lost even more land (Smith, 1992). Also with apartheid, church mission areas became associated with what became 'Coloured Rural Areas'. Divisions and boundaries became more static as the state assumed control of these areas and reserved 74 percent of land in Namaqualand for whites (Dunne, 1988). As a result fences were erected and human and livestock movements were curtailed. A qualitative comparison of communal and commercial LFS for the karoo AEZ is presented below.

Comparison	Communal areas	Commercial farms
History	Rooted in dispossession and confinement. Linked historically to indigenous Khoi subsistent economies characterized by large cycles of transhumance	Arise from European colonization in 18th and 19th centuries with a focus on market economies, private ownership and sedentarism
Location and size	Predominantly in the west comprising 2.3% of karroid rangelands	Throughout the karoo covering probably >80%of the land area
Biophysical environment	Generally in low (<250 mm/yr) and hyper-arid (<50 mm/yr) rainfall areas of succulent karoo biome; dominated by leaf succulent shrublands	In <50 mm/yr to >500 mm/yr rainfall environment of Nama and succulent karoo biomes, dominated by grasses (in the east), and dwarf karroid shrubs
Land tenure	'Citizenship' grants individual rights to shared grazing areas and water sources and leased cropland areas	Ownership grants individual rights to exclusive, responsible use of rangeland resources
Institutional authority	Elected village and Reserve council representatives linked to district, provincial, and state authorities	Elected municipal, district, provincial, and state authorities
State and business involvement	Community and individual benefits via limited direct infrastructural (e.g. boreholes and fencing); and remittances, pensions, etc	Individual benefits via direct subsidization of infrastructural improvements, drought aid, loan subsidies, extension services, etc
Human density	Relative high population (>5 people/km2) and farmer density	Relatively low population (<5 people/km2) and farmer density
Production objectives	Multiple use of range (firewood, construction materials, etc) but primarily for increasing small-stock animal numbers for meat, investment and to a lesser extent hides and milk	Primarily for cash sales focussed on the quality and quantity of wool, meat and pelts
Livestock density	Generally twice the recommended carrying capacity estimates, often sustained over decades	Generally at or below (according to 1995 data) the recommended carrying capacity estimates, also sustained over decades
Herd size	Usually between 10 and 500 animals	Usually greater than 500 animals
Dominant breeds	Boer goats and Dorper sheep, donkeys	Boer and Angora goats, Merino, Afrino, Dorper, and Karakul sheep, beef cattle, ostriches
Management strategy	Animals herded daily around grazing area-water source- night kraal orbit	Free ranging herds in paddocks with associated water point, often under rotational grazing and resting systems
Production coefficients	Relatively poor lambing and weaning percentages, slow growth rates, high mortalities	Relatively high lambing and weaning percentages, higher growth rates, lower mortalities
Marketing strategy	Poor access markets and reliance on speculators	Markets form integral part of production system
Impacts on natural resources	Transformation from perennials to ephemeral and poisonous plant mix in heavily grazed areas	Shift from palatable to unpalatable shrubs; increase in short-lived grasses especially in the east

Figure 1.5 Communal-Commercial Karoo LFS Table.

Source: Hoffman et al (Dean and Milton, 1999)

1.3.1 LIVESTOCK FARMING SUBSIDIES[6]

In the 1930's the government sought to address the 'poor white problem' through land subsidies and irrigation projects. Loans at market rates were made available to farmers in order to create a white middle class with high state support. Other subsidies include drought relief, fencing, restoration with saltbush, and windmills. In addition, from the 1930's to the 1960's, the state began subsidizing the removal of stock from Namaqualand around crop seeding time. From May to December livestock were removed out of arable lands in Namaqualand to summer rainfall areas lying east in 'Bushmanland'.

Livestock would graze in 'Bushmanland' while wheat would grow in the winter rainfall areas in Namaqualand for harvest beginning in October. Thereafter, livestock would be returned to the graze the stubble during the dry summer months thereby reducing impact on the veld (on commercial farms) during fragile low rainfall periods. Subsidies in the form of price floors on wheat encouraged this; as a result yields as low as 700 kg per ha became acceptable. Livestock prices dropped to R2 per goat as prices for wheat increased dramatically which benefited the commercial farmers.

In keeping with the pattern of following trends in white farmers' agricultural practices, communal farmers began growing wheat and removing stock from arable land during the growing season, but on a relatively small scale, and they could not send their animals to 'Bushmanland'.

1.3.2 SMALL-STOCK MARKET TRENDS

In the 1940's and 1950's Afrikaaner and Karakul sheep, and local goat breeds were kept. Karakul sheep were mainly "fat tailed" which means that fat is within flesh, not outside. This period was also the peak of the Karakul wool market. By the 1960's the market demanded Dorper sheep (sheep with fat outside flesh). Also around this time, Red-Haired Boerbuck goats were brought in from Kwazulu-Natal, and sold via markets in Upington back to Kwazulu Natal (mainly for traditional festivals in December). Communal farmers emulated white commercial farmers by buying 'reject' Dorper sheep from commercial farms and by keeping Boerbuck goats.

1.4. LIVESTOCK FARMING SINCE THE 1960's

During the 1980's, CRAs were governed by the *Bestuursraad*, or *Raad*. The *Raad* had 2 or 3 administrators from every subdivision in a CRA (1 political, 1 elected from the district). The Leliefontein *Raad* was located in the subdivision of Karkams. To farm livestock a farmer had to apply to the *Raad* for a *veepost* (stockpost). The *Raad* was controlled by the Department of Coloured Affairs, and it appointed people from the community to be administrators. There was a livestock fee based on the number of animals a farmer kept.

Traditionally, communal *veepost* locations were developed by farm families over time. This changed with the introduction of windmills in communal areas during the 1980's. Farmers began to group their herds in new areas that were more accessible to watering points. There was also a 'pound' for stray

animals to be held until claimed. A *saaiperseel*, or cropping area, was available through the *Raad*, which typically charged R70 per year for 3 ha. A dryland garden, usually near a river, for planting pumpkin and squash would cost R40 per year. Today there is no formal regulatory structure on where to plant or graze.

Following successful rotational grazing on white farms, 'economic units' were introduced from the late 1960's through the 1980's. Economic units emerged on CRAs under the guise of rotational grazing schemes called 'betterment schemes'. Individual farmers had to apply to the *Raad* for access to grazing lands, but these private units of production were largely rejected by communal residents because it benefited a wealthy minority, and because farm sizes were actually too small to be feasible.

Sharp (1984) recounts how so-called 'betterment' schemes of the 1960's separated land into discrete residential and agricultural zones (to the benefit of the wealthy and/or supporters of the *Raad* administration) with the aim of increasing agricultural production. These schemes divided the population into *bona fide* farmers and non-farmers. This did not take into account the social and cultural aspects of communal agricultural production, and the medium of reciprocity it represents.

Archer et al (1990) found 'economic units' to be economically unfeasible. As a result, community response to 'betterment schemes' ranged from luke-warm to outright rejection on the smaller 'reserves' (Sharp, 1984). Another

privatization scheme was initiated in the 1980's, but four Leliefontein residents convinced the Supreme Court to annul it on procedural grounds in 1988.

During the transition to a non-racial democracy in South Africa, the state disbanded the *Raad* because it was deemed unqualified to administer the former 'reserves'. As a result, no regulation of livestock farming occurs today. There is no regulation of where and when livestock can graze on communal lands. Thus a 'free for all' exists, and a classic case of the 'tragedy of the commons' prevails (Hardin, 1968).

1.5 MINING IN NAMAQUALAND

Most livestock owners in Namaqualand supplement their income from other sources and the mining sector is the principal form of formal employment. Eighty-six percent of Namaqualand's Gross Geographic Product (GGP) comes from mining. Approximately half of the 'reserve' residents, and 46 percent of the economically active residents of Namaqualand work in copper and diamond mines (Steyn and Krohne, 1990). Two diamond mines and two non-ferrous metal mines account for most of the formal employment in the district.

Mining began in Namaqualand in 1852, but it did not have a strong effect on the economy until much later. The mining sector expanded during the 20th century, so by the 1960's a cash economy had developed in Namaqualand. At this time, remittances and wages from mines were the primary cash source for reserve residents. Livestock represented the only form of equity for CRA residents since there was no formal rural banking system (a situation that

remains the same today). Income from the mines was invested in livestock for security and insurance in old age, so as a result, stock numbers increased dramatically.

Mining company profits have been declining in the last 20 years. Usually these profits are invested outside of the district (because of limited investment opportunities) making Namaqualand one of the poorest districts in South Africa (Seyn and Krohne, 1990). The level of SD is likely to increase as more migrant laborers return home to the communal areas, so the current problems of veld degradation and lack of alternative livelihood sources in Namaqualand is foreseen to worsen in the near future.

The 'reserve' residents have traditionally served as a labor pool for the mines, and communal residents typically invest their income from mining into livestock. Migrant laborers from the 'reserves' are highly insecure in their mining jobs since international prices for minerals fluctuate widely. Livestock is seen as a form of security to this uncertainty. Uncertainty in mining sector jobs has increased with a decline in profits reported by the major mining companies, and will probably continue to do so because of long term exhaustion (during the next ten years) of diamond deposits in the region (UNCTAD, 1998).

1.5.1 MINING AND SOCIAL STRATIFICATION

In the paper "Controls and Constraints: Land, Labor, and Mobility in Namaqualand," John Sharp and Martin West (1984), present a historical account of how the reserves, and the system of racial stereotyping and classification

were created after colonial settlement of Namaqualand. The study serves as an overview of anthropological research in the 1980's that focused on the development of social and economic differentiation as some communities accumulated wealth, while others, particularly the 'coloured' populations on the reserves, became impoverished.

The authors describe how the development of copper mining industries influenced social differentiation based on racial classification. The paper relates colonial legislation, and employment practices in the mines, to the contraction of communal areas, and lack of capital investment on them. Conversely, these factors led to expansion in the size of commercial farms, and to overall increased investment in commercial agriculture.

According to Sharp and West, an era of flexibility and mobility came to an end with the onset of copper mining in the late 19th century. Mutually benefiting *bywonership* agreements ceased when agricultural production became more lucrative as the mining sector increased food demand. Wealthy land owners began employing wage labor from the 'reserves' as did the mining companies who also imported labor from Mozambique, and later from the Eastern Cape Province.

Land shortage, drought, and indebtedness forced local populations into wage labor in the mines (as did the 1909 Mission Stations and Communal Reserves Act which imposed a tax on adult males in the reserves-forcing them out of agriculture and into the mines). This law reduced the size of the reserves

in Namaqualand to 26% of the region, and transferred control of the reserves from the Missions to the (secular) colonial government.

Locals were given the most menial jobs, thus employment categories began to further entrench social differences based on race, origin, and physical appearance. According to the authors, "Their (the locals) lack of skills thus confirmed the status accorded by the Tickets of Occupation." Sharp and West point out that some whites were not much better off than locals, and although some of the unskilled ones left the regions (since they resented doing menial lobs in the mines) the remaining ones benefited from increased training in the mines. They were paid more than local employees, and were thus able to invest this in agriculture. In addition, the land holdings of the whites who remained in the area grew as they took over land from emigrating whites.

The report points out the instability of the mining industry sector, and discusses how each opening and closing disproportionately affected the local 'coloured' population. In 1918, the mines closed due to difficulties with shipping at the end of World War I. They re-opened in 1940, but scaled back operations in 1975 because of difficulty with reaching copper deposits, and a decline in copper prices.

The retrenched African (black) workers were returned to their home regions, and white workers found employment elsewhere. 'Coloureds' faced hardships in finding other work because of discrimination in employment, lack of marketable skills, and because authorities limited housing units for them in urban areas.[7] Thus the number of 'coloured' workers in the mines increased relative to

black and white employees (and in absolute terms from 1300 in 1975, to 1800 in 1982). Sharp and West argue that these local employees were more dependent on the mining companies since they were tied to the region, and the companies benefited because 'coloureds' were paid less for the same positions whites held.

The authors conclude by stating that the 1980's were more flexible than the 1950's when apartheid was first introduced, but they describe such flexibility as 'superficial' since the racial boundaries were still the same. The only major change they observe is increased economic differentiation within each racial category depending on access to employment, capital and land. This paper by Sharp and West has therefore set the stage for future studies to examine how trends in the mining sector affect the communal areas in Namaqualand.

1.5.2 CURRENT TRENDS IN THE MINING SECTOR

GGP in Namaqualand declined by 32 percent in real terms between 1980 and 1991, and continued to fall between 1992 and 1995 due to declines in the mining sector (UNCTAD, 1998). At the same time the farming sector and the service sector grew. The trend of moving from the mines to livestock farming is supported by the responses to the survey questionnaire in this study. Farmers expressed that livestock is a post mining investment for most.

There are two major Diamond mines in Namaqualand, one of them is government owned Alexkor, which retrenched 338 employees in 1997 (as a pre-privatization restructuring measure). Okiep Copper Company retrenched employees in 1998 due to diminishing ore reserves. Formal employment in

Namaqualand fell from 87.5 percent to 66.5 percent during the 1980's (ibid.). So, declines in the mining sector (which increase the demand for livestock farming) continue to dominate the attention of the Northern Cape Provincial Government today.

CHAPTER 2: AREA AND LIVESTOCK ECONOMY DESCRIPTION

2.1. AGROECOLOGICAL ZONE (AEZ)

Paulshoek is located at 18°16' E and 30°22' S. It falls in the winter rainfall region (June-August) of South Africa's succulent karoo agroecological zone (AEZ) shown by the semicircle in figure 1.1. Rainfall in Paulshoek ranges between 150mm and 250mm, with a mean of 200 mm and a coefficient of variation of 33 percent (Todd and Hoffman, 1999a). The higher lying (western) region of Paulshoek near the Kamiesberg foothills receive 250mm of rainfall while the while the eastern area, near Moedverloor, receives between 120-130mm (May et al, 1997). Low rainfall in the succulent karoo AEZ is supplemented by heavy coastal fog from the Atlantic Ocean (Cowling et al, 1999). Farmers surveyed in this study indicate they can expect above average (good) veld condition two of every ten years, and they indicated same probability of expecting below average (poor) veld condition years.

The mean annual temperature in Paulshoek is 15.9 °C with large seasonal and daily amplitudes, and there is a 2-2.5 °C increase in annual temperature following a west-east gradient (May et al, 1997). The soils in Paulshoek are coarse and sandy with over 50 percent of the sand grains having a diameter of greater that .3 mm (Allsop, 1999).

Acocks (1953) indicates two distinct veld types: Mountain Renosterveld in the cooler, high-lying regions of the Kamiesberg foothills in the western areas of Paulshoek, and Namaqualand Broken Veld in the low-lying western regions. Paulshoek is in the Kamiesberg mountains, between 1100 and 1300m (Allsop,

1999). To the west is the low-lying sandveld, and to the east is Bushmanland Plateau.

Aerial photography done by Vetter (1996) and cited in May et al (1997) reveals four distinct land forms in Paulshoek: Riverine areas (comprise less than one percent of land area but support many of the boreholes), sandy pediments (located in low-lying areas-14 percent of Paulshoek), rocky pediments (33 percent of the area and characterized by shallow soils dominated by small/medium size rocks), and steep rocky slopes (52 percent, rising sharply out of surrounding pediments and consisting of large rocks, boulders, and foliated gneiss).

2.2 LAND USE SUB-SYSTEM

The greater karoo AEZ covers the western 35 percent of South Africa, and extends into Namibia. The succulent karoo is dominated with succulents, and comprises the westernmost strip of this zone (see figure 1.1). Eighty percent of the greater karoo is owned by commercial farmers or mining companies; in Namaqualand district this figure is 74 percent (Anon 1986 cited in Dean and Milton 1999; Dunne 1988). Half of the commercial farms in the greater karoo are 3000 ha or less, and 25 percent are larger than 6000 ha (Anon 1986 cited in Dean and Milton 1999). The remainder of the land falls under communal management on former 'reserves'.

Agricultural water supply in Paulshoek is obtained from the seven operational windmill boreholes. There are currently 26 separate cropping areas that grow oats, wheat and rye, but crop and vegetable production are minimal

compared to livestock production because of ecological and input constraints. Currently there are approximately 2000 sheep and goats in Paulshoek (other domestic animals include a few head of cattle, and over 20 donkeys) with goats comprising 63 percent of the small-stock.

2.3 LIVESTOCK MANAGEMENT PRACTICES

Commercial farmers service a month or two earlier than the communal farmers; this ensures that peek ewe demand for veld (just after dropping) corresponds with the winter rainy season when the veld is in good condition which allows the ewe to recover more efficiently. Commercial farmers give supplemental feed in November or December. They generally send rams to service ewes in December which drop in May, and they begin selling the cohort at 3 to 5 months old (depending on veld condition) around peek price time beginning in August. Sale of *young* lambs and kids also affords a premium.

The communal farmers' ram and ewe are in poor condition since they have less biomass to graze, and they service ewes later than commercial farmers-thus they drop in July to August, at the end of the rains and the ewes have little time recover on good veld. The ewes do not recover and as a result the lambs do not suckle sufficiently and grow rapidly enough for sale during the peak price period in December. Thus the communal farmers are forced to keep their small-stock on the veld longer. This is usually until the winter rains of the following year.

This practice causes them to miss the peak September-December season, miss the premium on younger animals, and it puts pressure on the veld

for another year. The commercial farmers also gives a little supplemental feed during the summer, for good milk. This system is highly efficient from a profit maximization perspective.

Feeding at three critical periods would increase lambing percentages and weaning percentages for communal farmers to close to the level of the commercial farmers'; the three periods are[8]:

1) Before servicing ewes.
2) Six weeks before lambing.
3) As soon as the lamb is dropped.

Major differences in management practices also exist between communal and commercial LFS with respect to goats. Goat kids are more immature at birth than sheep lambs, so they must stay in the kraal. In communal system, goats go out of the kraal to graze while the kids stay because they would be prey for jackals outside of the kraal. This practice of separation does not allow the kid to suckle to grow to its full potential.

Commercial farmers have enough land and fenced areas to allow goat and kid to roam together in a paddock for three weeks to a month after birth. Fencing for small camps to kraal goat kids at three months would decrease mortality, but this is difficult in a communal system where land is owned by the community, and any one farmer cannot restrict access to other farmers.

Keeping goats is generally more labor intensive than sheep. During rains some farmers do not plant crops because they are looking after goats.

Communal farmers lose relatively more goats due to aborted fetuses as a result of vitamin E deficiency. When goats abort they re-conceive in June and lamb in summer, beginning in August, requiring sale during the *following* pre-December season which puts pressure on the veld for an extra year-with no additional cash benefit to the farmer. Communal kraaling also presents problems with the spreading of gostridium infection that results in a runny stomach. The solution to this is to move the kraal every fortnight and dose the kids with sulfazine.

2.3.1 COMMUNAL OPEN ACCESS

The communal farms stock at double the density of commercial farms because they have no property rights that links their individual actions of stock reduction to higher profits (or even the use-value of milk and meat) since other farmers can continue increasing stock numbers. In other words, there is no price mechanism to indicate a decreasing value of veld as animal inputs are increased. They do not internalize the value of veld.

The dual LFS in Namaqualand has high societal costs in the form of on-farm and off-farm environmental externalities, such as soil erosion and loss of plant species (or the spread of noxious species such as *Gelania Africana* in Paulshoek). This duality is evident in the patches of relatively over-grazed and over-stocked communal lands that are surround by commercial farms.

The case of a non-exclusive and rival goods produces environmental externalities because the cost of veld is not internalized by the livestock enterprises of the farmers. Panayotou (1995) states that, "If externalities are local (e.g. local watersheds, village forest, or local fishery), communal property

rights combined with private use rights (regulated by the community) could internalize external costs with minimal management efficiency loss." Internalization of veld costs in Paulshoek could be realized in the form of a small-stock head tax (see section 5.2.3). Survey responses indicate that communal farmers keep livestock primarily for income, so they presumably would keep less stock if it was perceived to increase income.

Aside from causing degradation (visible in figure 1.4) the communal property rights structure causes an input factor price imperfection since the opportunity cost of grazing veld is zero which makes the factor price of purchased feed inputs relatively higher, and higher than its social value[9]. Communal farmers apply very little purchased inputs at the expense of natural grazing (farmer 1005 is a classic example) because they are capital constrained, and also because they substitute veld for purchased forage at a socially inefficient rate.

The deviation of social cost to a zero private cost for land constitutes the externality which is manifested by the decreased ground cover on communal land visible in figure 1.4. Section 3.3.3 presents an economic perspective of this phenomenon. According to de Janvry et al (1998) "Achieving the social optimum requires either inducing a non-cooperative behavior by individual members that mimics what cooperative behavior would dictate, or inducing cooperative behavior." Simulating cooperative behavior by introducing an animal head tax is discussed in section 5.2.3.

Livestock experts in the region emphasis the timely use of forage and veterinary inputs applied according to the lambing cycle of small-stock. The low

level of purchased inputs that communal farmers utilize causes them to be labeled 'inefficient' farmers who simply run subsistence hand-to-mouth operations. Lack of capital, lack of knowledge in managing feeding regimes, high transportation cost of acquiring feed, and the imperfect factor cost of forage all contribute to low productivity.

Internalizing veld cost is required for purchased forage use to be at a social and private optimal level. Question 21 of the survey questionnaire asked the communal farmers if they would be willing to invest in forage to feed their animals at three critical periods during the lambing cycle as the commercial farmer does. They all responded positively, but cited capital constraints as to why they do not do it.

2.3.2 COMMERCIAL ROTATIONAL GRAZING

Commercial management of small-stock in the karoo follows a rotational grazing system. This system and other karoo livestock management practices originate from a research station established in 1934 at Middleburg. The rotational system uses fenced camps that allow the resting of veld at various times of the year instead of continuously grazing the veld (as practiced in communal areas).

This system simultaneously attempts to maximize the growth of animals and shrubs. It is predicated on two principles: The first is that different veld areas (e.g. foothills and floodplains) have varying plant composition and carrying capacities, so if they are not separated and grazed separately then selective grazing would occur. It therefore advocates the grouping and fencing of similar

landscapes. The second principle is the rotation of grazing periods from year to year. This is done because different types of plant species (i.e. grasses and shrubs) in the karoo are thought to flower and germinate at different times of the year, so by fluctuating grazing period no one species would be over-grazed Hoffman et al (Dean and Milton 1999).

2.4. SMALL-STOCK MARKETING SYSTEM

2.4.1. SHEEP

Sheep in Namaqualand are primarily sold on a dead-weight basis (unlike goats which are sold on a live-weight basis). The commercial farmer can either take the sheep to the livestock auction (where the farmer groups animals of similar weight by pen and an offer is made per pen), or an agent comes to the farm and pays for the animals on a per kilogram basis. Currently the agent charges R11 per head for this service.

The communal farmer has two options, he can sell his sheep to the cooperatives or sell to a speculator[10] who comes around the communal areas. The cooperative transports the carcasses to the abattoir where they are graded (A, B, C), weighed, and slaughtered. The communal farmer is sometimes working at the mines and therefore cannot take his animals to the cooperative (where he can get about R180 per head several weeks after it has been slaughtered). In this case the farmer is paid weeks later by the cooperative minus a commission which is a disincentive.

The more common scenario, particularly for less developed communal areas such as Paulshoek, is the practice of selling to a speculator who comes

around when the farmer is with his herd. The speculator pays R12 per kilogram for a dead-weight carcass, skin, and offal (carcass weight of ewes is generally around 20 kg which is 60% of the live-weight, and a sheep lamb carcass weight is about 12kg or 40kg live). Direct sales to local urban areas are not possible since transportation costs are prohibitively expensive (for example, the cost from Paulshoek to Garies is R150 for a 50 km distance) and market mechanisms other than auctions do not exist.

The commercial farmer in this study keeps a few goats around for sheep lambs to suckle (in case some sheep ewes have twins and there is increased demand for milk), but his primary enterprise is sheep production.

2.4.2 GOATS

Typically, agents come from Upington for a monthly auction and buy primarily from commercial farmers to supply traditional Zulu festivals that occur in December. For this reason goats can be marketed at a premium from September to November-for sale through December in Kwazulu-Natal Province. During this time of the year, livestock agents from Upington buy goats at auction. They usually buy from commercial farmers and transport the sheep, southeast, across the country.

All the communal farmers in this study said they sell in the peak price spring months because of good (animal) condition in spring after the winter rains; they are not aware of market premiums. They do not benefit from pre-December price premiums anyway because they generally do not sell at auction. Instead of going to livestock auctions, communal farmers sell to speculators who drive

around buying livestock to take to the Garies and Kamieskroon auctions. The farmers prefer to sell to speculators. Why do they do this? Why are communal farmers effectively shutout from goat auctions that occur at Garies and Kamieskroon in late September to November?

1) They are paid in check instead of cash.
2) They prefer not to pay a sales agent a commission.
3) They sell by weight, but the farmers prefer eyeball pricing.
4) They usually do not have transportation or it is too expensive.
5) They do not feel welcome at auctions because they were not allowed to attend during the apartheid period.

When communal farmers sell to a speculator they suffer from a lack of market information. In addition, they operate in an environment where (because of asymmetric information) the livestock agent does not pass-through the December price increases that he will receive. Even if the communal farmers went to the auctions, agents would buy from commercial farmers in the area who are generally producing goats in better condition. There also is a high probability that the agent, who is white, would buy from a commercial farmer, who he has historically dealt with (both personally and through family networks, and on the basis of race) instead of buying from a communal farmer. For these reasons, the auction aspect of the LFS in Namaqualand has remained the business of commercial farmers.

CHAPTER 3: RESEARCH OBJECTIVES AND DESIGN

3.1 GENERAL OBJECTIVES

The objective of this study is to relate Stocking Density (SD) to productivity, subject to Good, Average, Poor (GAP) veld conditions, for livestock farmers in the succulent karoo agroecological zone (AEZ) of Namaqualand sampled at Paulshoek, and a neighboring commercial farm. Productivity is measured by the Factor Productivity of animals (FP_A), land (FP_L), and Total Factor Productivity (TFP) or net return per head, hectare, and total net return, respectively. The independent variable, SD, will be defined as sheep and goats per hectare. The dependent variable is the net return to the farmers' livestock enterprise measured on a per animal and per hectare basis. The mediating variable is a qualitative description of veld as 'Good', 'Average', or 'Poor' as conceptualized by the farmer.

The farmer usually expressed these GAP conditions as a function of rainfall, but veld condition (or biomass productivity of rangeland) can be modeled to include many factors. These include evaporation (a function of rainfall, temperature, relative humidity, windspeed, and solar radiation), evapotranspiration (which include the slope of land, aspect, soil type, and root depth), and other determinants such as plant wilting point and run-off amounts (Shultink et al, 1987). Todd and Hoffman (1999b) found that stocking numbers in Paulshoek are correlated with two year mean rainfall. This supports the farmers' perceptions of decreased productivity during years of poor veld condition, and

the intuition that less rain results in reduced plant growth. Figure 3.3 shows the relationship between rainfall and SD in Paulshoek from 1971-1998. This study utilizes a survey questionnaire to obtain animal production data to use in GAP annual farm budgets.

The intention of this study to promote the Quality of Life (QOL) of communal residents that live in the succulent karoo AEZ and specifically Namaqualand. Therefore, the findings will be used to identify policy measures that reduce SD and increase the QOL of communal residents. This is particularly relevant with respect to large scale reduction of work force in the mining sector.

3.2 RESEARCH QUESTIONS

This study aims to provide insights into the carrying capacity of the succulent karoo AEZ under current boundaries and management practices. This is done by comparing FP_A, FP_L, and TFP in GAP veld condition years while answering the following four questions:

1) What is the current SD and what is the difference between Paulshoek and the neighboring commercial farm?
2) What are the net returns per animal for farmers in this study? How do communal and commercial farmers compare?
3) How do net returns per animal relate to GAP veld condition years for surveyed farmers?

4) What are the differences in net returns between Paulshoek farmers' enterprises, and the less densely stocked commercial farms, in GAP veld condition years?

Low net returns per animal, and large differences in net returns per animal, between GAP veld condition years would indicate that SD (i.e. grazing demand) on veld is too high to be sustainable for the level of expected climate variability. Sustainability is defined as achieving zero economic profit in the worst, or 'poor', expected veld condition year. Furthermore, negative net returns per animal (for any given veld condition year) leads to the deduction that SD is beyond the economic carrying capacity of the succulent karoo AEZ under the current farm/reserve boundaries and existing management practices.

A stocking density beyond the economic carrying capacity of the succulent karoo AEZ has a depressing effect on QOL (defined earlier as a function of income, land quality and quantity). Large differences in net returns between the communal area of Paulshoek (with relatively low QOL and high SD), and neighboring commercial farm (high QOL and low SD) would support this premise[11].

3.3 THEORETICAL PERSPECTIVES

3.3.1 LAND USE-CAPACITY

The theory used to compare the relationship between SD and productivity under climatic variation is the Land Economics theory of land use-capacity. A key

concept in land use-capacity theory as it relates to this study is production at the intensive margins of input use, and the extensive margins of land quality.

Land economics was expanded and developed in the 1920's. The first general course on the subject was offered by Richard Ely in 1892 in a seminar entitled 'Land Property' at the University of Wisconsin. The US Department of Agriculture established the Division of Land Economics in 1919, and the first course materials dealing specifically with Land Economics were published in 1922 (for additional details see Salter, 1948; Ely, 1949; Barlowe 1986).

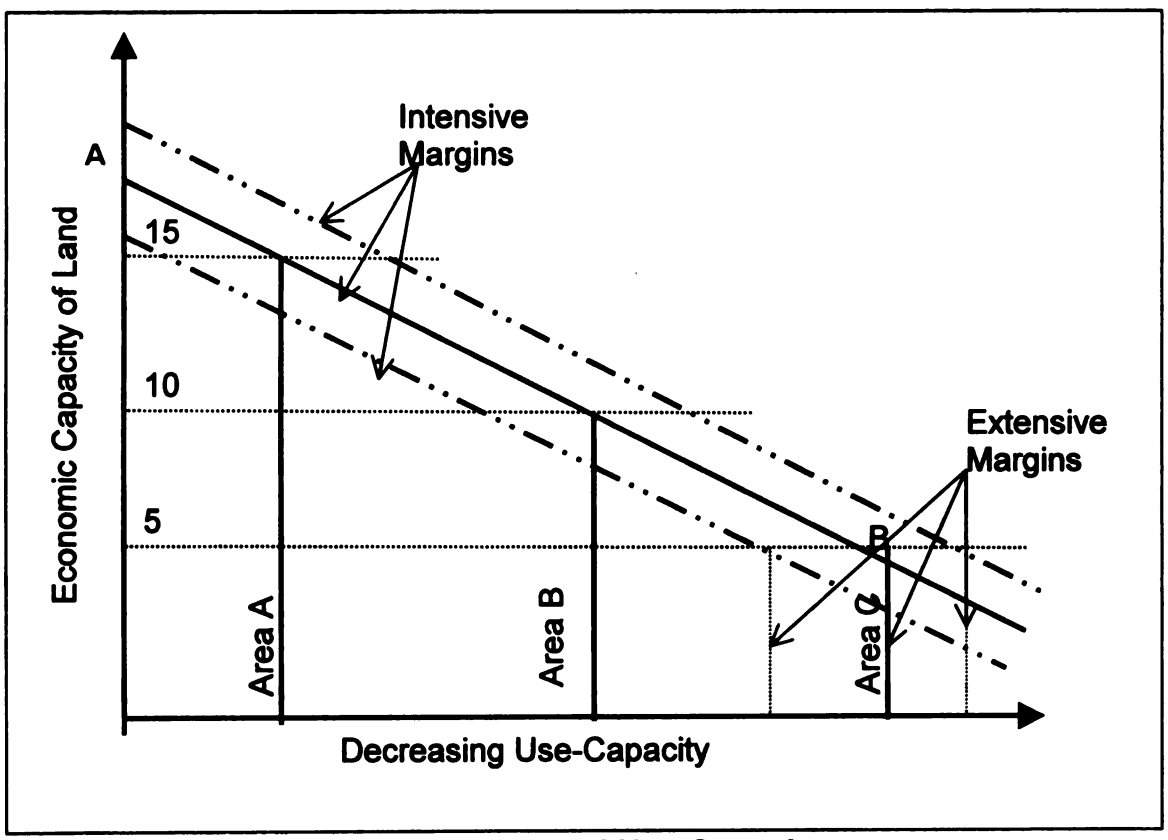

Figure 3-1 Land Use-Capacity

(Source: Barlowe, 1986)

Barlowe (1986) states that land-use-capacity "involves the relative ability of a given unit of land resources to produce a surplus of returns and/or satisfactions

above the cost of utilization for a given use at a given time with a given technological and production conditions." Schematically it is represented above.

The horizontal axis represents decreasing use-capacity of land types, and the vertical access represents the resultant economic capacities of these land types. As one moves right on the x-axis, the quality of land decreases and the number of economic inputs that can be utilized to gain economic profit (i.e. positive net return) at a particular land use-capacity decreases also (a downward shift along the y-axis). In this study, economic inputs are sheep and goats. The intensive margin is the point where the cost of an additional input is just greater than the returns for a given grade of land. The extensive margin is the point where it is not profitable to bring an additional unit of land into production for a set number of inputs.

The optimal points (where it does not pay to utilize an additional input) on successively decreasing land qualities, is represented by the line A-B. Where this line crosses a particular grade of land represents the point where Marginal Cost (MC) of an input equals the Marginal Revenue (MR) gained from it on a given grade of land.

The farmers in the study expressed that in relatively good veld condition years they are able to attain higher profits from their livestock farming enterprise, and that their returns become successively less as they encounter years of average and poor veld condition. This would indicate a positive relationship between net returns and veld condition. If net returns decrease as veld condition declines, and assuming technology and management practices do not change in

the inter-annually (across GAP years) then the horizontal axis can be modified for this study to represent decreasing use-capacity as one moves through $G \Rightarrow A \Rightarrow P$ veld condition years.

In figure 3.2 below, the vertical axis represents animal inputs per ha of land, or SD, which is expressed as sheep and goats per ha. The average number of small-stock in Paulshoek between August 1998 to March of 1999 (the latest period where stock data is available for both Paulshoek and the surveyed commercial farmer) is represented by the line SDp. The commercial farmer's stocking level is represented by SDc. SDp = .13 small-stock per ha (2880 small-stock on 22,000 ha, or 7.6 ha per animal, and SDc = .09 sheep per ha (460 small-stock on 5200 ha, or 11.3 ha per animal). Animal numbers are lower than average because 1998 was a poor veld condition year[12].

The 26 years average (1971-1995) SD for Paulshoek is 3906 small-stock. The Long-Run SDp (LRSDp) is .18 animals per ha (or 5.6 ha per animal). The commercial farmer expressed that his long-run average stock numbers roughly correspond to the Department of Agriculture's recommended stocking level for succulent karoo AEZ (.10 animals per ha, or 10 ha per animal). The figure of .10 animals per ha is assumed for LRSDc.

The traditional theory of use-capacity assumes different entities of land representing 'use-capacities' at a specified time with other production variables constant. In this study, the opposite is true; the area of land under study is constant as are the exogenous variables-inherent Land Quality (L_Q), Technology (t), and the endogenous variable, Management Practices (MP). The exogenous

variables- time (annual with respect to veld condition) and animal prices vary. This produces theoretically changing use-capacities on a constant land entity. An SD line above and to the right of line A-B represent small-stock inputs (SD) beyond the intensive margin of production for a given biomass productivity year (GAP). Conversely, positive net returns per animal input to veld can only be realized when SD falls below and to the left of line A-B.

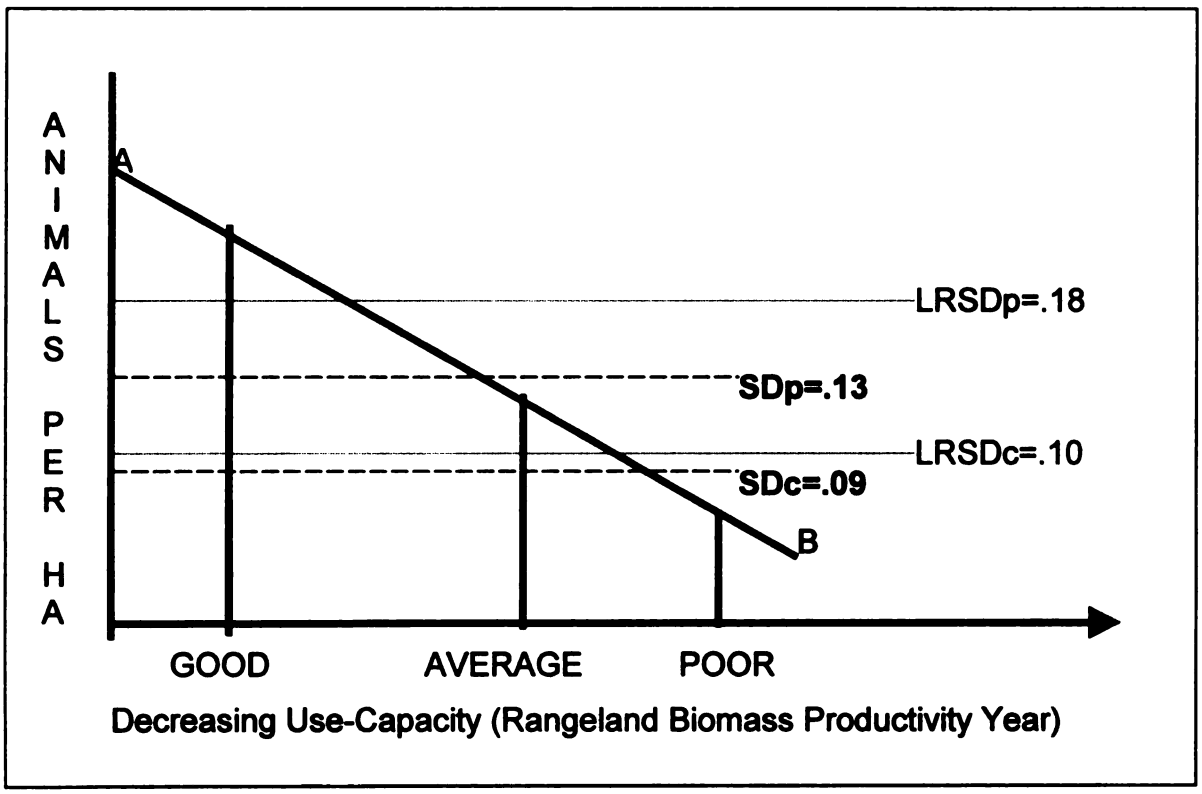

Figure 3-2 Land Use-Capacity in GAP Veld Condition Years

MP, Lq, and *t* differ between communal and commercial LFS. They are assumed to be constant between the two LFS in the medium-term (across GAP veld condition years). The profitability of a particular SD will be determined for a given set of variables (MP, Lq and *t*) that exist on commercial and communal

LFS. This allows for a comparison of the dependent variable, productivity (as measured by FP_A), and the independent variable SD, through changes in the mediating variable, annual (GAP) veld condition. This relationship is expressed below.

$$\Delta FP_A, FP_L(G \leftrightarrow A \leftrightarrow P) = f\left[SD \middle| L_Q, M_P, t\right]$$

The MR of an additional animal per ha is going to be diminishing to the point of being negative if the number of animal inputs per ha, or SD, is beyond the intensive margin for a given use-capacity (above and to the right of line A-B in figure 3.2). If this is the case, SD is beyond the use-capacity for a given veld condition year. Net returns are expected to be negative, and with time, SD will shift down in response.

The change in net returns *between* GAP veld condition years can be used to indicate how far from the economic carrying a given SD is given the level of climate variability. A conservative stocking rate would produce a smaller magnitude of change in net returns from year to year since there would be enough ungrazed forage for animals to utilize in years of lower use-capacity (poor veld condition years).

An analysis of SD in relation to climate variability by Danckwerts (1984) found that farmers lose profits by applying a 'conservative' stocking rate when encountering a 'wet' year (since SD is not high enough to utilize the increased use-capacity of the improved veld-SD is below and to the left of line A-B in Figure 3.2 in this case). These loses were found to be disproportionally smaller in magnitude to those incurred by applying a 'liberal' stocking rate and

encountering a 'dry' year. Thus a high, or 'liberal', stocking rate would produce greater changes in net returns (see the equation above) in GAP years, and thus affect QOL more acutely. "If one adds to this the fact that the frequency distribution of rainfall is positively skewed, then farmers are benefited financially by applying conservative stocking rates" (ibid.).

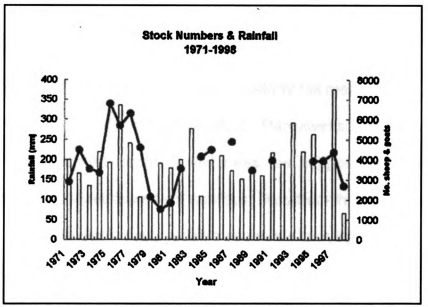

Figure 3-3 Rainfall in Springbok and Stocking Density (SD) in Paulshoek
(Source: NBI, 1999)

Figure 3.3 above shows the relationship between SD in Paulshoek and rainfall (represented by the bar chart) measured in Springbok-the nearest site where long term rainfall data are available). Drops in net returns as rainfall decreases can be principally attributed to decrease in animal output (through decreases in lambing and weaning percentages) and increased deaths. The positive relationship between rainfall and stocking density have been established

by a number of reports (for in semi-arid regions of South Africa see Dean and Macdonald, 1994 and Van den Berg, 1983).

Decreases in stock inventory in poor veld condition years are supported by data collected for this study (see annual farm budgets in Appendix B). The data collected for this study indicates a strong positive relationship between productivity and veld condition.

3.3.2 ECONOMIC vs ECOLOGICAL CARRYING CAPACITY

The purpose of this study is to relate productivity (as measured by net returns per animal) to SD under climate variability. Danckwerts (1984) assigns 'veld condition scores' to GAP separate veld areas, and suggests a decreasing stocking rate for successively lower veld qualities. Data from this study supports the concept of a, climate dependant, variable economic carrying capacity.

Aside from being more practical for measurement, micro-scale communal land enclosures, agroecological factors, and the objectives of farmers requires the use of economic carrying capacity (see this section and 3.3.3). Todd and Hoffman (1999b) found that SD in Paulshoek, is at or close to, ecological carrying capacity, and state that, "if this were not the case, stocking rates would not track rainfall, as there would be enough residual forage to maintain stocking rates through short drought periods".

This study will determine the level of profitability for the current SD (which may be close to the ecological carrying capacity) for the scale level of Paulshoek. Scale is an important determinant that has often been overlooked in

analysis of carrying capacity of livestock. Turner (1993) writes, "Environmental analyses that focuses solely on stocking rates, no matter what their spatial scale, oversimplify the biophysical aspect of vegetative response to grazing." Results from this study may be applicable to the other reserve areas that have a similar are to Paulshoek, but caution should be used when applying the findings to larger spatial scales.

An argument for the basis of using economic carrying capacity is given after a synopsis of the 'ecological carrying capacity' concept using the paper "Rethinking Range Ecology: Implications for Rangeland Management in Africa" by Behnke and Scoones (1991).

According to Behnke and Scoones, the concept of carrying capacity is fluid and that grazing systems are not and cannot be at a static equilibrium. They note that traditional concepts of equilibrium are based on livestock numbers being controlled by forage availability, and the amount of forage being controlled by livestock numbers. This negative feedback mechanism will necessarily lead to a stable equilibrium of livestock numbers and forage levels as the two check each other to reach 'ecological carrying capacity.' They argue that climate and other variability create chaos which effectively makes a static carrying capacity incompatible with climatic perturbations.

They also state that the notion of an 'economic carrying capacity' is based on the objectives of commercial beef ranch-farming for marketing, and is the point where livestock attain the point of highest off-take and thus optimal live-weight for marketing. They assert that many African pastoral and communal

livestock systems are perceived as overstocked and overgrazed because of a misplaced application of this economic carrying capacity concept.

Behnke and Scoones maintain that carrying capacity should be determined according to the objectives of a particular farming system. In the case of extensive communal livestock systems this would not be at a conservative economic carrying capacity, but close to ecological carrying capacity. They propose 'opportunistic management' which is predicated on the movement of livestock (as historically practiced by pastoral herders in Africa) that mimics amplitudes in climatic change; moving to better vegetation and thus to an area of higher carrying capacity.

The premise of opportunistic management is captured in the idea that the overall carrying capacity of a landscape is determined by the highest accessible and available 'patch' comprising a sub-landscape. Thus, if movement is permitted, degraded patches affected by seasonal drought could be avoided, and livestock can move to exploit 'greener pastures' (if such lands are available *and* accessible) elsewhere-thereby increasing the overall carrying capacity of the entire landscape, and allowing for the long-run regeneration of the degraded patch.

Variable carrying capacities exist due to climatic variation, and also because of social, political, and economic forces that converge to form fragmented landscapes as is the case in and around former 'reserves' and 'homelands' of South Africa and Namibia. Behnke and Scoones observe that current tenure arrangements may need to change to create the flexibility needed

for opportunistic management. "Livestock movement is a second means to adjust to local imbalances in stock numbers and forage availability. Opportunistic management would seek to maintain mobility as a production strategy and to adapt this characteristic feature of pastoral nomadism to changing economic and institutional conditions. A new approach to pastoral land tenure would need to be a critical component of this effort."

This study attempts to relate SD to productivity by making profitability comparisons between communal and commercial farmers', or assessing the net return to livestock farming with climate induced variations to veld. Assessing the profitability of communal and commercial SD implies the use of economic carrying capacity which is determined to be an appropriate measure for the following reasons:

1) Survey responses indicate that communal and commercial farmers do not differ in their objectives (profit seeking) for engaging in livestock enterprises. The communal farmers and the commercial farmer invariably cited 'income' as the primary reason for keeping livestock (see Appendix A). Therefore, the profit maximizing objective is found to be the same on communal and commercial LFS, but the rate of stock liquidation, or sales, on communal farms slower, perhaps due to the lack of a rural banking system[13].

2) Nama-speaking Khoi pastoralists are no longer found in Namaqualand. Communal and commercial residents of Namaqualand are now sedentary, and share the same mother language, Afrikaans. They are both participants and competitors in the agricultural economy that is now attempting to reform past

forms of duality (see Lipton et al, 1996; Lipton and Lipton, 1993). Dual agricultural policies have ended, and the South African economy is moving toward equal effective input costs, market prices, and the level of government services provided (e.g. agricultural extension service).

3) In the context of relative and absolute poverty found in the former reserves of Namaqualand, standard economic benchmarks and productivity ratings are needed to assess the benefits associated with livestock farming in the semi-arid karoo. Economic carrying capacity directly addresses the pressing question of poverty in the former 'reserves' since it assess how income is related to a SD decision on the primary form of livelihood found in the succulent karoo.

High SD results in stock numbers tracking rainfall in Paulshoek. This happens through changes in livestock productivity which results from changes in inventory (i.e. decreased output) and increased deaths. This suggests that Paulshoek is at *ecological* carrying capacity, on a micro-scale, where income and QOL are acutely affected. Is it equitable, efficient and sustainable for a communal livestock farmer to loose half his herd and incur negative net returns in a poor veld condition year? How does this affect his position of relative and absolute poverty[14]?

4) There are fewer options for opportunistic movement on the micro-scale and/or ecological carrying capacity has been reached in Paulshoek. To be sure, micro-scale seasonal movement occurs across altitude in Paulshoek; during the winter growing season the lowlands are grazed more, but the highlands are utilized more during the dry summer months as moisture availability increases

with altitude (Todd and Hoffman, 1999b). The result is the lowlands becoming heavily degraded as they are grazed during the growing season. Also boreholes are located in the low lands which causes clustering around them, and thus increased degradation due to increased grazing and trampling.

5) Within the context of the dual livestock farming economy, static farm boundaries as they are in place today, are assumed for this study. Movement is a prerequisite for opportunistic management (Behnke and Scoones, 1990; Sanford, 1983) but movement is severely restricted (on the Paulshoek scale) because of the 'camp' nature of the former 'reserves'. Economic carrying capacity may be a crude indicator of an *ecological* carrying capacity since economic and ecological carrying capacity may not differ by much when there is less opportunity to exploit 'patchiness' or sub-landscapes of varying carrying capacities.

6) As a practical matter, determining ecological carrying capacity on a medium or large-scale is not feasible in Namaqualand because of fences that divide private, government, and communal lands[15]. Grazing outside of current stock-posts and farm boundaries are needed to achieve the broader view (i.e. on a larger, transhumance scale) of ecological carrying capacity. Large increases in communal land that eliminate landscape fragmentation are not foreseen to occur in the near term because current market based land reform are not radical (see Eicher and Rukuni, 1996; Binswanger and Deininger, 1993; Levin and Weiner, 1996) in the sense that land acquisitions for the land reform program are

purchases of individual commercial farms to expand communal lands, and do not at all represent large scale land transfers to communal area residents.

3.3.3 STOCKING DENSITY MODEL FOR PROFIT MAXIMIZATION

'Income' is given as the primary response to why livestock are kept by all farmers in this study, so it is appropriate to examine SD through a model of profit maximization. The fact that communal farmers have open access to the veld makes it economically sensible for them to stock at (relatively liberal) SDp instead of profit maximizing (conservative) SDc in Figure 3.4. Grazing-land *within* Paulshoek is a non-exclusive rival good, so the short-term benefits, but not the veld costs, are shared by the livestock farmer. Thus there is no incentive for any one farmer to reduce stock if other farmers are not required to do the same.

This results in the 'tragedy of the commons' (Hardin, 1968) as overstocking takes place since there is no price mechanism to indicate the scarcity of veld. The rival feature of the communal LFS encourages farmers to stock at higher levels than the use-capacity for a given veld condition year. This reduces productivity since SD is beyond the economic carrying capacity, or intensive margin at particular veld condition year.

There is a wealth of literature which take a different view and argues the merits of high stocking rates on communal farms (see Cousins, 1996b; Scoones, 1992; Boonzaier et al, 1990; Behnke 1985). These studies emphasize the use-value of livestock; their social function which includes reciprocity among neighbors and the form of social/financial security they represent. While these

social functions are important, this study focuses on the specific effects that relatively high SD has on productivity (measured by net returns per animal) and how this affects QOL.

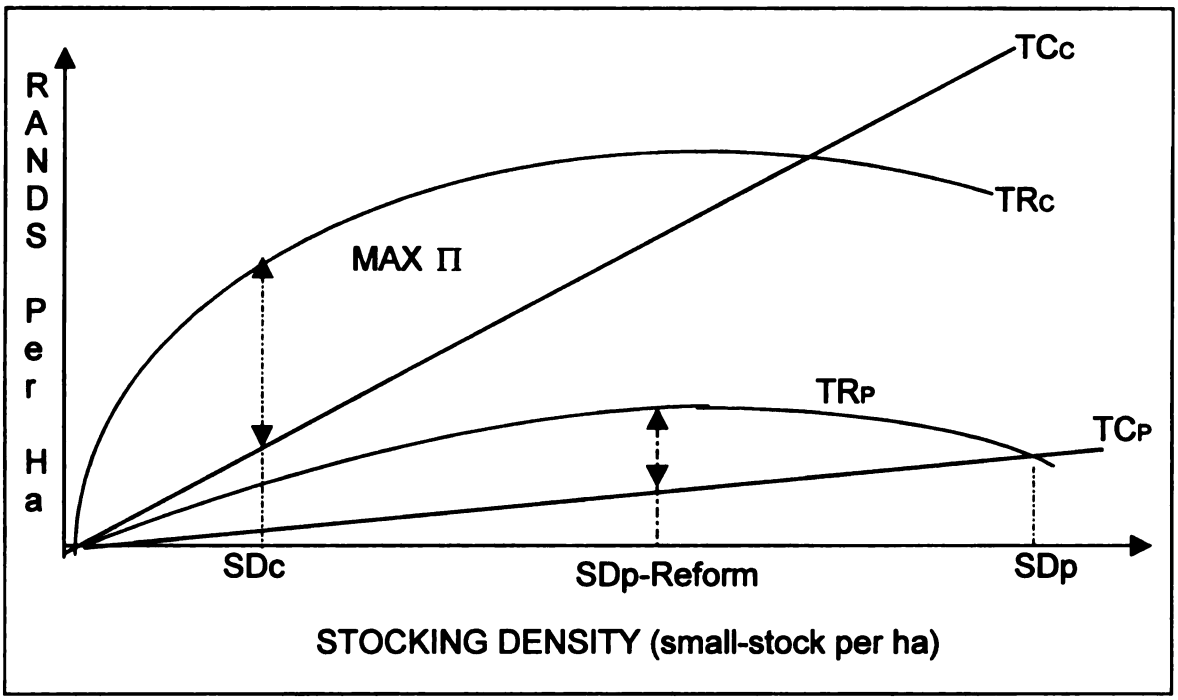

Figure 3-4 Profit Maximization and Stocking Density

The point where the vertical distance between Total Revenue (TR) and Total Cost (TC) is the largest represents the SD that yields maximum profit. At this point the *slopes* of the TR line and the TC line are the same, and the distance between them is not increasing nor decreasing. This represents the point where MR and MC are equal, and the point of optimal input use for a given use-capacity (a point along line A-B in figures 3.1 and 3.2). The commercial farmer's SD is at point SDc where the vertical distance between TCc and TRc is

the greatest. TCc is greater than TCp because it includes land cost. TRc is greater than TRp because land degradation and poor management practices decreases revenue in the communal LFS.

Paulshoek farmers' stock at SDp since they do not pay for land; veld is an open access resource in the absence of any institutional cooperation. This forces the Paulshoek LFS to be at SDp, where TR=TC, and there is zero profit. Communal open access veld in Paulshoek is analogous to the model of an open access fishery where fish, like veld, is free. Since profits are net TC, and TC is close to zero, the promise of revenue with almost zero cost encourages over-extraction of fish, veld, and diverse open access resources alike.

The race to catch the greatest number of fish, without cooperation among fishermen, results in a greater number of fishing nets utilized as individual fishermen attempt to maximize their individual profit. This occurs as 1) new entrants (fishermen) increase, and 2) as more nets are used by existing fishermen. The Paulshoek LFS similarly attracts more livestock farmers, and encourages the increase in stock numbers by existing farmers. SD increases, and a 'tragedy of the commons' result when all the profit is essentially competed away. SD only stops increasing at SDp, this occurs when TR falls far enough to equal TC (Gordon, 1954; Hardin, 1968; Berkes, 1989; van Kooten, 1993).

Even if farmers cooperate to reduce SD by creating entry barriers and limiting stock size, TRp remains lower than TRc in the short run, and will not change in the long-run without active veld restoration and improved management practice. So communal farmers accept a lower MR than the commercial farmer

from every additional animal per ha[16]. Thus MC and MR are equal at 'SDp-Reform', but not as high as SDc, which results in lower profit, and 'SDp-Reform' still being to the right of SDc. TCp does not change under cooperation since land cost is still zero. It is emphasized that veld degradation and poor management practice has shifted TRc down to TRp, so the communal LFS is expected to attain lower profits even with cooperative reform (section 5.2.3 discusses internalizing veld cost using an animal head tax).

In poor veld condition years, use-capacity decreases, and the relative overstocking becomes more acute in terms of the pressure on the veld since stocking is beyond the intensive margin. This is expected to cause MR to fall below MC. A dynamic graph would shift SDp and SDc in Figure 3.4 to the right under good veld conditions, and a poor veld condition year would shift SDp and SDc to the left. TR and TC would, of course, also shift.

3.4 METHODS OF COMPARISON

The dependent variable, productivity (FP_A) measured in net returns per head) are related to the independent variable, SD, under climate dependant (GAP) changes in use-capacity. The focus of this analysis is a comparison between communal and commercial farmers' productivity, and how productivity changes as veld condition varies. Changes in productivity are revealed by analyzing changes in net returns of communal and commercial farmers in hypothetical GAP veld condition years. This is done by calculating the following in GAP veld condition years:

- Lambing and Weaning Percentages[17]
- Effective Factor Productivity of Animals (FP_A)=Net Returns/Head
- Effective Factor Productivity of Land (FP_L)=Net Returns/Hectare
- Effective Total Factor Productivity (TFP)=Total Net Returns

TFP is a measure of the overall productivity of the two LFS. One must remember that communal and commercial farms face (differing) farm-specific production costs as a result of the different production methods that characterize the two LFS (for information on farm specific input costs see Berry and Cline 1979; Ellis 1993). For example, communal farmers do not incur a land-lease cost that the commercial farmer does.

The opposite is true with respect to labor costs, which communal farmers incur, and commercial farmers do not. Communal farmers obviously do not pay for land, and commercial farmers do not pay for labor since they practice rotational grazing in camps, so they do not hire a herder[18]. The two LFS also differ in their mobility of herds; the commercial farmer moves from one fenced camp to another while the communal farmers move stockpost location.

3.5 SURVEY QUESTIONNAIRE

The survey questionnaire for the 8 case studies consists of 21 questions with various sections to each question (see Appendix A). The questions were asked in Afrikaans (for the communal farmers) with the assistance of an

interpreter[19]. The commercial farmer answered in English sometimes with the assistance of his wife (their first language is also Afrikaans). The interviews were done on the sixth field trip by the author to the Paulshoek area. The first visit occurred in July of 1998, and the remaining five visits (two approximately a week long, two-a day long, and one-two days long) occurred between February and May of 1999[20]. These visits allowed the author an opportunity to be familiarized with the farmers and their livestock operations, and to prepare the survey[21]. The first and only visit with the commercial farmer occurred during the sixth, and last field trip. Follow-up questions for both commercial and communal farmers were done by telephone in subsequent months.

The communal farmers herd their animals by following them in the veld (usually with the assistance of hired herder) so every attempt was made to make the survey as short as possible in order not to take the farmer away from tending to his animals. Sometimes it was necessary to do the surveys in the very early morning, or late evening for this reason. The questionnaire focused primarily on an inventory of inputs and outputs in historically recalled GAP veld condition years. This was done in order to analyze changes in productivity as climate changes, and relate it to SD and the carrying capacity of the veld. Questions that attempted to gain a qualitative description of the LFS are numbers: 1, 2, 16, and 19-21 (see Appendix A).

The input/output focus of the thesis, and the time constraints of farmers and the interpreter did not permit for an extensive Farming Systems Research (FSR). This was addressed in two ways; a discussion with one communal farmer

and an interview of the author's interpreter. The informal discussion between the author and one communal farmer focused on 'why' people farm livestock on the reserves. Its duration was approximately one hour, and occurred during a drive to Kharkams (another communal area in Leliefontein) with the assistance of the interpreter.

In addition, an interview with the author's interpreter answered some questions that would have been pertinent to all the farmers in Paulshoek. The information gained from this centered on common livestock farming practices, market condition, and prices (which permitted the author to spend time on idiosyncratic data collection from the farmers). The interpreter also answered questions that were thought to be too sensitive, such as how much herders are paid and who gets a pension in the community. Christensen (Devereux and Hoddinott, 1992) was referred to as a guide for collecting sensitive livestock farming data.

The commercial farmer and his wife explained their LFS including some general information on the farming enterprises of other commercial farmers in Namaqualand, and gave commentary on communal and commercial LFS.

3.5.1 SAMPLE POPULATION

The communal farmers were classified according to large, small and medium herd owner. A selection of seven farmers ranging in herd size from 33 animals to 182 small-stock were chosen for the case-study surveys. The criteria for selection included availability, willingness to cooperate, and their proximity to

Paulshoek's center and campsite where the author stayed (see section 4.1). Two farmers resided away from Paulshoek's center, so bicycles were used to reach them.

Figure 3.5 displays the percentage of total small-stock in Paulshoek the sampled farmers owned in May and October 1996, March and October 1997, and February 1998 to March 1999 (except April 1998). There are no large differences in the percent of small-stock holdings which indicate that farmers follow a predictable pattern of livestock management. Therefore responses to the survey questionnaire are presumed to reflect non-deviant, general, management practices during varying annual veld conditions in Paulshoek. Farmer No.1002 worked on a commercial farm until 1997, so he has no animal data until March 1997.

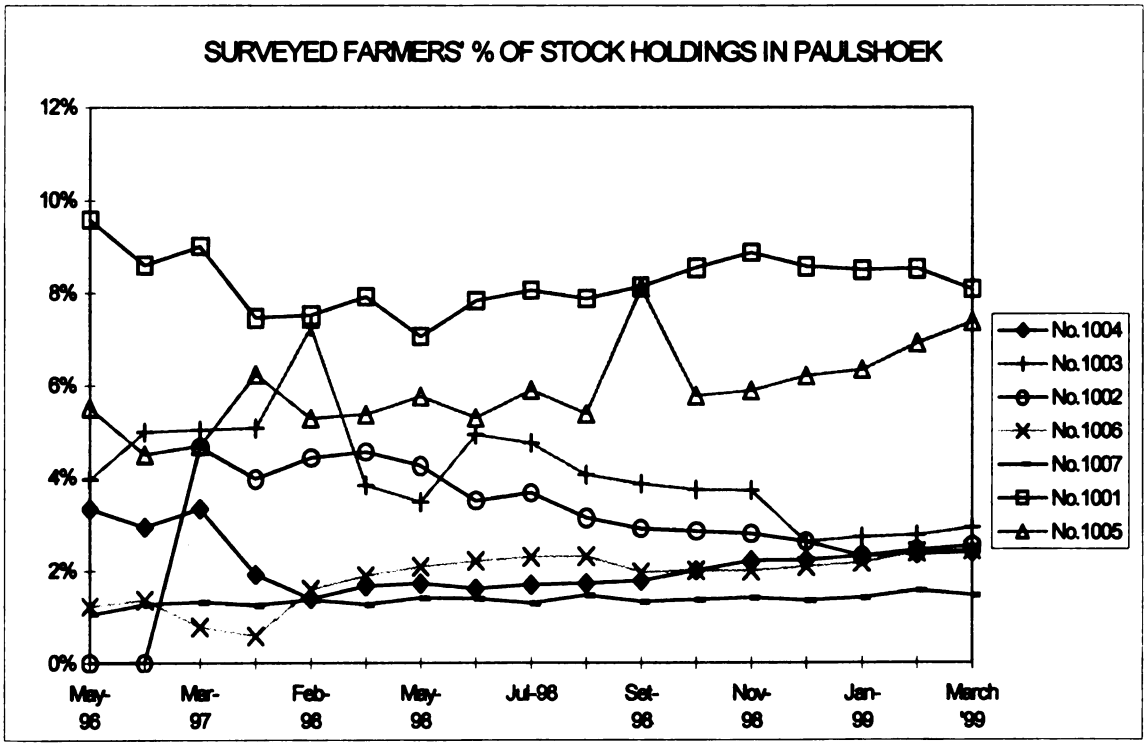

FIGURE 3.5

3.6 GOOD, AVERAGE, POOR (GAP) ANNUAL FARM BUDGETS

Cash values for the farm budgets were estimated based on responses to the survey questions, and also based on the author's knowledge of the area's livestock market. The survey identified the farmers who utilize family labor and those who hire labor, and the monthly labor price were gained from the interpreter's feedback. All data come from the survey questionnaire found in Appendix A.

A pertinent reference for comparative studies of LFS is "Measuring the Benefits of Subsistence Versus Commercial Livestock Production in Africa" by Behnke (1985). The paper presents various approaches to valuing rangeland products for which there is no market price. Three methods for measuring the productivity of livestock farmers, and the QOL associated with commercial and subsistence, sometimes communal, LFS are discussed. 1) Biological measures of herd number and quality, 2) assigning cash values to in-kind produce, and 3) the nutrition level of human populations engaged in commercial and subsistence livestock production. This study uses the first of these methods, and the second to a limited extent.

3.6.1 OUTPUT DATA

Cash values for sheep and goats are based on typical market prices. The communal farmers face the following prices for sheep and goats: R100 in a poor veld condition year, R200 in an average year, R250 in a good year. The commercial farmer reported getting the same price per animal, R250, across

GAP veld condition years. This information is counter to what would be expected to happen, but the commercial LFS mitigates weight loss in poor veld condition years better than the communal LFS.

The survey responses to the amount of LOCAL SALES[22] (animals sold within Paulshoek), MARKET SALES, and SLAUGHTER were multiplied by these prices. The low price received by communal farmers could partly be a result of a low price quote from speculators who know that farmers sell for immediate cash needs. This is especially true in years of poor veld because of increased input demands coupled with increased animal losses and decreased animal products.

The aggregated small-stock monetary values comprised of LOCAL SALES, MARKET SALES, and SLAUGHTER yield the TOTAL OUTPUT number for each farmer. GROSS INCOME was then calculated by adding any changes in livestock inventory to TOTAL OUTPUT. Inventory change was calculated using the following method [Births - Deaths -Sales - Slaughter]. So gross income is [Births-Deaths]. Analyzing the INVENTORY CHANGE section of the farm budget allows for identification of areas where losses or gains are occurring as a result of changes in veld condition.

Milk and skins are not valued for the following reasons. 1) It was difficult for farmers to recall information on the annual number of skins sold and liters milked, and how these numbers changed according to veld condition. 2) While helpful for a more complete understanding of the LFS, it is not essential for this study because the emphasis of this study is on carrying capacity and livestock production as it relates to GAP veld condition years. 3) Both are also extremely

minimal contributions to farmers' income although milk has another social value (it is usually given to neighbors/friends or in exchange for labor).

Past comparative studies have underestimated the contribution of non-commercial products of communal farmers such as goat milk, draught power, and manure for fertilizer (Barrett 1992; Behnke 1985). In terms of output, communal farmers in Namaqualand differ from commercial farmers only in their production of goat milk. The amount of goat milk produced by communal farmers is small, for example between August and April 1999 (a poor veld condition year), NBI data indicate that the average communal farmer milked between zero and two liters of milk. During the same period, communal farmers generally sold none to a few skins, and the most sold by a single farmer, from the entire population of livestock farmers, was 10 skins at a market price at R3-6 (price gained from question 9 of the survey). Skins are even sometimes thrown away because of currently depressed market prices.

A Willingness To Pay (WTP) survey on goat milk (question No.8) was included in the survey to understand the value of milk since there is no market for milk; it was found to be minimal (on average R3.3 per liter) and thus milk is not valued. This study stops short of including these quantitative values for milk and skins in the annual farm budgets. Providing a detailed analysis on the role of goat milk and other use-values of livestock is beyond the scope and objectives of this study.

3.6.2 VARIABLE INPUT DATA

All input data are from the survey questionnaire and are based on annual amounts except for forage costs (question No.10). The cost of feed was asked on monthly basis for the communal farmer and then multiplied by 12 in the annual farm budget. The commercial farmer expressed forage cost on an annual basis. Variable costs include forage (feed) costs, veterinary, and the cost of moving stockpost locations (for communal farmers). Purchase of animals is also a cost, but only one farmer (No.1001) does it regularly. These animals are assumed to be purchased at the price farmers expect to sell their animals.

The stubble that remains after harvesting crops is also minimal because of minimal crop acreage; it is grazed however (in poor veld condition years there is usually no harvest and thus no stubble). Stubble is not valued in the farm budget because it is difficult to accurately estimate its cost, and because it is a positive externality without other use-values (there is only a minimal nutrient increase in soil fertility from not grazing it). Also, this study focuses on productivity related to SD on the veld; crops are grown on separate cropping areas in rangeland.

3.6.2.1 FORAGE

Data on forage come from survey No.10. This question began by asking what forage costs were in GAP veld condition years, but the communal farmers had difficulty recalling annual forage costs, so the question was changed to

monthly estimates of forage costs. The commercial farmer expressed forage costs on an annual basis.

3.6.2.2 VETERINARY COST

The veterinary costs associated with keeping livestock were determined for each farmer by survey question No.12. Veterinary costs per year appear to be inversely related to veld condition year.

3.6.2.3 MOVES

Moves are a variable of veld condition and other variables; in years of poor veld condition livestock farmers move their stockposts more often in search of better grazing areas. Moves cost between R30-R50, so an average of R40 was multiplied times the number of moves. The commercial farmer does not 'move', he practices rotational grazing in camps. He opens the gate to the part of the farm, or camp, he wants his animals to graze on, so he has no move costs (rotational grazing is discussed in section 2.3.2).

3.6.3 FIXED INPUT DATA

Breeding rams, labor, and the commercial farmer's land-lease cost (to the commercial farmer) are considered fixed costs. The annual cost of a fixed durable inputs (in this case rams) is calculated by dividing the difference between the purchase price and the salvage value at the end of use by the number of years of expected use.

3.6.3.1 MAINTENANCE AND LIVESTOCK FARM-IMPLEMENTS

Only one communal farmer bought any farm-implements cost during the past year, and none had a regularly reoccurring fixed farm-implement costs, so fixed investments costs are assumed to be zero for all communal farmers. The commercial farmer has a reoccurring investment cost for maintaining his farm machinery (he estimated this to be R1000 per year).

3.6.3.2 LABOR

The communal farmers use family and hired labor in livestock production. The commercial farmer practices rotational grazing on his 5200 acre farm that is subdivided with fences; he manages all the operations on his farm, so he does not hire a herder or use full-time family labor. Hired labor and full-time family labor value (on communal farms in this case) is the sum of salary and benefits.

The market rate of monthly labor is approximately R200, and the benefits can be values at another R200, so the annual cost is R4800/year. The work involved can be functionally described as that a shepherd or herder would do. All communal farmers generally use the assistance of one herder (in passing, note the low pay and poor working condition of herders).

Benefits include food (usually flour for bread), and very basic shelter (corrugated steel structures or *maikeshuts*). The herders also get shoes and tobacco. Three of the surveyed communal farmers use family labor. The shadow price for family labor is proposed to be R300 per month, or R3600 per year. This figure arises from adding the 'in-cash' portion of hired labor (R200) to the portion

of 'in-kind' labor cost that is additional, due to herding, to what is already consumed in the household (for example shoes that need to be replaced more often due to herding). This is estimated to be R100 per month.

3.6.3.3 RAMS

Ram costs were gained from survey responses. All the communal farmers bought breeding rams from commercial farmers except for one farmer who uses his own breeding stock, and one other who buys rams from other farmers in Paulshoek; their ram costs are estimated to be R250 based on the market rate of a locally bred rams. For farmers who kept both sheep and goats, the annual cost of sheep and goat rams were averaged. At the end of a ram's use period it is added to inventory (sold, slaughtered, or castrated and incorporated into the stock). The residual value of a ram is assumed to be R200 for the communal farmer who buys them from commercial farmers. R400 is the residual value assigned to the commercial farmer's rams which are bought from a ram breeder for between R800 to R1000 (R900 was used as a cost price).

3.6.3.4 LAND LEASE

The commercial farmer leases 3400 ha of his 5200 ha farm (he inherited 1800 ha). The farmer stated that the lease cost per year is between R20000 and R18000, so R19000 was used.

CHAPTER 4: FINDINGS AND ANALYSIS

4.1 STOCK HOLDINGS

The sampled farmers' stock holdings as of March 1999 are represented by Figure 4.1. The largest farmer (No.1008) is the commercial farmer. He keeps 363 sheep and 18 goats. The same sequence, moving left to right (smallest to largest herd owner) is maintained for the analysis that follows in this chapter. The first farmer (No.1007) keeps only goats; he is representative of a small farmer in Paulshoek (to compare his and other surveyed farmers' stock holdings to the entire livestock farming population in Paulshoek see Appendix C). Images in this thesis are presented in color.

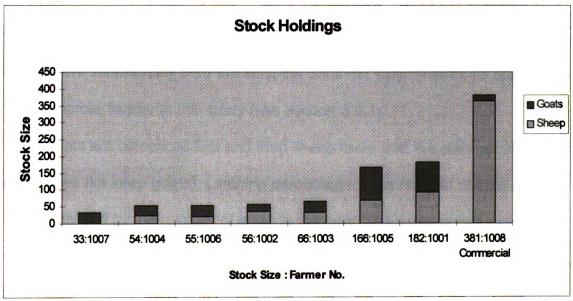

FIGURE 4-1

The commercial farmer markets only sheep; he keeps a few goats around for home goat milk consumption, and for (sheep) lambs to suckle in case that some twins are born and there is increased demand for milk. Farmers 1004, 1006, 1002, and 1003 have between 54 and 66 small-stock and are considered average size communal farmers. Farmers 1005 and 1001 represent large stock farmers with 166 and 182 animals respectively.

4.2 LAMBING PERCENTAGE

The first measure of productivity analyzed is lambing percentage. The birth rate of lambs or kids is an objective rating of herd performance. Percentages of births and deaths do not reveal the quality of the herd, only the quantity and proportion to the number of ewes that are dropped. Subjective (quality) differences are partly revealed by the prices received per animal. Price per head can vary by as much as 150% between poor and good veld condition years for the communally bred animals, but does not vary for animals reared by the commercial farmer in this study (see section 3.6.1).

Goats are compared first and then sheep (note that the commercial farmer does not keep goats). Lambing percentage is the number of kids or lambs dropped divided by the number of ewes in the herd. The number can run over two hundred percent, particularly in good veld condition years for goats since goats generally drop twins and sometimes triplets. Sheep ewes usually drop one lamb at time, but may have twins, on occasion. These data are taken from

question No. 3 of the survey questionnaire found in Appendix A, and analyzed using the farm budgets found in Appendix B.

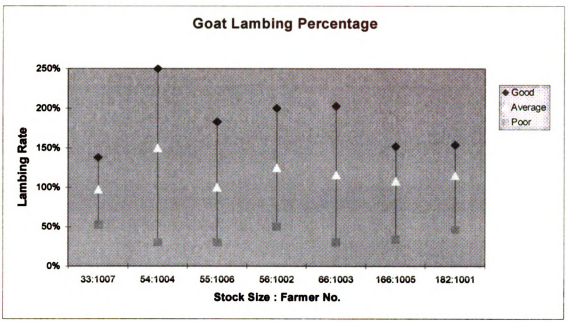

Figure 4-2

Lambing percentage is calculated in Good, Average, and Poor (GAP) veld condition years and the differences are expressed below for goats and then for sheep. The change in lambing percentage between good and poor veld condition years is at least a decrease of one hundred percentage points for all farmers. The two largest communal farmers (Nos.1005 and 1001) and the smallest farmer performed better than the rest. The commercial farmer's stock of goats is minimal and he does not monitor their breeding so no data are available for farmer No.1008.

Smaller farmers are affected more acutely by large drops in lambing and weaning percentages since a greater percent of their wealth (represented by

animals) is affected. Low lambing and weaning percentages pushes stock numbers down as happens in years of poor veld condition. The lambing percentage of sheep is represented below.

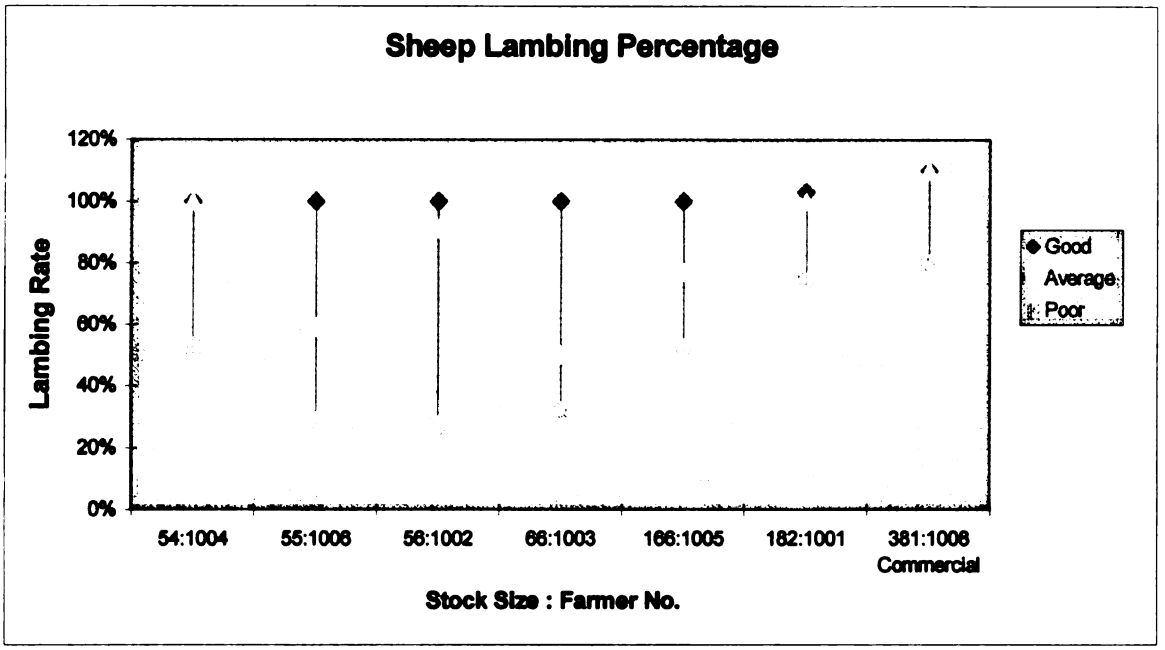

Figure 4-3

The sheep lambing percentage difference across veld condition years is smaller than the goat lambing percentage difference. Goats usually drop twins so their lambing percentage is expected to be double that of sheep. Therefore there are proportionally more lambs at risk with poor veld condition (note the y-axis scale difference between figure 4.2 and figure 4.3). This variation is also explained by the physiology of goats; the fetus is less attached to the uterus than for sheep. This causes the goat ewe to abort, especially 6 weeks prior to lambing, (a problem partly caused by a deficiency in vitamin E).

The commercial farmer has the highest average lambing percentage and he is the farmer with the least change between GAP veld condition years (there is effectively no change between average and good years). Farmer No.1001's lambing percentage performance is a close second to the commercial farmer's, but averaging all veld condition years, the commercial farmer's herd achieved a higher overall lambing percentage. The communal farmers get close to the lambing percentage of the commercial farmer as veld condition improves, but they are far lower in poor veld condition years indicating that they have surpassed *ecological* carrying capacity.

4.3 WEANING PERCENTAGES

Weaning percentage is an indicator of mortality. Like lambing percentage, weaning is also an objective measure; either a kid or lamb dies or lives past four months. It is measured by dividing the number of lambs or kids that survive beyond four months by the number born. Figure 4.4 displays the variations in weaning percentage for goats in GAP veld condition years (note again that the commercial farmer does not keep goats).

Farmer 1007's and 1001's (the smallest and the largest communal farmers) have the lowest changes in mortality rate across veld condition years. All farmers except 1007 and 1001 have relatively high rates of change in weaning percentage across veld condition years.

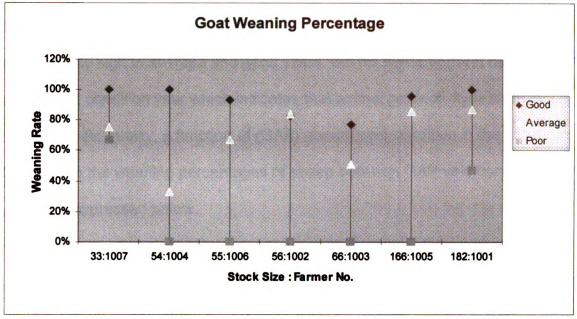

Figure 4-4

Farmer 1005, whose herd performed relatively well in 'lambing' across all veld condition years, has a high rate of change in weaning percentage. Not surprisingly, he spends the least on inputs of any other farmer (total input cost per animal per annum in GAP veld condition years are R29, R32, R40 respectively). Farmer 1005 is the second largest communal farmer, but he relies most heavily on the natural veld as an input, reducing his cost of purchased inputs.

Farmer 1005 is an interesting subject to study to determine how net returns are affected by veld quality and indirectly SD. His lambing and weaning percentages are relatively high in average and good years, but his herds perform marginally in a poor veld condition year which indicates that animal productivity is strongly related to veld quality; a function of (GAP) annual veld condition in the short-run. Changes in the weaning percentages of sheep between GAP veld condition years are expressed below.

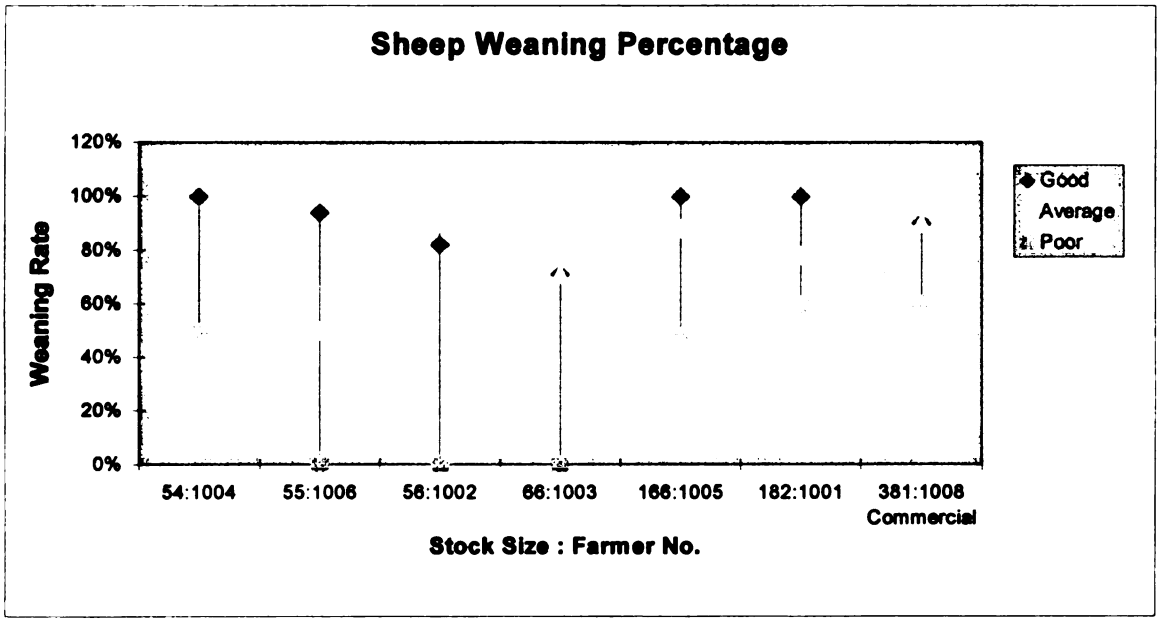

Figure 4-5

The most noticeable difference between the weaning percentage of goats and sheep is the fact that four of the seven farmers' herds attained percentages close to fifty percent and higher during poor veld condition years. Weaning

percentages were far lower for goats, under similar veld conditions, probably due to differences in physiology.

As expected, the commercial farmer had the least difference across years, but this does not directly translate to better overall herd performance. The large communal farmers (Nos. 1005 and 1001) had slightly lower weaning percentages than the commercial farmer in poor years, but their herds performed better in good years, so the difference in herd productivity between GAP veld condition years is greater.

Farmer 1002 (one of the seven communal farmers surveyed) is an anomaly; his herd weaned better in an average year than in a good year. The difference is small but could be attributed to an error in recalling herd performance, or perhaps he did not understand the question as it was posed to him, or there was a mistake in asking question. In any case his data should not be used to arrive at overall conclusions about the communal livestock farmers' productivity.

4.4 FACTOR PRODUCTIVITY OF ANIMALS (FP_A)

Factor productivity of animals, or net returns per head, is attained by simply dividing the net returns to a farmer's livestock enterprise by the number of animals in his herd. The results are expressed below in figure 4.6. All farmers earned economic profits, or positive net returns, in good veld condition years. The communal farmers earned more profit per head than the commercial farmer did because of the fact that their lower biomass cover (from relatively higher SD)

is mitigated by unusually good veld. The commercial farmer attains lower returns in good veld condition years because of the relatively high variable input levels (R10 per head).

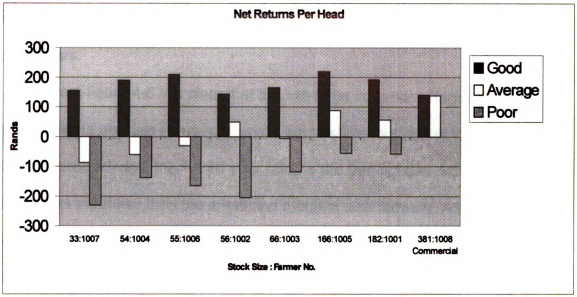

Figure 4-6

Also, a key point is that the rotational grazing method employed by the commercial farmer allows him to be more productive in the medium term (when averaged across all annual climate induced veld conditions). His method restricts animals from grazing lush veld outside an enclosed camp for a set period of time. His communal neighbors enjoy the improved veld while it lasts, in a free-for-all, and at higher stocking rates. The commercial farmer's method allows for the long-term regeneration of veld, and thus higher returns per head in poor and average years.

Farmer's with the three smallest herds, and farmer 1003 earned negative returns per animal in average veld condition years. Farmer No. 1002 achieves higher returns in an average veld condition year than his counterparts with similar stock size, but his data may not be that accurate since his responses produced higher sheep weaning percentages in an average years compared to good years.

From figure 4.6 it is clear that the two large communal farmers' productivity of animals in average years are positive (but half of the commercial farmer's productivity), their good year returns are the highest, and their losses in poor years are lower than the small and medium size farmers. All communal farmers earned negative profits in a poor veld condition year, but the commercial farmer achieved the least loss and almost 'breaks even' in the worst (poor) veld condition year. This would imply that he is closer (than the communal farmers) are to the use-capacity a poor year will support in terms of animal inputs on veld. Sustainability was defined earlier as earning at least zero economic profit in the worst expected climatic conditions; the commercial farmer has the most sustainable LFS using this definition.

Implications for the relationship between the dependent variable, productivity, measured here in net returns per animal, and the independent variable SD, under veld condition variability, can be gleaned by observing the differences in net returns per animal between GAP veld condition years. Figure 4. 7 below show the general difference in net return per animal (between good and poor veld condition years) is greatest on the small and average size

communal herds. The commercial farmer hedges against losses in a poor veld condition year by stocking less densely; he had the least change between good and poor years (less than half of the change experienced by some communal farmers).

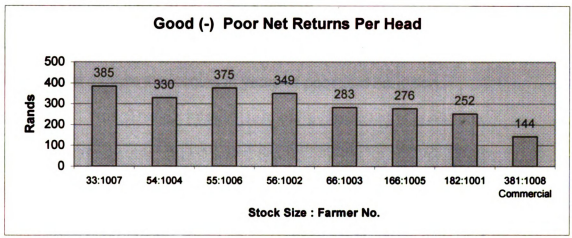

Figure 4-7

4.5 FACTOR PRODUCTIVITY OF LAND (FP_L)

There is inverse relationship between productivity per animal and productivity per land (Behnke, 1985). The highest productivity per animal is attained when there are few animals per hectare, whereas high net returns per hectare are gained when SD is relatively high. When animals per hectare are increased, productivity per animals begins to decline as the livestock compete for veld. "At the same time, productivity per hectare continues to increase since per capita reductions in animal productivity have been more than offset by the

increasing number of animals" Behnke (1985). This study confirms the inverse relationship to some degree; while communal FP_L are not clearly higher in all (GAP) years, they are closer to the commercial FP_L than communal FP_A is to commercial FP_A. Behnke uses an adaptation taken from Mott (1960) to show this phenomenon in figure 4.8. Stocking rate A is where productivity per animal begins to decline while productivity per hectare is increasing; this study shows SDc is around this point. Stocking rate B is where both productivity per animal and hectare decline this occurs in years of poor veld condition.

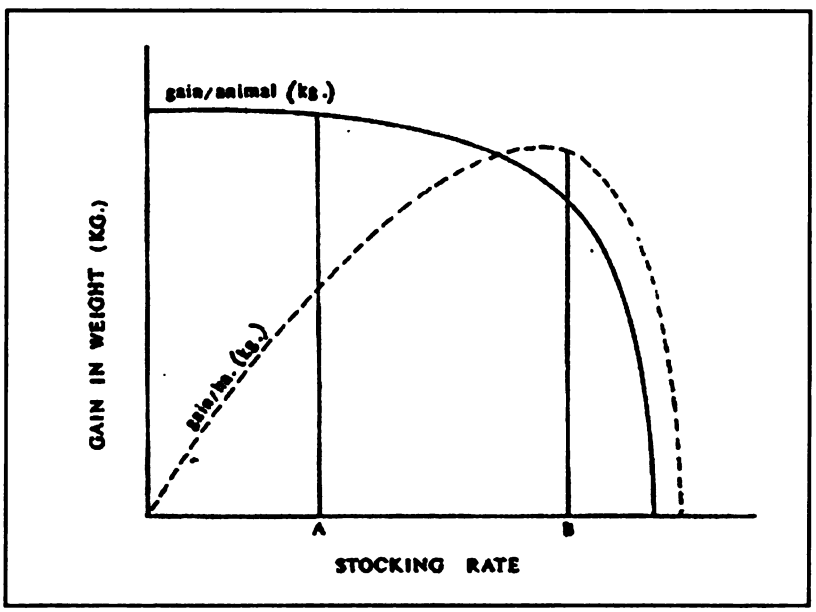

Figure 4-8 Weight Gain Per Animal and Hectare
(Source: Behnke, 1985)

Communal farmers have equal and open access to the approximately 22,000 ha area of Paulshoek. Larger herd owners benefit disproportionately more than small her owners since they have more animals to access the free veld, and turn it into meat which is sold for cash or slaughtered for home

consumption. So calculating net returns per hectare, the amount of land used by each communal farmer was taken in proportion to his number of animals.

Communal farmers received higher returns per hectare than the commercial farmer only in good veld condition years. In average and poor veld condition years, the commercial farmer attained higher returns per acre. In poor veld condition years all the communal farmers attained large negative returns per hectare (between -R5.9 and -R23.6) while the commercial farmer almost broke even at a negative 0.1 Rands returns per hectare (see farm budgets in Appendix B). A veld condition probability weighted average in section 4.7 reveals that the commercial farmer generally has higher net returns per hectare despite stocking at half the density of communal farmers. This is indicative of the disparity in productivity and veld cover between the two LFS.

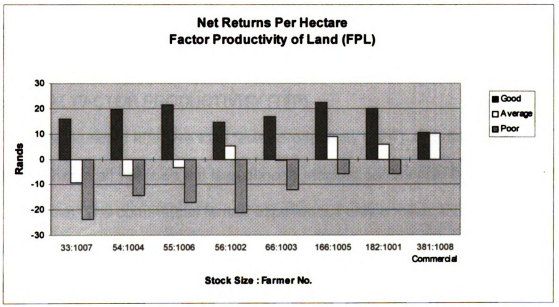

Figure 4-9 Net Returns Per Hectare

The implications of negative communal net returns per animal *and* negative communal net returns per hectare in poor veld condition years is significant for determining the economic sustainability of current communal SD (see figures 4.6 and 4.9) [23]. From figure 4.8 it is evident that point B, where negative weight gain per animal combines with negative weight gain per hectare is the threshold of sustainable stocking density. Behnke (1985) describes this point where both weight gain per animal *and* weight gain per hectare are dropping as the 'breaking point' where, "the pasture resource is badly overtaxed and everything collapses-the range is degraded and yield both per animal and per hectare declines." The negative numbers in this study are net cash returns, not weight, but the two are related since decreasing weight per animal and hectare reduce net returns. Poor veld condition years decrease the weight gain of animals. Resultant decreases in lambing and weaning percentages also lower aggregate weight gain per hectare.

4.6 TOTAL FACTOR PRODUCTIVITY (TFP)

As expected effective total factor productivity (TFP), or total net returns, were higher in all years on the less densely stocked commercial farm (see figure 4.10 below). The commercial farmer experiences only a minimal difference in returns between average and good veld condition years, but he experiences a large drop in returns during poor veld condition years.

So even the commercial farmer's relatively low SD may not be low enough for him to earn an economic profit in a poor veld condition year. What is interesting is that he is close to breaking even, or producing at the point where TR is equal to TC in poor veld condition years, by every effective measure of productivity (FP_A, FP_L, and TFP).

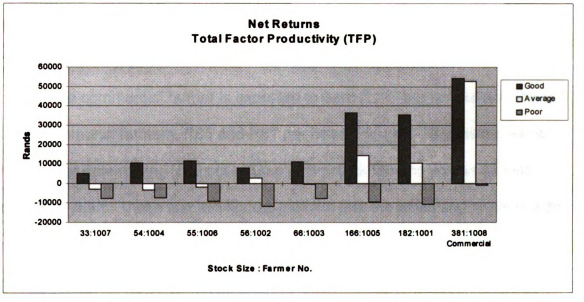

Figure 4-10

Small and medium communal farmers are only profitable in good veld condition years. This is when the extensive margin, referred to figure 3.1, is increased to a good veld condition year level (where their relatively high SD is capable of making a profit)[24]. The two large communal farmers are able to attain positive net returns in average and good veld condition years, but not in poor veld condition years.

4.7 VELD CONDITION PROBABILITY WEIGHTED FP_A and TFP

Finally, the differences in net returns are calculated across all veld condition years. Taking a consensus of farmer responses, poor veld conditions are thought to occur once in five years, and the same is true for unusually good veld conditions, so average veld can be expected 3 out of 5 years[25]. A weighted average using these probabilities was used to predict the medium-term annual average net returns per animal, or FP_A, for each farmer in this study (figure 4-11).

The commercial farmer is expected to earn R111 per animal and the two large communal farmers, R85 and R61 per head. Figure 4-12 uses the same method for determining total net returns to livestock farming across all veld condition years. These last two figures indicate that the small and medium size communal farmers are practicing a subsistence level of livestock farming.

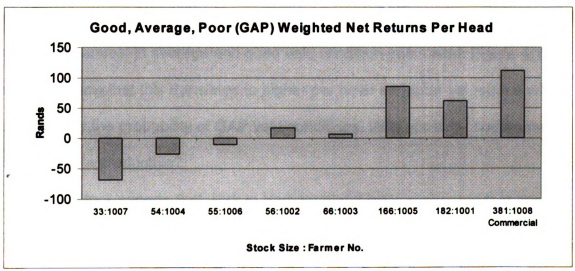

Figure 4-11

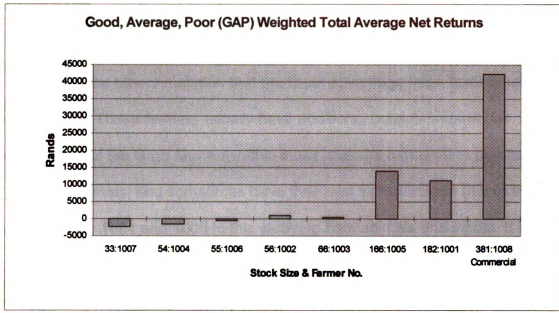

Figure 4-12

4.8 DOES COMMUNAL HERD SIZE MATTER?

The two largest farmers are able to reduce losses more effectively in poor veld condition years than smaller farmers. They also achieve relatively higher net returns per animal in average and good veld condition years also. Figure 4.11 and 4.12 show that this translates to higher per head and total net returns when averaged by the probability of GAP veld conditions. Why are large communal farmers more productive?

Livestock experts that work in Namaqualand have suggested that large herd are intrinsically more effective at covering areas of superior veld cover. Others, meanwhile, adhere to the institutional and socio-economic explanations. Large communal farmers have better access to markets, come from families that

are better 'connected', and have better access to information on livestock farming practices which give them various advantages over smaller farmers.

Still some others maintain that the fiscal advantage large communal farmers have. These farmers usually have additional outside income (for example one of the large farmers in this study is also a herbalist) to purchase inputs and animals, and sometimes have their own transportation (not in the case of farmer 1001 and 1005 in this study) to haul animals and inputs. It is also possible that large size farmers benefit from being able to spread their costs over more animals. This final possibility is explored briefly in the remainder of this chapter.

4.8.1 LABOR COST ADVANTAGE

For all communal farmers, labor is consistently over half of all input costs, and close to 100 percent in good veld condition years for some farmers. Labor is an indivisible (fixed) input that may explain the higher productivity of large herd owners.

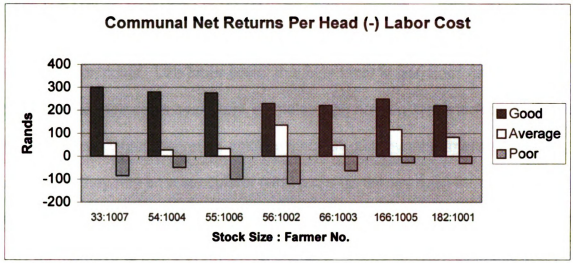

Figure 4-13

To determine the extent to which this input is a determinant of higher productivity in larger herds, labor cost is subtracted from GAP annual farm budgets.

Figure 4.13 shows a relatively high percent increases in net returns per head accrue to small and average size communal herds when this is done. The two large communal farmers' net return per animal fell in all three (GAP) years as a result of this adjustment, but when averaging across all three veld condition years, their returns remain higher than that of smaller communal farmers[26]. Thus labor use efficiency is a contributing factor as to why large herds are more productive.

4.8.2 TRANSPORTATION ADVANTAGE

Long distances between urban hubs in Namaqualand translate to high transportation costs. Like labor costs, this may favor larger stock farmers who could spread their costs over more animals when hauling their stock or feed. It is less of a factor when marketing animals since all communal farmers in the study stated that they rely on a speculator (who picks up the animals) for marketing and transporting their animal. Large farmers sometimes own their own vehicle so they do not have to pay a premium for transportation. A weakness in this study is the lack of accounting for transportation costs. Transportation cost was not valued because it is sporadic, sometimes free and highly unpredictable by the farmer.

4.8.3 ALLOCATION OF INPUTS

In many cases larger herd owners have outside sources of income, so the assumption is that they purchase a higher level of inputs for their livestock enterprises than smaller farmers. Figure 4.14 tests this assumption by comparing the amount of variable costs (FORAGE, VET, and MOVE costs)[27] invested per animal in GAP veld condition years. It is evident that large communal farmers actually spend less per animal than smaller farmers. The smaller communal farmers invest more per animal than the larger communal farmers, and even more than the commercial farmer in poor veld condition years. Large farmer No. 1005 consistently spends less than the other large size farmer (No.1001) yet he is more productive (see figure 4.11).

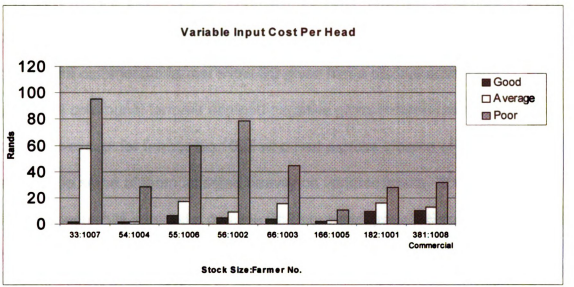

Figure 4-14

Assuming forage and medicines are give to the animals properly, this could indicate that veld has become overgrazed to the point that forage inputs make little difference to animal health, or that these inputs are 'too much, too late'.

All communal farmers have the same SD since the communal SD is taken in aggregate, so it is not possible to make any conclusions on how SD affects productivity between the communal farmers. However, the findings indicate that a lower SD benefits the commercial farmer, since he invests a small amount on veterinary and purchased feed in proportion to his relatively high net returns per animal. Thus SD (half of the communal rate) is a likely factor that leads to a relatively higher level of productivity on the commercial farm.

The commercial farmer is notably more productive than the small communal farmers, yet four small communal farmers invested more in poor years (per animal) than commercial farmer (No.1008). The commercial farmer is

also 46% more productive than the two large communal farmer across GAP veld condition years (see figure 5.1 for various production data).

The commercial farmer's low SD gives him a distinct advantage in poor years. All communal farmers attained negative gross income (as much as -R40 per head-except for farmer No.1007 who had a gross income of R12 per head) even while some of them invested heavily on variable inputs. The commercial farmer meanwhile attained a positive R82 per head gross income in a poor veld condition year; this is the prime productivity difference between the two LFS.

Large size farmer (No. 1005) invested a relatively small amount on purchased inputs compared to all other farmers, yet he achieved higher net returns. Similarly, farmer No. 1001 is out-spent on variable inputs, per animal in all (GAP) years, by all the small herd farmers (except by farmer 1007 in a good year, and 1004 in average and good years), yet he achieves higher overall FP_A.

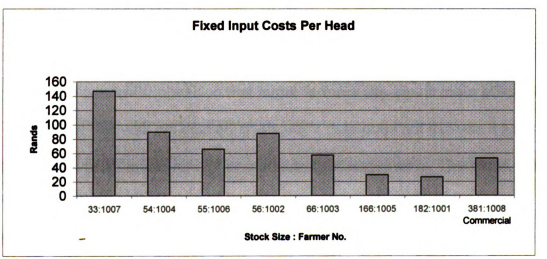

Figure 4-15

Fixed cost inputs per head are presented in figure 4.15. Note that the fixed costs do not change with GAP veld condition years. Note also that commercial farmer incurs a minimal maintenance cost that communal farmers do not, and a high land lease cost that the communal farmers do not incur either.

Fixed inputs are shared, or divided, across more animals so there is an inverse relationship between the cost of fixed inputs per animal and herd size. It may be possible that *variable* inputs are affected in a similar way since feed and medicines are purchased in bulk (some critical mass amount may be a factor) which may be distributed more sparingly, before diminishing returns, and thus allocated more efficiently by larger farmers.

Based on visual observations, discussions with farmers, and responses to the qualitative sections of the survey questionnaire, the most plausible reason why communal farmers do not receive the benefits of high input use is their pattern of application. They do not time the application of inputs based on climate and lambing cycles; feed and medicines are given on an ad hoc and emergency basis to the worse-off animals. Farther empirical study is needed to confirm the general supposition that larger farmers use inputs more efficiently.

While this was not studied, this study's data does not exclude it as the mechanism responsible for higher productivity of large herds. Therefore, a topic for future study(s) could test the hypothesis of large sheep and goat enterprises in the succulent karoo AEZ attaining relatively high levels of productivity because of a superior allocative efficiency in the application of inputs.

CHAPTER 5: SUMMARY, CONCLUSION, AND POLICY RECOMMENDATIONS

5.1 SUMMARY AND CONCLUSIONS

The purpose of this study has been to show the causal relationship between Stocking Density (SD) and productivity in the short term (annual) and medium term, across Good, Average, and Poor (GAP) veld condition years. This was done within the framework of a comparative analysis of communal and commercial Livestock Farming Systems (LFS) using a case study approach. According to Snyman (1998), the short term productivity of rangelands is a function of 1) climate variation, 2) soil characteristics, 3) stocking rate, 4) management systems, and 4) type of animal farmed. This study focused on the effects on productivity arising from 1 and 3, climate variation and stocking rate.

To capture the heterogeneity of the farmers, seven communal farmers were studied and compared independently while only one commercial farmer was made available for survey. The commercial LFS analysis is less representative than that of the communal since only one farmer was surveyed. To overcome this problem, qualitative questions about other commercial farmers were posed to the surveyed commercial farmer.

Productivity findings reveal that there are three distinct clusters of farmers, 1) small and average size communal farmers, 2) two large communal farmers (Nos. 1005 & 1001), and 3) the commercial farmer. A typology of the two LFS resource endowments and productivity based on the case studies for this thesis are presented in the table below.

	Commercial-Farmer 1008			Communal-Paulshoek					
Land Area	5,200 hectares			22,000 hectares					
Number of Livestock Farming Families	1			29					
Number of Households	1			140					
Population	3			800					
Hectares per Household	5200			157					
Average Number of Sheep & Goats	520			3906					
Average Hectare per Sheep & Goats	10			5.6					
	Commercial Farmer (No.1008)			Small & Average Communal Size Herds			Large Size Communal Herds		
Veld Condition	G	A	P	G	A	P	G	A	P
Goat Lambing %	N/A	N/A	N/A	195	118	39	153	112	40
Sheep Lambing %	110	110	80	100	75	35	102	89	63
Goat Weaning %	N/A	N/A	N/A	91	62	13	98	87	24
Sheep Weaning %	90	90	60	87	65	13	100	83	54
Climate Probability Weighted Average NR per head	R 111.22			R -16.57			R 73.1		
Climate Probability Weighted Average NR per hectare	R 8.15			R -1.71			R 7.49		
Climate Probability Weighted Average Total NR	R 42,373			R -587			R 12,633		

Figure 5-1 Commercial-Communal Quantitative Comparison Table

Data indicate that in years of good veld all farmers' SD is at a level within their intensive margin of production-where they realize positive net returns. In poor and average veld condition years small and average size communal farmers generally do not make any economic profit. The two large communal farmers in this study attain positive net returns in average veld condition years, but run a losing enterprise in poor veld condition years. The communal farmers experience large productivity loses in poor veld condition years even with a high level of variable (i.e. feed and veterinary) input use. This indicates that SD is beyond the use-capacity of the succulent karoo agroecological zone (AEZ) given the level of climate variability.

The commercial farm is able to make positive returns in average and good veld condition years, and he just about breaks-even in poor veld condition years. The relatively small change in productivity between Good and Average veld condition years, and his generally positive net returns indicate that commercial farmer's SD in closer to the use-capacity for the worse condition year than the communal farmers.

Even the commercial farmer stocks beyond the intensive margin of production for the worse, 'poor', use-capacity year for his given combination of other inputs. However, by breaking even in the worse years, figure 4.12 shows that he is able to maximize profits over the medium term (across GAP years). Average, unweighted, profitability of communal and commercial livestock farming, on a per animal basis in GAP veld condition years are compared graphically by figure 5.2.

The area represented by the area ABCFG is below the commercial line of productivity, and above the communal. It is the net return per animal the communal farmers forgo from not adopting a commercial LFS system. The triangle CDE is the relative benefit of the communal system with high SD. This higher productivity in a good year is partly a function of lower communal input use in good years, and also a result of high animal density on communal farmers that utilize the increased veld cover more rapidly. Conversely, the commercial farmer has relatively higher inputs in good years, and has a low SD overall. Lower SD sub-utilizes the veld in a good year, but this also prevents overutilization in poor and average years, and allows for higher productivity in the long term.

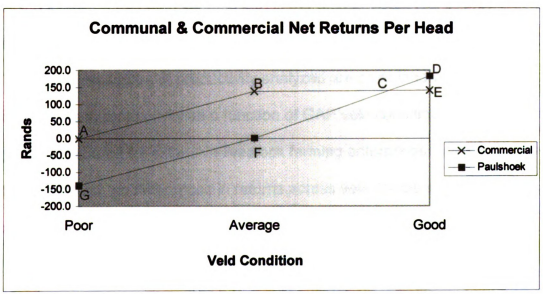

FIGURE 5-2

The area difference between ABCFG and CDE is the difference in average (unweighted) net return per animal between the two LFS in GAP years, and it is also symbolic of the difference in the Quality of Life (QOL-defined as income, land quality and quality) between the two groups. The disparity between the two LFS is more acute when considering that the triangle area CDE occurs only 2 out of 10 years. Subsequent sections discuss some scenarios on how to close the QOL gap between the two LFS.

Relatively higher productivity is attained by larger herd size communal farmers, and by commercial farmers (who farms with half the SD of communal farmers and with relatively large herds). The findings in chapter 4 displays the total net returns of each farmer, the returns on a per animal and per hectare basis, and also evaluate the level of input use per animal. There is no evidence which indicates that high variable inputs per animal yields higher productivity on communal farms, in fact the opposite is true in poor veld condition years.

The measures of productivity analyzed are combined with relative differences in productivity as a function of GAP veld condition years. Veld is the primary resource for extensive livestock farming enterprises found in Namaqualand, so differences in returns across veld condition years may be used as an indicator of sustainably meeting the veld requirements of animals.

The large change in net returns across GAP years indicates that it is not possible to maintain the current level of SD *and* improve the welfare of communal residents. This is because the veld is utilized beyond what it can produce positive net returns (use-capacity) under the expected level of climate

variability. The communal stocking rate compared in their proximity to economic carrying capacity, or their intensive-margin of animal inputs, for a given annual veld condition are too high.

Essentially, the commercial farmer makes a SD decision by 'erring on the side of caution' and hedges against negative returns in a poor year. The two large size communal farmers are relatively profitable compared to the small and average size farmers in the study. Small and average size communal farmers continue to invest in livestock enterprises even when net returns are negative in all but good veld condition years. SD reduction is one of the necessary conditions for QOL to increase in Paulshoek.

Why then do communal residents in Namaqualand continue to invest in livestock? The reasons include 1) low input cost (i.e. free land and inexpensive labor costs), 2) livestock produce for use-value (inexpensive meat and milk) and also for income from sales, 3) a form of social security and savings particularly with the insecurity of employment in the mining sector, 4) social and cultural reasons (a livestock farmer is seen as someone who is doing 'something' despite the limited opportunities in an isolated semi-desert environment), 5) attachment to the history of livestock farming in the region, and 6) lack of any other livelihood alternatives.

Two general conclusions are that externality costs to communal farming are high, and large herd size is a prerequisite for increasing productivity. In terms of the specific research question, SD is found to be inversely related to productivity. SD in Paulshoek is beyond the use-capacity of a poor veld condition

year which results in large negative returns, and possibly reduces income in average and good veld condition years in the long-run. Productivity is directly related to income, which, along with land quantity and quality define QOL. Thus continued high SD on communal lands that comprise the former 'reserves' will not alleviate the low QOL of its residents, and in fact functions to preserve the status quo. SD can be controlled and planned to meet long-term policy objectives. In the short-term, management of herds is a key determinant of productivity since larger herds are found to be more productive.

5.1.1 STOCK SIZE AND PRODUCTIVITY

It can be concluded that large herd size is a prerequisite to achieving high productivity because the two largest communal farmers in this study have relatively higher net returns per animal in poor and average years, *and* when averaged according to the probability of GAP veld conditions. Exactly how large is unknown. There is a gap of 100 animals between the largest average size herd and the smallest large size herd.

Some Paulshoek residents own less than ten sheep or goats, so they group their animals into larger herds. Also, it done as a matter of convenience because the livestock owner is usually away working as a migrant laborer, typically at the copper and diamond mines, so it is not possible for him to herd his own animals.

It is possible, but not likely that these large farmers reinvested their profits from their relatively efficient livestock enterprises back into livestock-thus

efficiency and high stock size are observed today. If this were the case, there would be more variation in the productivity of the small and medium size farmers. One of the large communal farmers runs a lucrative herbalist business, proceeds of which could have been used to invest in livestock.

5.2 RECOMMENDATIONS

Many changes to the livestock management system could improve productivity of the LFS in Namaqualand. This section focuses on policy measures that aim to decrease the SD of communal lands and increase productivity and QOL. Four specific topics of intervention are discussed:

1) Land reform
2) Pooling of herds
3) Animal head tax
4) Extension services

Biologic measures such as the planting of certain restoration plants, resting of veld areas, increasing watering points, genetic improvement of stock are not addressed, but discussed if related to the four subjects above. The recommendations are conservative in the sense that long-term structural changes to the LFS are not made. Introduction of banking service/culture to reduce reliance on livestock is an example of a long-term, demand-side, structural change that would decrease SD and possibly increase QOL.

5.2.1 LAND REFORM

A discussion on recommendations for reforming the communal LFS is inherently grounded in the land question. As Steyn and Krohne (1990) state: "(In Namaqualand) There is one thing the people in the reserves feel strongly about: that they have been dispossessed of their land. If exploitation of the soil is discussed, then the residents emphasis that one of the reasons why there is overgrazing is because they have been dispossessed of their land." Dunne (1988) reports that 74 percent of land in Namaqualand was reserved for the minority white population during the apartheid period. Results from this study show that the communal residents have access to 157 hectares per family (when Paulshoek is divided by the number of families present), and commercial farmer's family lives on 5,200 hectares. The 1994 Restitution of Land Rights Act created the legal framework and institutions for South Africa's land reform program.

A minimal amount of commercial farms have been bought by the state (shown in figure 5.3) as part of the land reform program, and are in the process of being incorporated into the communal areas. In Leliefontein, a commercial farm on the southern border of Rooifontein (north of Paulshoek) is in the process of being distributed to communal farmers. Levin and Weiner (1996) discuss the institutional and political dynamics that have slowed the pace of land reform.

Communal farmers in Namaqualand are capital, land and information constrained. Increasing land area for livestock will address this problem.

Although a tenure reform discussion is beyond the scope of this paper, a cursory discussion of tenure topics as it relates to livestock management is provided.

It should be emphasized that most productivity-based arguments for land reform cite an inverse relationship between farm size and productivity. Small farms in crop agriculture are more intensely utilized than large farms, and there is no 'moral hazard' with labor use (since family farms typically use family labor), so they are generally more productive. The findings for this study suggest that more intensely grazed communal areas are not as productive because SD surpasses use-capacity climate variability in the semi-arid succulent karoo AEZ. This results in low off-take and, over time, leads to veld degradation. Poor livestock management practices aggravate these factors. Increasing land area that will decrease SD to recommended levels is expected to increase productivity particularly in poor and average veld condition years.

In the short-term, increasing land-transfers to communal residents is only a partial solution to reducing SD. Concurrent property rights and economic policy measures must also be in place to keep SD at a level that would maximize communal farmer incomes and elevate their relatively dismal QOL.

The author is aware of only scant attention being paid to the former CRAs and their unique agroecological and tenure system in the *national* land reform debate. There is hardly any mention of these communal areas in the White Paper on Land Reform, nor in subsequent comments submitted to the government. Communal areas in former black 'homelands' have received much more attention in the national debate (for example see Christodoulou, 1990).

Lipton and Lipton (1993) argue that the 'tragedy of the commons' perspective is a fallacy since there is usually sufficient community oversight for communal area management. While there are clear community restrictions on outsiders bringing their stock to graze in Paulshoek, there is no limit on stock size. In the mid 1990's, Paulshoek experienced the breakdown of the *skikkingslyn* (the principle where all livestock farmers agree on which veld to rest and agree not to graze there), and there is no evidence of community organized management of grazing now.

A vacuum has been created with the demise of the *Raad*, which oversaw the reserves in the past. May et al (1997) find that the older generation of farmers of stock farmers are more open to community control of grazing in Paulshoek than the younger generation who have no experience of living under any effective administration in the communal areas. It can be argued that current communal management structures, or lack thereof, have not sustainably managed livestock enterprises.

Apartheid policy imposition of privatizing Namaqualand's communal areas into 'economic units' proved to be a failure (see Archer et al, 1989). Thus the solution is probably a combination of communal principles coupled with policies that promotes equitable and efficient use of rangelands, and that account for spatial, temporal, and climate variability. The unique history of the Namaqualand 'reserves' and the dual LFS requires equally unique solutions to address the rural poverty found here.

5.2.1.1 MARKET LED INITIATIVES

Tenure reform that complements the current framework of a nation-wide market-led land reform (see Deininger, 1999; de Klerk 1990) that South Africa is currently pursuing may be part of the solution to address equity, efficiency and ecological concerns in Namaqualand. Implementation of this reform has not met the intended targets, but is continuing with the re-election of the ANC in 1999 (see the land transfers for Namaqualand in figure 5.3).[28]

Markets for land and labor in Namaqualand have been in existence since *bywonership* agreements of the 1800's. These agreements may have served to stabilizing veld conditions and smoothen out discrepancies in resource use and incomes in the past. Currently, 'good neighbor' arrangements allow a limited number of communal farmers to provide labor in exchange for access to grazing commercial areas. This is an example of how communal areas can adopt regulations for long term sustainability (Lipton et al, 1993). However, because of the current pattern of land and other resource endowments, these partnerships are inherently exploitive. So there is a need for government intervention to enhance and balance such informal market initiatives.

5.2.1.1.1 LAND-LEASE

The experience of countries who have attempted to redistribute land during this century show that a land reform is usually doomed if not successful within the first five years of implementation (Riedinger, 1995). As is the case in South Africa, a new approach is needed.

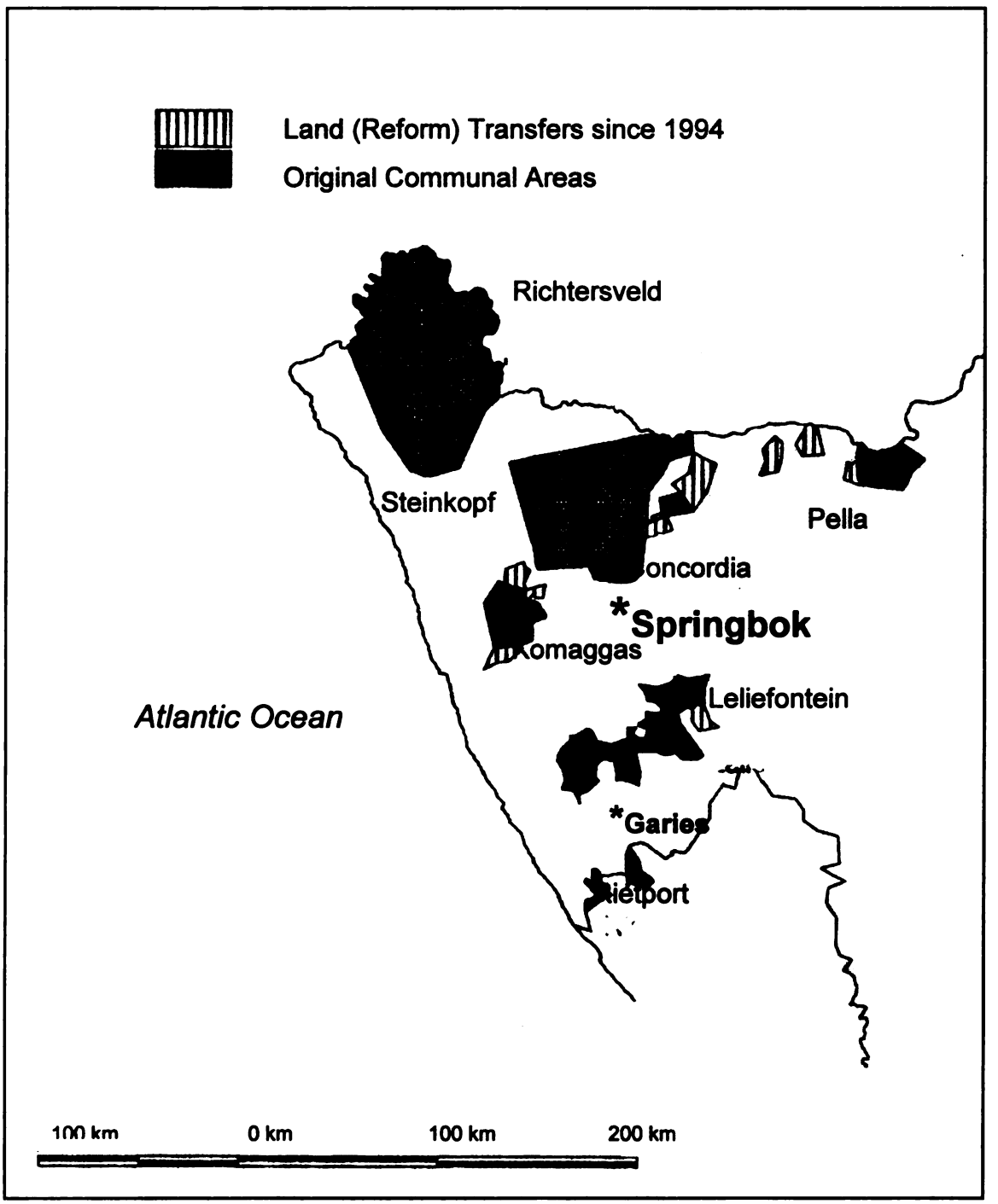

Figure 5-3 Namaqualand showing Communal Areas and Land Transfers

On marginal karoo lands, where access is perhaps more important (and affordable) than title, state enhanced leasing of commercial land that permit mobility may be a potential route to simultaneously increase QOL and reduce SD.

Cousins (1995) advances the need for institutional innovation that "combine elements of traditional or customary set with newer, more formal arrangements initiated by the state," and cites Lawry's work (1990) on co-management of common pool resources by community and the state.

Environmental externalities exist together with economic externalities. In this case there is no effective market for grazing-land. There is no mutual gains from trade between communal and commercial farms, and thus no consumer or producer surplus. Physical, social, and political barriers that prevented such transactions from occurring in the past have created these economic trade barriers. This has also restricting the movement of livestock which would allow for 'opportunistic management'. Trade, in the form of an affordable land market, could improve the productivity of communal herds, and aid in the restoration of degraded areas, but would have to be coupled with a progressive and targeted tax policy for equity and QOL concerns to be addressed.

One hypothesis is lease grazing commercial lands to overcome physical barriers and allow for opportunistic management of livestock enterprises. For example, lease grazing is common in the western United States and in Canada (see chapter 15 of van Kooten, 1993 for a discussion on the economic aspects of this). Physical barriers have taken the form of boreholes that encourage

sedentarization, some restrictions within communal areas, and common boundaries drawn between communal and commercial lands. Land Evaluation (LE) theory supports this approach which aims to take advantage of heterogeneous land qualities by exploiting land which has the greatest unrealized production potential (i.e. least stocked lands, or stocked below use-capacity) which are the commercial lands. (FAO, 1984).

One of the survey questions aims to determine the viability of communal farmers grazing animals on commercial veld by asking a Willingness To Pay (WTP) question for a commercial land-lease. This question also tested the socially acceptability of grazing outside of traditional stock-posts and on previously restricted land. The findings also serendipitously reflect on what animal head tax (for internalizing the cost of veld and reducing SD) the communal farmers might be willing to accept without revolt. A WTP question for communal land, which is free now, would have probably resulted in 'zero' Rands as a response.

The results reveal commercial land leasing occurs on an ad-hoc basis, but few farmers engage into these agreements. It must be noted that surveyed farmers were chosen for survey based partly on their willingness to cooperate, so this sample is a more liberal group than the general communal population. One communal farmer put the market rate at R7 per / head / month, and the commercial farmer said the rate is R5.

All but two communal farmers are open to the idea of grazing on commercially held lands. Farmer No.1007 said he would never do it; when asked

if he would do it if it were free he responded 'maybe'. Farmer No.1003 said 'no', but would pay R2 / head / month in an absolute emergency. When asked why he does not graze on commercial land now, he said the R7 / month / animal is too expensive. Communal farmers generally expressed this figure in a lump-sum amount per month. When divided by the number of livestock they own, per head amounts ranged between less than one Rand to R3.6 with an average of about R2.

Thus the gap between communal farmers' WTP for commercial land, and the high-end estimation of the market rate of such an arrangement is approximately R5 / animal / month. In years of poor and average veld condition, paying to graze on commercial lands would appear feasible (particularly when veld demand is high according to lambing and climatic cycles). Thus in theory, a subsidy of R5 / animal / month could allow degraded communal veld to rest while the livestock graze higher veld biomass on commercial farms.

The commercial farmer said he would allow communal farmers access to his lands if he 'had space'. Relative to the communal farmers' SD, he does have space, so this is obviously a subjective measure. Farmer No.1008 said he would charge R50 for 100 sheep per month (R 5 / animal / month). He is not doing it now, but expressed that he tried what can be described as a sharecropping arrangement. He said he let one communal farmer graze 40 animals in exchange for labor, but this did not work because, according to him, the communal farmer did not provide the labor.

In the commercial farmer's opinion, one needs a minimum of 800 animals (and 8000 hectares at recommended stocking levels) to be 'economically viable' in Namaqualand. What criteria he used to come up with this number was not explored in detail and it seems too large especially considering he had only 381 sheep at the time. Farmer No.1008 generally tries to adhere to the recommended 10 ha per animal SD for the succulent karoo, but he currently has about 14 ha per animal. He sold an usually high number of stock for increased income in this past year, and lost more than the usual number of animals since the winter rains of 1998 were poor.

It appears that there is an informal system of lease grazing, and some communal farmers are aware of it, but they state that it is too expensive to graze this way. Social barriers from past segregation and dual agricultural policy also contribute to the underutilization of this option. The commercial farmer in this study, who has relatively good relations with communal neighbors when compared to other commercial farmers, expressed that he was willing to reduce his grazing fee to less that one Rand per month per animal 'subject to availability'. So there are future potentials for cooperative agreements if mechanisms that facilitate and normalize land-lease transactions were instituted.

Aerial photos, soil data, and vegetation species-count can be done to identify areas of superior veld. These can also be combined with ground-truthed information from interviews. This information, combined with studies on the community organization dynamics of Leliefontein and other reserves, can assist

with formulating policies and pilot projects that restore degraded areas and increase QOL by providing access to previously restricted land.

5.2.2 INCREASE HERD SIZE BY POOLING HERDS

A comprehensive rural livelihood survey conducted in Paulshoek by the Surplus People Project (May et al, 1997) study found that most livestock owners supplement their income from other sources. The percentage of the 37 livestock owners[29] in 1995 who received income solely from livestock is 21.6%. The majority of livestock owners supplement their income with pension and welfare (35%), permanent income (24%) and self employment (13.5%) (farmer Nos.1002, 1003, and 1004 in this study receive pensions or benefit from a disability fund). Recent reductions in employment in mining sector is a major cause for concern since SD in communal areas is foreseen to increase as residents move back to the reserves and invest in livestock.

As a result of diversified income sources, herds of various persons are often grouped together. A policy objective should be to build on this and encourage a higher level of stock aggregation since productivity is found to be greater in larger herds. More research is needed to confirm this and ascertain the reasons. The average net returns per head of the two largest communal farmers in this study is almost R100 more than the average net returns per head of the small and average size herd.

A majority of herd aggregation (5 of the 6 identified cooperative pooling networks) in Paulshoek was found to run along kinship lines (May et al, 1997).

Thus farther aggregation would have to identify and exploit positive social relations between these kinship lines in order to create partnerships that can realize higher incomes. Cooperation is enhanced by improving "the flow of information for monitoring and the ability to enforce rules, for instance through the formation of sub-coalitions, improved leadership, or enhanced social norms and social capital" (McCarthy et al, 1998).

Preserving the social networks is important since the cooperation of large herd owners are needed for them not to sabotage efforts to enhance the welfare of smaller farmers who might be perceived a new competitors. There is empirical evident that shows when there is heterogeneity in production efficiency among communal livestock farmers, the more efficient (large herd owners) benefit less, and may even lose, when cooperating to reduce overall grazing level (ibid).

5.2.3 INTRODUCE ANIMAL HEAD TAX

An animal head tax would internalize the cost of veld degradation, reduce the number of animals and SD-allowing farmers to realize higher profits. Dalton and Masters (1998) model an optimum 'pasture tax' and show how it could raise farmers' QOL and at the same time "offset herders' incentives to overuse open-access resources" in Mali.

This policy counters the previous recommendation of having fewer and larger herds, so a reduction of this tax must be considered when farmers pool animals under a single management scheme. An optimal level of head tax would bring the SD to a level where the communal farmers are stocking at the intensive

margin with the policy objective of making at least zero economic profit in a poor veld condition year.

A head tax would not automatically shift the farmers input choice in favor of purchased feed since they could graze in unlimited amounts once the head tax is paid. An additional tax based on the amount of time spent grazing would increase the amount of purchased feed relative to natural grazing. The transaction cost involved with monitoring this would probably make this option unfeasible.

A head tax would reduce deaths, increase lambing and weaning percentages, and increases weight gain. It is expected that farmers will earn more with fewer animals as productivity increases per animals. The underlying assumption behind this recommendation is that increasing herd numbers will involve paying more taxes, so the farmer keep fewer animals, and thus reduce SD.

Normally, such economic policy initiatives aims to 'weed-out' inefficient farmers/businesses (i.e. those that are not efficient enough to afford a tax and still maintain their businesses). In Paulshoek the average age of a livestock farmer was found to be 57 years (May et al, 1997). When some of these farmers drop out (smaller herds) they would effectively have no other livelihood option other than pension; this is one consequence of a head tax that should be anticipated and mitigated. The head tax should at least be enough to prevent existing farmers from increasing stock (perhaps based on responses to question 19 of the survey questionnaire-the WTP for leasing commercial land).

This tax should be higher for new entrants to livestock farming, so only more efficient, large (preferably grouped herds-for equity reasons) would farm livestock. When the elasticity of demand for animals, with a tax imposition, is known, then the optimal tax that would maximize profit and reduce SD to recommend levels could be better estimated.

Van Kooten (1993) suggests a procedure to determine the level of permissible grazing by, "estimating the total forage yield, allow 45 percent carry-over to avoid damage to the range, and divide the remaining forage by the requirements of one Animal Unit Month (AUM).[30]" In other areas of the world areas where farmers have a higher disposable income than on former CRAs, a market determined head tax, or grazing permit, is found to be more efficient than an administrative tax (ibid).

5.2.3.1 TAX-SUBSIDY

Imposition of fees on an already marginalized population would work against equity concerns, principally for the small herd farmers, so redistributing the tax would address this. There would be a resistance to a tax that would have to be offset by redistributing the revenue. To compensate for the tax, the farmer would have to be convinced that a higher utility is gained from paying the tax.

A government subsidy would be required since the cost of the subsidy will conceivably be higher than the tax collected, but the social benefits may justify a subsidy. According to van Kooten (1993), "reforestation of denuded public forestland is often uneconomical if based solely on commercial timber values,

but when non-market or external values are taken into account, it may be possible to justify such investment. The same is true for rangeland investments."

Higher long-term income from a head tax would be a 'hard-sell', so farmers must realize some short-run benefit from a tax, so they should be compensated in order for them to cooperate. A demand driven development approach to development (as a reward to the farmer for paying a tax) is a highly desirable options for rural development projects to be successful (de Janvry, 1997).

Question 20 of the survey questionnaire addressed this by asking what the one change to livestock farming practices farmers would do (if capital and land constraints were not a factor). Invariably, the communal farmers wanted better rams. High quality rams increase herd productivity which allow the farmer to attain higher returns with less stock, thereby reducing SD.

A 'carrot and stick' approach to decrease SD and increase productivity could be used to get the farmer to do what he doesn't want to do (pay a head tax) if he is lured by the prospect of something he wants. For example this could be a good ram that he currently cannot afford and desires. The 'carrot' could possibly be a good breeding rams possibly bundled with feed and livestock extension education. Future studies could determine the feasibility of this.

5.2.4 LIVESTOCK EXTENSION SERVICE

Livestock extension education service would help to improve the management practices of the communal farmers. Inefficient application of inputs

is one reason communal farmers have relatively low productivity. Present day communal farmers have suffered ever since the Agricultural Development Acts of 1904, and 1907 which sought to provide cheap credit and marketing assistance to commercial (European) farmers. Extension services to the communal area would help alleviate the differences in the two LFS that have arisen out of a dual agricultural policy.

For example, these services could include instructions on the most opportune times to service ewes (around December for better health and also for marketing), and the timing of providing feed inputs (before servicing ewes, six weeks before lambing, and as soon as the lamb or kid is born). Extension services could also strengthen existing communal cooperatives that are involved with procuring feed and marketing animals. Simple changes to management techniques can result in higher returns for relatively little additional input cost.

An area where extension services would make an impact is by providing market and technical information. This is discernibly lacking on the communal farms. Sanford (1976) found uncomplicated changes to marketing, administration of veterinary services, and transportation strategies can greatly increase farmers' incomes with minimal cost.

Based on research in Zimbabwe, Mehretu (1995) states that, "solutions to redress spatial mismatch and relieve land use pressure in the small-holder sector must be found in a comprehensive and integrated strategy that is not limited to search for 'new lands' but also include stewardship of existing land resources, diffusion of technology and social infrastructure." An example of

social infrastructure that needs capacity building is the livestock auctions that are not currently inclusive of communal farmers. These farmers still do not attend livestock auction that they were prohibited from in the past, so extension services could provide information that would get the communal farmers to market their animals.

Binswanger and Deininger (1993) sum up commission reports on the 'land question' in Kenya, South Africa, and Zimbabwe done as early as the 1950's by stating, "any lasting solution must at least eliminate constraints limiting access of African farmers to output markets and land outside reserves.....simply eliminating restrictions on access to output markets, in response to the Swynnerton Plan (in Kenya) of 1954, evoked considerable response from smallholders." Deninger (1999) reiterates the need for marketing and technical assistance for small-scale agriculture in South Africa. McCarthy et al (1998) emphasis targeted assistance through "boosting the efficiency of the less efficient (farmers) through technical assistance and relaxing constraints on stocking due to selective lack of access to credit." May et al (1997) finds that less efficient Paulshoek farmers who have a high average animal age perceive marketing problems to be the cause.

5.3 AFTERWORD AND RECOMMENDATIONS FOR FUTURE STUDY

Many farming settlements with dual livestock farming characteristics can be found in Namibia and South Africa.[31] In Namaqualand alone, six communal areas constitute 25% of the districts' area, and represent 70% of the 24 former 'reserves' land area (see figure 5.3). Thus, information gained from this study in

Paulshoek may prove to be beneficial to other communal areas. An immediate follow-up to this study should focus on identifying best management practices, and on why large communal farmers are more productive.

Snyman (1998) states that in Southern Africa, "The ecologically sensitive arid and semi-arid climatic regions require specialized expertise in effective rainfall utilization with short and long term financial benefits for the farmer." This can be accomplished by reducing or increasing stock numbers in anticipation of climatic conditions; an Early Warning System (EWS) that assess the factors that affect veld condition and recommends changes in stock numbers is a possibility for future research and pilot projects. Follow-up studies could include the use of a Geographic Information System (GIS) to identify communal areas in a similar AEZ and apply a yield model based on this and other studies. These future studies could check GAP qualitative veld condition descriptions with quantitative historical climate and stock number data.

Unemployment in Namaqualand is likely to increase with the depletion of mineral resources in the next decade (UNCTAD, 1998). Migrant farmers returning to the communal areas to farm livestock will negate any policy recommendations to decrease SD. Those who do not farm livestock and cannot find other means of survival will migrate to urban areas. This would increase already high urban poverty and crime, leading to political instability. Eicher and Rukuni (1996) find inequitable land holdings and rural poverty are leading to urban in-migration which lead to "tension and crime in urban areas". Lipton and

Lipton (1993) find urbanization (particularly in cases of high intrarural poverty-as found in Paulshoek) is a legitimate threat to the political stability of South Africa.

An unemployed and landless rural population should be avoided *prima facie*. It is also a threat to the growth of the region, and specifically to the commercial farmers who continue to occupy most land in Namaqualand and South Africa in general. Just around Paulshoek, several commercial farmers have sold their farms and moved to Australia and the United States, partly because of this perceived threat. The slow rate of land reform and lack of employment opportunities is of particular concern in Namaqualand with the eminent reduction of mineworkers as diamond deposits become depleted.

The lack of diversified livelihood sources in Namaqualand presents both a problem and an opportunity. There are potentials to develop alternative forms of livelihoods, both new and those that compliment livestock farming, with backward and forward linkages. Machethe et al (1997) find that expansion of farm and non-farm economy linkages is a highly desirable rural growth plan for South Africa. The communal areas have been part of the dual economy that insulated them from information, education, and technology. As such, the off-take of information diffusion, technology adoption, and creation of linkages are potentially higher than in the predominantly white commercial economy that has already adopted these practices and technologies. Backward linkages already exist with the growing of feed for livestock. An expanded agricultural extension service to the communal areas would facilitate such linkages.

Some examples of alternatives to livestock farming are given in the report, "Alternative and Sustainable Systems of Production and Livelihood in Marginal Lands" (UNCED, 1990). There is no empirical evidence to support the feasibility of the suggested alternative livelihood options for Namaqualand, but they are worth mentioning as examples of successful projects in areas outside of Namaqualand.

The curing and tanning of leather has been done on a relatively small scale in communities that produce hides. Despite some environmental concerns, this benefits the workers through wages, and secures economic multipliers (by increasing effective demand) remain in the region. A large-scale forward linkage in the livestock sector could be a cooperative abattoir to process and market a ready supply of meat from communal areas. Some of these examples need a high level of community participation, so the creation of new institutions, or increasing the capacity of existing ones is required. This needs a high level of cooperation on all scales, namely from farmers, government, entrepreneurs, and NGOs.

Livestock farming in the karoo has generally been regarded as a mismatch between land capability and actual land use. A key recommendation for future study is the initiation of systematic LE with FSR approach (to understand the complex social factors in communal societies). A LE could aid in identifying new source of livelihoods by comparing actual and alternative land use options (FAO, 1983). Typically, this is based on biophysical, social, economic, labor and capital constraints of alternative agricultural enterprises

(e.g. cropping of high value arid fruits/herbs, or game/ostrich farming), and non-agricultural enterprises (e.g. tourism, or developing medicines from the existing herbalist culture).

Sivakumar and Valentin (Greenland et al, 1998) describe such an approach, based on relevant temporal and spatial scales, which could be integrated by a GIS or other spatial (yield) modeling techniques. They point out southern Africa as a 'bright spot' for holistic range management using these LE techniques. Similar arid winter rainfall regions in the Middle East and North Africa have diversified by growing feed for livestock, and arid fruits and nuts such as olive and pistachio (ibid.). Figure 5.4 provides a 'mind-map' of the dual LFS found in Namaqualand and wider karoo.

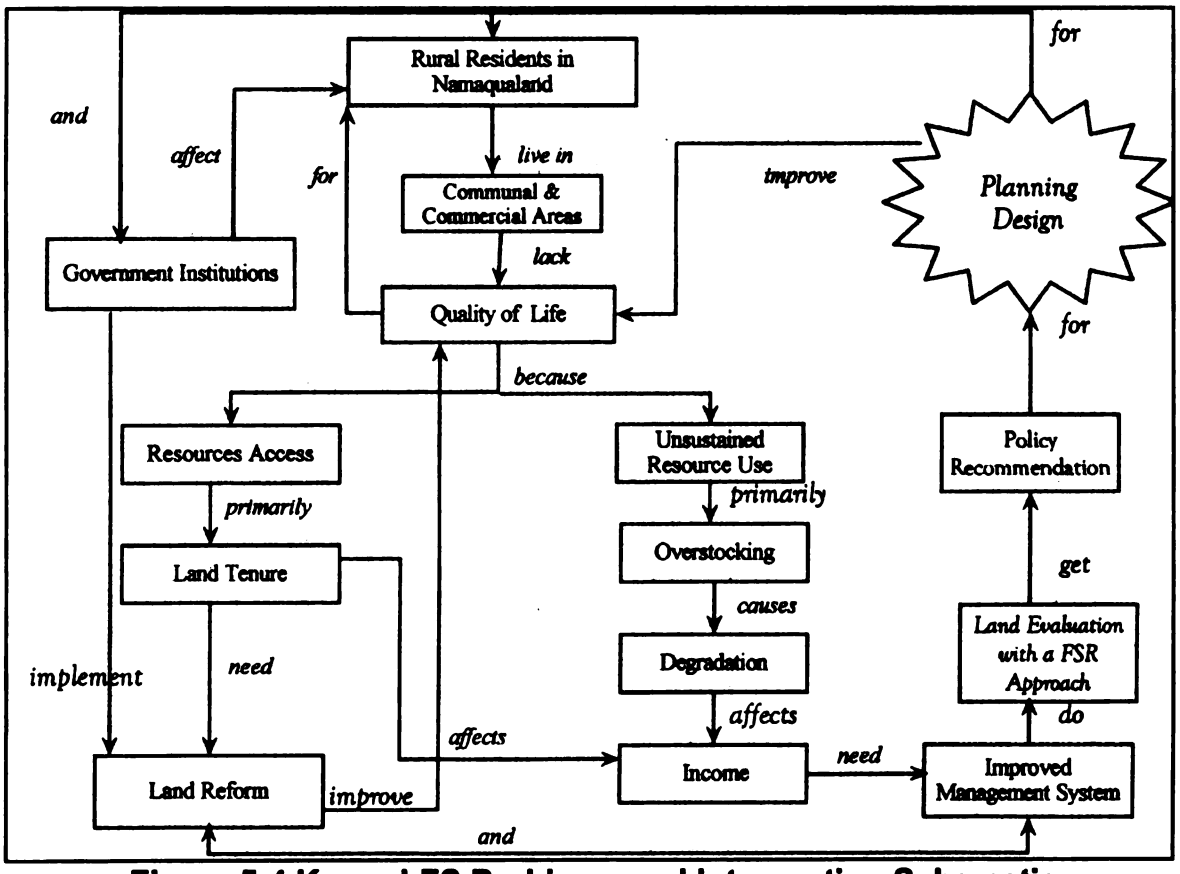

Figure 5-4 Karoo LFS Problems and Intervention Schematic

[1] There were 24 CRAs designated during apartheid for persons of mixed racial descent. The seven CRAs in Namaqualand, represent 70 percent of all CRA lands and 25.3 percent of the total land area of Namaqualand. They are also referred to as 'reserves' or communal areas.

[2] The terms 'communal' and 'commercial' are terms of convenience used to describe the Livestock Farming Systems (LFS). It is not an *a priori* editorial on the relative efficiency of the individual farmers in this study. The terms are also used euphemistically for 'coloured' and white farmers.

[3] May et al (1997) found that 45% of Paulshoek's residents live in brick houses, 40% in corrugated iron houses, and 15% in 'other' types of structures.

[4] There is one female livestock farmer in Paulshoek, but she has dropped out and does not currently own any animals.

[5] A 'ticket of occupation' was issued for Leliefontein in 1854.

[6] Information for the remainder of section 1.3, and for 1.4 is taken from discussions with Mr. David Makin-Taylor; livestock expert at the Land Development Unit (LDU)-an NGO that works in Namaqualand.

[7] Those who did settle in urban areas faced the Illegal Squatting Act of 1976 that prevented them from being employed without approved housing.

[8] Detailed information on this feeding regime were gained from discussions with Mr. Christof Smith, a livestock extension officer at the Department of Agriculture, Nature Conservation and Land Reform based in Springbok.

[9] Social prices are the opportunity cost of a resource to the wider economy.

[10] Commercial farmers refer to a livestock purchaser as an 'agent', while communal farmers use the term 'speculator'.

[11] The negative correlation between SD and welfare (QOL) can be made between commercial and communal LFS. It is not possible to assess this relationship *among* communal farmers because SD is taken in aggregate and therefore the same for all communal farmers.

[12] SD lines are symbolically not mathematically placed in figure 3.2.

[13] Information on the commercial aspects of communal livestock farming were gained from discussions with Dr. Mohammed Karaan a professor at the Department of Agricultural Economics, University of Stellenbosch.

[14] These questions are particularly relevant with the contraction of the mining sector.

[15] More than 80% of greater karoo lands are privately owned (Anon, 1986 cited in Dean and Milton, 1999).

[16] For example the commercial farmer in this study pays R19,000 to lease part of his farm while the communal farmers do not have pay for land.

[17] Lambing percentage is the number lambs or kids dropped divided by the number of ewes. Weaning percentage is the number of lambs or kids that survive beyond four months divided by the number dropped.

[18] Factor market imperfections exist since commercial farmers are land and capital intensive in an area where labor is abundant and a majority of residents are land constrained (see Ellis, 1993).

[19] Mervin Cloete collects monthly stock data for the EU Global Change and Subsistence Rangeland in Southern Africa Project. He assisted in translating the survey questionnaire and farmers' responses for this study.

[20] The author's academic advisor participated in one of these field trips.

[21] Field trips to Paulshoek were facilitated by NBI who provided transportation courtesy of the Mazda Wildlife Fund.

[22] Capitalized text indicates title of spreadsheet entry (Appendix B).

[23] Economic sustainability is defined here as making at least zero profit in a poor veld condition year.

[24] This is based on a static 'snap-shot' of SD in a given annual veld condition year. Stock numbers do rise and fall through changes in lambing and weaning percentages with changes in veld condition (these changes are found to be greater on the more densely stocked communal farms).

[25] Veld condition is determined by many climatic factors; the low but relatively predictable nature of rainfall in the succulent karoo has been documented by Cowling et al. (1999) and Desmet and Cowling (Dean and Milton, 1999) which support the 60% probability of average veld conditions.

[26] A discussion on minimum herd size follows in chapter 5.

[27] Move costs apply only to communal farmers, note also that farmer No.1001 had a variable cost of animal PURCHASES.

[28] The department of Land Affairs acknowledged that it could not meet its goal of redistributing land to approximately 25 million citizens by 1999. Since 1994 only 400,00 citizens, just 0.6% of the target number, have been resettled. South Africa Mail & Guardian, 21 January 1999.

[29] The number of livestock owners is greater than the number of livestock farmers since livestock farmers often manage animals of friends and family in their herds.

[30] The same source estimates the feed requirements of one AUM to be 300 kg (660 lb), and small-stock are equivalent to between .20 and .25 AUMs.

[31] It is estimated that 87 percent of land in South Africa is not suitable for arable crop production and better fits the use-requirements of extensive farming systems (Scholes, 1994 cited in Cousins, 1995).

APPENDICES

Appendix A

Question Number	Name:				Number: 1001	
	Date: 5 May 99 Time Begin: 9:55				Time End: 10:42	
	Survey Response					
Q 1	a) How long have you kept livestock? 26 years b) Why do you keep sheep and goats? "Life is the livestock" and primarily for income. He would look for work outside the village if LF was not an option.					
Q 2	a) At what age do you sell and why? 6 mo-1yr b/c that they are younger and will fetch a higher price b) What time of the year & why? November b/c animals are in best condition c) When do you service your ewes? February					
Q 3	Good		Average		Poor	
	Ewe G=65	Ewe S=68	Ewe G=65	Ewe S=68	Ewe G=65	Ewe S=68
Lambs	100	70	75	68	30	50
Lambs Dead	0	0	10	15	16	20
Q 4-7	Total G=90	Total S=92	Total G=90	Total S=90	Total G=92	Total S =92
Sales Market	30	30	20	15	0	0
Sales Local	4	6	4	7	8	0
Slaughter	12	7	8	5	6	4
Deaths	0	0	8	10	20	30
Q 8	a) Do you milk your animals? Y b) Do you sell the milk? N c) Do you trade it? N d) Do you give/share it? Y e) How much would you pay for a liter of goat's milk? R2 f) How do you compare it to shop milk? Preferred					

<table>
<tr><td rowspan="3">Q 9</td><td colspan="3">Name: Number: 1001</td></tr>
<tr><td colspan="3">Date: 5 May 99 Time Begin: 9:55 Time End: 10:42</td></tr>
<tr><td colspan="3">a) Do you typically sell skins? Y
b) How much do skins sell for now? Goat R2 Sheep R3
c) What do you do with them when you don't sell them? Throw it away</td></tr>
<tr><td></td><td colspan="3">Notes: Sells it locally</td></tr>
<tr><td rowspan="3">Q 10
Forage Cost/Mo</td><td>Good</td><td>Average</td><td>Poor</td></tr>
<tr><td>0</td><td>100</td><td>300</td></tr>
<tr><td colspan="3">Notes: Started to give forage last year & is still giving b/c there is no rain and nothing to graze. Generally he gives feed Feb to rains.</td></tr>
<tr><td>Q 11</td><td colspan="3">a) Do your animals graze off crop-land stubble? Y
b) For how long? Goats 4 hrs/day; Sheep 10 hrs/day
c) During which months? Dec-Jan</td></tr>
<tr><td rowspan="3">Q 12
Vet Cost/ Year</td><td>Good</td><td>Average</td><td>Poor</td></tr>
<tr><td>500</td><td>600</td><td>800</td></tr>
<tr><td colspan="3">Notes: Gives every year (Jan, March, April, June, Nov) & whenever the animals are sick.</td></tr>
<tr><td>Q 13</td><td colspan="3">How many herders do you hire? 1</td></tr>
<tr><td>Q 14</td><td colspan="3">What investments have you made to LF and how much have you paid?
Fencing = R285 for 15 yards
Cement = 8-50 kg bags @ R18 each</td></tr>
<tr><td></td><td colspan="3">Notes: The fencing is for the kraal. The community members who have vehicles help him w/ transportation to Garies about every other month.</td></tr>
<tr><td rowspan="2">Q 15
Moves/ Year</td><td>Good</td><td>Average</td><td>Poor</td></tr>
<tr><td>1</td><td>3</td><td>4</td></tr>
<tr><td>Q 16</td><td colspan="3">How do you market your animals? Sell to speculator</td></tr>
<tr><td>Q 17</td><td colspan="3">a) Have you bought animals in the last year? Y
b) How many? 5
d) How many sheep & goats do you typically buy in a year? 5</td></tr>
<tr><td></td><td colspan="3">Notes: Started buying in 3 years ago. Just buys when people come around wanting to sell. 5 ewes a year is an estimate from these 3 years.</td></tr>
</table>

<table>
<tr><td rowspan="6">Q 18

Purchase & use of rams</td><td colspan="3">Name: Number: 1001</td></tr>
<tr><td colspan="3">Date: 5 May 99 Time Begin: 9:55 Time End: 10:42</td></tr>
<tr><td></td><td>Goat</td><td>Sheep</td></tr>
<tr><td>a) Frequency?</td><td>1 every 3 years</td><td>1 every 3 years</td></tr>
<tr><td>b) Cost ?</td><td>R300</td><td>R300</td></tr>
<tr><td>c) From?</td><td>Commercial farmer</td><td>Commercial farmer</td></tr>
<tr><td></td><td>d) Disposal ?</td><td>Castrates</td><td>Castrates</td></tr>
<tr><td>Q 19</td><td colspan="3">a) Are you willing to graze on commercial farms? Y
b) How much are you willing to pay? R50/mo</td></tr>
<tr><td>Q20</td><td colspan="3">What change would you make to LF? Buy better rams</td></tr>
<tr><td rowspan="2">Q 21</td><td colspan="3">a) It would reduce deaths if you fed your animals at 3 critical periods (the 3 are explained) what is your opinion of this intervention?
Good idea

b) Would you be willing to do this? Yes</td></tr>
<tr><td colspan="3">Notes: Did it before but didn't give feed before servicing. Gave feed 6 weeks before lambing and after. Doesn't do it now b/c it's too expensive he says. He gave it to his pregnant ewes.</td></tr>
</table>

APPENDIX A

Question Number	Name: Number: 1002 Date: 4 May 99 Time Begin: 14:00 Time End: 15:00 **Survey Response**					
Q 1	*a) How long have you kept livestock?* 40 years working for a commercial farmer & 3 years on communal *b) Why do you keep sheep and goats?* Income					
Q 2	*a) At what age do you sell and why?* Sheep at 7 mo; Goats at 9 mo b/c get a good price at that age. *b) What time of the year & why?* August- January *c) When do you service your ewes?* February					
Q 3	Good		Average		Poor	
	Ewe G=20	Ewe S=33	Ewe G=20	Ewe S=33	Ewe G=20	Ewe S=33
Lambs	40	33	25	30	10	9
Lambs Dead	7	6	4	3	10	9
Q 4-7	Total G =20	Total S =36	Total G 20=	Total S =36	Total G =20	Total S =36
Sales Market	8	15	8	0	0	0
Sales Local	0	5	0	0	0	0
Slaughter	0	5	2	3	2	4
Deaths	4	3	3	4	18	4
	Notes: Usually doesn't sell locally b/c price is not good. Markets in good years b/c there is more to sell & in good condition.					
Q 8	*a) Do you milk your animals?* Y *b) Do you sell the milk?* N *c) Do you trade it?* N *d) Do you give/share it?* Y *e) How much would you pay for a liter of goat's milk?* R7 f) *How do you compare it to shop milk?* Preferred					

	Name: Number: 1002		
	Date: 4 May 99 Time Begin: 14:00 Time End: 15:00		
Q 9	*a) Do you typically sell skins?* Y *b) How much do skins sell for now?* R5 *c)What do you do with them when you don't sell them?* Throws it away		
	Notes: He used to get R40, so he is resentful to sell at R5, so he is not sure if he will sell at this price.		
Q 10 Forage Cost/Mo	Good	Average	Poor
	0	0	300
	Notes: Usually gives feed Aug-March if he has money & in poor years.		
Q 11	*a) Do your animals graze off crop-land stubble?* N *b) For how long?* N/A *c) During which months?* N/A		
Q 12 Vet Cost/ Year	Good	Average	Poor
	200	400	600
Q 13	*How many herders do you hire?* 0		
Q 14	*What investments have you made to LF and how much have you paid?* Nothing		
Q 15 Moves/ Year	Good	Average	Poor
	2	3	5
Q 16	*How do you market your animals?* Sells to speculator		
Q 17	*a) Have you bought animals in the last year?* N *b) How many?* N/A *c) How many sheep & goats do you typically buy in a year?* None		
Q 18 Purchase & use of rams		Goat	Sheep
	a) Frequency?	1 every 3 yrs	1 every 3 yrs
	b) Cost ?	R600	R500
	c) From?	Commercial	Commercial
	d) Disposal ?	Sells to other farmers	Sells to other farmers

	Name: Number: 1002 Date: 4 May 99 Time Begin: 14:00 Time End: 15:00
Q 19	*a) Are you willing to graze on commercial farms?* Y *b) How much are you willing to pay?* R 200/mo
Q20	*What change would you make to your LF?* Better rams
Q 21	*a) It would reduce deaths if you fed your animals at 3 critical periods (the 3 are explained) what is your opinion of this intervention?* Good idea *b) Would you be willing to do this?* Yes
	Notes: He would do it if he had the money, but now it is too expensive.

APPENDIX A

Question Number	Name: Number: 1003 Date: 4 May 99 Time Begin: 11:40 Time End: 12:45 **Survey Response**					
Q 1	*a) How long have you kept livestock?* 17 years *b) Why do you keep sheep and goats?* Primarily for income, but also b/c of tradition and b/c of his unemployment.					
Q 2	*c) At what age do you sell and why?* 6 mo old b/c better price. *d) What time of the year & why?* Nov-Feb b/c better condition *e) When do you service your ewes?* Feb					
	Notes: Did not specify if it was better to sell pre/post Dec, when asked he said that it did not matter, yet when pushed he acknowledged that pre Dec goats get better price although his response indicates that the speculator does not pass through these price changes.					
Q 3	Good		Average		Poor	
	Ewe G=32	Ewe S=28	Ewe G=32	Ewe S=28	Ewe G=32	Ewe S=28
Lambs	65	28	37	14	10	9
Lambs Dead	15	8	18	4	10	9
Q 4-7	Total G =32	Total S =34	Total G =32	Total S =34	Total G =32	Total S =34
Sales Market	12	6	8	4	5	5
Sales Local	0	NR	6	NR	0	NR
Slaughter	7	8	3	6	4	7
Deaths	5	5	3	4	6	4
Q 8	*a) Do you milk your animals?* Y *b) Do you sell the milk?* N *c) Do you trade it?* N *f) Do you give/share it?* Y *g) How much would you pay for a liter of goat's milk?* R3 h) *How do you compare it to shop milk?* Preferred					

Q 9	Name: Number: 1003		
	Date: 4 May 99 Time Begin: 11:40 Time End: 12:45		
	a) Do you typically sell skins? Y *b) How much do skins sell for now?* R5 *c)What do you do with them when you don't sell them?* Throws it away		
Q 10 Forage Cost/Mo	Good	Average	Poor
	0	50	200
	Notes: Usually Feb-rains in poor and average years. Says that b/c of winter rainfall pattern veld gets very bad in Feb; although in any given years it will at least rain once during the season.		
Q 11	*a) Do your animals graze off crop-land stubble?* Y *b) For how long?* 2 hrs/day *c) During which months?* Jan-Feb		
Q 12 Vet Cost/ Year	Good	Average	Poor
	R175	R300	R400 +
Q 13	*How many herders do you hire?* 0		
Q 14	*What investments have you made to LF and how much have you paid?* Nothing		
Q 15 Moves/ Year	Good	Average	Poor
	2	3	4
Q 16	*How do you market your animals?* Speculator		
Q 17	*a) Have you bought animals in the last year?* N *b) How many?* N/A *c) How many sheep & goats do you typically buy in a year?* None		

Q 18 Purchase & use of rams	*a) Frequency?*	Goat	Sheep
		1 every 2 years	1 every 2 years
	b) Cost ?	R300	R275
	c) From?	Commercial	Commercial
	d) Disposal ?	Slaughter	Castrates
	Notes: Slaughters sheep while selling goat ram b/c goat ram is of higher quality and better to sell.		

	Name: Number: 1003
	Date: 4 May 99 Time Begin: 11:40 Time End: 12:45
Q 19	*a) Are you willing to graze on commercial farms?* N *b) How much are you willing to pay?* R2 in an absolute emergency
	Notes: Not prepared b/c currently it costs R7/head/mo. He would "always" do it if it was free.
Q20	*What change would you make to your LF?* Better rams
Q 21	*a) It would reduce deaths if you fed your animals at 3 critical periods (the 3 are explained) what is your opinion of this intervention?* Good idea *b) Would you be willing to do this?* Yes
	Notes: He is not doing it b/c it is too expensive; he gives feed only when veld is bad. He knows about it b/c the commercial farmers do it. He thinks it would cost about R900

APPENDIX A

Question Number	Name: Number: 1004					
	Date: 3 May 99 Time Begin: 19:30 Time End: 21:00					
	Survey Response					
Q 1	*a) How long have you kept livestock?* 28 years *b) Why do you keep sheep and goats?* Income from sales. Used to be income from sheep wool, but no more					
Q 2	*c) At what age do you sell and why?* 1 year b/c of good price *d) What time of the year & why?* Oct-Dec b/c of good price *e) When do you service your ewes?* Jan-Feb					
Q 3	Good		Average		Poor	
	Ewe G=20	Ewe S=15	Ewe G=20	Ewe S=15	Ewe G=20	Ewe S=15
Lambs	50	15	30	15	6	8
Lambs Dead	0	0	20	8	6	4
Q 4-7	Total G =30	Total S =24	Total G =30	Total S =24	Total G =30	Total S =24
Sales Market	6	0	10	0	0	0
Sales Local	10	0	6	0	0	0
Slaughter	4	2	1	2	0	0
Deaths	0	4	3	6	7	8
	Notes: Says he needs approx. 40 sheep for him to be able to market, and doesn't sell in poor years b/c price is bad.					
Q 8	*a) Do you milk your animals?* Y *b) Do you sell the milk?* N *c) Do you trade it?* N *f) Do you give/share it?* Y *e) How much would you pay for a liter of goat's milk?* R2 *f) How do you compare it to shop milk?* Preferred					

	Name: Number: 1004		
	Date: 3 May 99 Time Begin: 19:30 Time End: 21:00		
Q 9	*a) Do you typically sell skins?* Y *b) How much do skins sell for now?* R6 *c)What do you do with them when you don't sell them?* Uses them for the home		
	Notes: Used to get R30 for skins		
Q 10 Forage Cost/Mo	Good	Average	Poor
	0	0	100
Q 11	*a) Do your animals graze off crop-land stubble?* Y *b) For how long?* 2-3 hrs/day *c) During which months?* One month (Dec or Jan) One month (Dec or Jan)		
Q 12 Vet Cost/ Year	Good	Average	Poor
	R80	R100	R250
Q 13	*How many herders do you hire?* 1		
Q 14	*What investments have you made to LF and how much have you paid?* Bought 2 maikes mates for R20 each		
Q 15 Moves/ Year	Good	Average	Poor
	0	0	2
Q 16	*How do you market your animals?* Doesn't market directly regularly, but sometimes loads about 10 animals takes them to Garies (transportation costs R150)		
Q 17	*a) Have you bought animals in the last year?* N *b) How many?* N/A *c) How many sheep & goats do you typically buy in a year?* None		
Q 18 Purchase & use of rams	*a) Frequency?*	Goat: 1 every 2 years	Sheep: 1 every 2 years
	b) Cost ?	Goat: R300	Sheep: R100
	c) From?	Goat: Commercial	Sheep: Commercial
	d) Disposal ?	Goat: Castrates/Slaughters	Sheep: Castrates/Slaughters
Q 19	*a) Are you willing to graze on commercial farms?* Y *b) How much are you willing to pay?* R150/mo		
Q20	*What change would you make to your LF?* Better rams		

	Name:	Number: 1004
	Date: 3 May 99 Time Begin: 19:30 Time End: 21:00	
Q 21	*a) It would reduce deaths if you fed your animals at 3 critical periods (the 3 are explained) what is your opinion of this intervention?* Good idea *b) Would you be willing to do this?* Yes	
	Notes: Says feed costs are too high	

APPENDIX A

Question Number	Name: Number: 1005					
	Date: 4 May 99 Time Begin: 15:00 Time End: 15:40					
	Survey Response					
Q 1	*a) How long have you kept livestock?* 17 years *b) Why do you keep sheep and goats?* For income through marketing and for slaugher					
Q 2	*c) At what age do you sell and why?* 1 year b/c growth & condition better *d) What time of the year & why?* Sept-Oct b/c animals are in best condition then *e) When do you service your ewes?* Feb					
Q 3	Good		Average		Poor	
	Ewe G=79	Ewe S=52	Ewe G=79	Ewe S=52	Ewe G=79	Ewe S=52
Lambs	120	52	85	40	27	27
Lambs Dead	5	0	12	5	27	14
Q 4-7	Total G =97	Total S =69	Total G =97	Total S =69	Total G =97	Total S =69
Sales Market	25	15	15	15	0	0
Sales Local	6	6	5	5	10	10
Slaughter	6	6	6	6	6	6
Deaths	0	0	4	5	20	20
	Notes: Says he slaughters & sells the same amount of sheep/goats					
Q 8	*a) Do you milk your animals?* Y *b) Do you sell the milk?* N *c) Do you trade it?* N *f) Do you give/share it?* Y g) *How much would you pay for a liter of goat's milk?* R2 h) *How do you compare it to shop milk?* Preferred					

	Name: Number: 1005		
	Date: 4 May 99 Time Begin: 15:00 Time End: 15:40		
Q 9	*a) Do you typically sell skins?* Y *b) How much do skins sell for now?* R5 *c)What do you do with them when you don't sell them?* Throws away		
Q 10 Forage Cost/Mo	Good	Average	Poor
	0	0	R100
	Notes: Gives from March to July		
Q 11	*a) Do your animals graze off crop-land stubble?* Y *b) For how long?* 4 hours (2 hrs in morning; 2 hrs in evening) *c) During which months?* Nov & Dec		
Q 12 Vet Cost/ Year	Good	Average	Poor
	R300	R300	R400
Q 13	*How many herders do you hire?* 1		
Q 14	*What investments have you made to LF and how much have you paid?* None		
Q 15 Moves/ Year	Good	Average	Poor
	2	3	5
Q 16	*How do you market your animals?* Speculator		
Q 17	*a) Have you bought animals in the last year?* N *b) How many?* N/A *c) How many sheep & goats do you typically buy in a year?* None		
Q 18 Purchase & use of rams		Goat	Sheep
	a) Frequency?	1 every 2 years	1 every 2 years
	b) Cost ?	R400	R400
	c) From?	Commercial	Commercial
	d) Disposal ?	Sell to other farmers	Sell to other farmers
Q 19	*a) Are you willing to graze on commercial farms?* Y *b) How much are you willing to pay?* R200-R300/mo		

	Name: Number: 1005
	Date: 4 May 99 Time Begin: 15:00 Time End: 15:40
Q20	*What change would you make to your LF?* Better rams
Q 21	*a) It would reduce deaths if you fed your animals at 3 critical periods (the 3 are explained) what is your opinion of this intervention?* Good idea *b) Would you be willing to do this?* Yes
	Notes: Thinks it would cost too much, but when asked how much he said R200

APPENDIX A

Question Number	Name:				Number: 1006	
	Date: 6 May 99 Time Begin: 19:50 Time End: 20:45					
	Survey Response					
Q 1	*a) How long have you kept livestock?* 12 years *b) Why do you keep sheep and goats?* Since there is now work here, he says "livestock farming is the only option."					
Q 2	*c) At what age do you sell and why?* 2-3 years b/c of better price *d) What time of the year & why?* Oct-Nov b/c of good condition *e) When do you service your ewes?* Jan-Feb					
Q 3	Good		Average		Poor	
	Ewe G=30	Ewe S=17	Ewe G=30	Ewe S=17	Ewe G=30	Ewe S=17
Lambs	55	17	30	10	1	5
Lambs Dead	4	1	10	5	1	5
Q 4-7	Total G =35	Total S =20	Total G =35	Total S =20	Total G =35	Total S =20
Sales Market	15	0	0	0	0	0
Sales Local	4	0	4	0	5	0
Slaughter	6	4	6	4	6	3
Deaths	1	4	5	6	15	7
	Notes: He says there is not much difference in sales & slaughter b/w average & bad years b/c there is not much difference in price					
Q 8	*a) Do you milk your animals?* Y *b) Do you sell the milk?* N *c) Do you trade it?* N *f) Do you give/share it?* Y *g) How much would you pay for a liter of goat's milk?* R0 *h) How do you compare it to shop milk?* N/A					
	Notes: He will not buy it b/c he does not like the taste of goat's milk. Says that he cannot compare w/shop milk b/c he doesn't drink it either					

	Name: Number: 1006		
	Date: 6 May 99 Time Begin: 19:50 Time End: 20:45		
Q 9	*a) Do you typically sell skins?* Y *b) How much do skins sell for now?* R5 *c)What do you do with them when you don't sell them?* Throws away		
Q 10 Forage Cost/Mo	Good	Average	Poor
	0	R35	R200
	Notes: He gives feed after lambing (in June)		
Q 11	*a) Do your animals graze off crop-land stubble?* Y *b) For how long?* 10 hours/day *c) During which months?* Nov & Dec		
Q 12 Vet Cost/ Year	Good	Average	Poor
	R150	R250	R500
Q 13	*How many herders do you hire?* 0		
Q 14	*What investments have you made to LF and how much have you paid?* None		
Q 15 Moves/ Year	Good	Average	Poor
	5	7	10
Q 16	*How do you market your animals?* Speculator		
Q 17	*a) Have you bought animals in the last year?* Y *b) How many?* I goat for R165 *c) How many sheep & goats do you typically buy in a year?* 0		
Q 18 Purchase & use of rams		Goat	Sheep
	a) Frequency?	1 every 2 years	1 every 2 years
	b) Cost ?	R250	R250
	c) From?	Self	Self
	d) Disposal ?	Castrates	Castrates
Q 19	*a) Are you willing to graze on commercial farms?* Y *b) How much are you willing to pay?* R200/mo		
Q20	*What change would you make to your LF?* In good years would not change anything. In bad years he would like to sell sheep & retain his goats b/c a goat, he says is a better animal to farm in bad years. He doesn't do it now b/c sheep are in OK condition.		

	Name:	Number: 1006
	Date: 6 May 99 Time Begin: 19:50 Time End: 20:45	
Q 21	*a) It would reduce deaths if you fed your animals at 3 critical periods (the 3 are explained) what is your opinion of this intervention?* Good idea *b) Would you be willing to do this?* Yes	
	Notes: Says it is too expensive, but when asked for an estimate he says it would cost around R200	

APPENDIX A

Question Number	Name: Number: 1007					
	Date: 5 May 99 Time Begin: 8:15 Time End: 9:15					
	Survey Response					
Q 1	*a) How long have you kept livestock?* 20 years *b) Why do you keep sheep and goats?* For income & b/c there is no other option. Says "it's my life."					
Q 2	*c) At what age do you sell and why?* 2 years b/c condition is good *d) What time of the year & why?* Oct-Dec *e) When do you service your ewes?* April; waits for rains					
Q 3	Good		Average		Poor	
	Ewe G=29	Ewe S=0	Ewe G=29	Ewe S=0	Ewe G=29	Ewe S=0
Lambs	40	N/A	28	N/A	15	N/A
Lambs Dead	0	N/A	7	N/A	5	N/A
Q 4-7	Total G =33	Total S =33	Total G =33	Total S =33	Total G =33	Total S =33
Sales Market	6	N/A	0	N/A	0	N/A
Sales Local	3	N/A	1	N/A	0	N/A
Slaughter	1	N/A	0	N/A	0	N/A
Deaths	0	N/A	2	N/A	6	N/A
	Notes: He says he lives alone so that is why he doesn't slaughter much					
Q 8	*a) Do you milk your animals?* Y *b) Do you sell the milk?* N *c) Do you trade it?* N *f) Do you give/share it?* Y *g) How much would you pay for a liter of goat's milk?* R7 *h) How do you compare it to shop milk?* Preferred					
Q 9	*a) Do you typically sell skins?* N *b) How much do skins sell for now?* R3 *c)What do you do with them when you don't sell them?* Cleans it and keeps it for home use.					
	Notes: Says doesn't sell b/c price is too low, especially goat skin prices & goats are all he keeps.					

	Name: Number: 1007		
	Date: 5 May 99 Time Begin: 8:15 Time End: 9:15		
Q 10 Forage Cost/Mo	Good	Average	Poor
	0	150	250
	Notes: Says he gets feed from Garies or Freedendal. Usually gets a 50 kg bag and "some lucerne." The trip to Garies costs him R150. He feeds from March until it rains. Unlike other farmers he gives feed to all his animals, not just weak or pregnant ones.		
Q 11	*a) Do your animals graze off crop-land stubble?* Y *b) For how long?* 4 hrs/day *c) During which months?* December		
Q 12 Vet Cost/ Year	Good	Average	Poor
	50	100	150
	Notes: Says that he likes to give medicines Aug-Sept		
Q 13	*How many herders do you hire?* 0		
Q 14	*What investments have you made to LF and how much have you paid?* None		
Q 15 Moves/ Year	Good	Average	Poor
	0	0	0
	Notes: He never moves b/c he believes the goats know the veld well where he is & therefore can survive better		
Q 16	*How do you market your animals?* Speculator		
Q 17	*a) Have you bought animals in the last year?* N *b) How many?* N/A *c) How many sheep & goats do you typically buy in a year?* None		
Q 18 Purchase & use of rams		Goat	Sheep
	a) Frequency?	1 every year	N/A
	b) Cost ?	R250	N/A
	c) From?	Local Farmers	N/A
	d) Disposal ?	Castrates	N/A
Q 19	*a) Are you willing to graze on commercial farms?* N *b) How much are you willing to pay?* Nothing		
	Notes: He will not lease commercial lands for grazing, when asked why he had no reason. When asked if it was free he said "maybe" he would do it		

	Name: Number: 1007
	Date: 5 May 99 Time Begin: 8:15 Time End: 9:15
Q20	*What change would you make to your LF?* Better ram
Q 21	*a) It would reduce deaths if you fed your animals at 3 critical periods (the 3 are explained) what is your opinion of this intervention?* Good idea when there is not enough forage *b) Would you be willing to do this?* Y
	Notes: It is too expensive for him to do, but when asked how much it would cost he estimated around R200.

APPENDIX A

Question Number	Name: Number: 1008					
	Date: 5 May 99 Time Begin: 17:15 Time End: 18:43					
	Survey Response					
Q 1	*a) How long have you kept livestock?* 21 years *b) Why do you keep sheep and goats?* For income & that is the only thing to farm in Namqualand					
	Notes: He grew up on the farm which he has inherited from his father. He has 1 brother & 1 sister, but					
Q 2	*c) At what age do you sell and why?* 3 mo in good years; 4-5 mo in bad years b/c of good price *d) What time of the year & why?* Sept-Jan b/c he lambs (May-June) in accordance w/rainfall (May-Aug) *e) When do you service your ewes?* Dec-Jan					
Q 3	Good		Average		Poor	
	Ewe G=14	Ewe S=325	Ewe G=14	Ewe S=325	Ewe G=14	Ewe S=325
Lambs	N/A	110% = 357	N/A	110%= 357	N/A	80%= 260
Lambs Dead	N/A	10% = 35	N/A	10% = 35	N/A	40%= 104
Q 4-7	Total G =18	Total S =363	Total G =18	Total S =363	Total G =18	Total S =363
Sales Market	N/A	300	N/A	300	N/A	300
Sales Local	0	0	0	0	0	0
Slaughter	N/A	12	N/A	12	N/A	12
Deaths	N/A	10	N/A	10	N/A	30
Q 8	*a) Do you milk your animals?* Y *b) Do you sell the milk?* N *c) Do you trade it?* N *f) Do you give/share it?* Y *g) How much would you pay for a liter of goat's milk?* 0 h) *How do you compare it to shop milk?* Worse					
	Notes: He thinks goat's milk smells at certain times of the year and doesn't like it					

<table>
<tr><td></td><td colspan="4">Name: Number: 1008
Date: 5 May 99 Time Begin: 17:15 Time End: 18:43</td></tr>
<tr><td>Q 9</td><td colspan="4">a) Do you typically sell skins? Y
b) How much do skins sell for now? R15 for wetskin; R5 for dryskin
c)What do you do with them when you don't sell them? Keeps them until prices improve</td></tr>
<tr><td rowspan="2">Q 10 Forage Cost/Year</td><td>Good</td><td>Average</td><td colspan="2">Poor</td></tr>
<tr><td>R3000</td><td>R4000</td><td colspan="2">R10000</td></tr>
<tr><td></td><td colspan="4">Notes: Gives feed Jan-rains. In a good year doesn't buy much fodder as he uses what he can grow (barley & oats) on 30 ha. Good years only buys "power food" that he mixes w/millies. I bag sows 1.5 ha. It takes 25 (50kg) bags @ R40 each for 30 ha. Good years= x10-12, Ave=x8, Bad=0. Two (2) years in 10 is a bad year</td></tr>
<tr><td>Q 11</td><td colspan="4">a) Do your animals graze off crop-land stubble? Y
b) For how long?
c) During which months? Dec-Feb</td></tr>
<tr><td rowspan="2">Q 12 Vet Cost/ Year</td><td>Good</td><td>Average</td><td colspan="2">Poor</td></tr>
<tr><td>R800</td><td>R1000</td><td colspan="2">R2000</td></tr>
<tr><td>Q 13</td><td colspan="4">How many herders do you hire? 0</td></tr>
<tr><td>Q 14</td><td colspan="4">What investments have you made to LF and how much have you paid? Bought windmill spares R300.</td></tr>
<tr><td rowspan="2">Q 15 Moves/ Year</td><td>Good</td><td>Average</td><td colspan="2">Poor</td></tr>
<tr><td>N/A</td><td>N/A</td><td colspan="2">N/A</td></tr>
<tr><td>Q 16</td><td colspan="4">How do you market your animals? Agent comes around to colllect animals; pays R11/head for this.</td></tr>
<tr><td>Q 17</td><td colspan="4">a) Have you bought animals in the last year? No
b) How many? N/A
c) How many sheep & goats do you typically buy in a year? None</td></tr>
<tr><td rowspan="5">Q 18

Purchase & use of rams</td><td rowspan="2">a) Frequency?</td><td>Goat</td><td colspan="2">Sheep</td></tr>
<tr><td>N/A</td><td colspan="2">1 ram in 3 years</td></tr>
<tr><td>b) Cost ?</td><td>N/A</td><td colspan="2">R800-R1000</td></tr>
<tr><td>c) From?</td><td>N/A</td><td colspan="2">Ram auction/private ram breeders</td></tr>
<tr><td>d) Disposal ?</td><td>N/A</td><td colspan="2">Ram auction/private ram breeders</td></tr>
</table>

	Name: Number: 1008
	Date: 5 May 99 Time Begin: 17:15 Time End: 18:43
Q 19	*a) Are you willing to grazing on your commercial farms?* Y, if there is space *b) How much would you charge?* R50/100 sheep/mo
	Notes: The market rate is R5/head/mo. In one experience he allowed a communal farmer to graze 40 animals on his farm in exchange the communal farmer would provide 1-2 days of labor; but problems arose from this arrangement and it was ended.
Q20	*What change would you make to your LF?* More camps & more jackle-proof
Q 21	*a) It would reduce deaths if you fed your animals at 3 critical periods (the 3 are explained) what is your opinion of this intervention?* Good idea *b) Would you be willing to do this?* Yes, does something like this
	Notes: He says he makes sure that the ram is in good condition before sending it to the ewes in Dec; meanwhile he makes sure that the ewes are as fat as possible in Dec-Jan. He does not give extra feed 6 weeks before lambing, but does it in bad years.

APPENDIX B

Farmer No.1001-Communal															
	POOR				AVERAGE				GOOD			
	Nominal	Monetary	Per Ha	Per Animal	Nominal	Monetary	Per Ha	Per Animal	Nominal	Monetary	Per Ha	Per Animal
OUTPUTS												
LOCAL SALES	8	800			11	2200			10	2500		
MARKET SALES	0	0			35	7000			60	15000		
SLAUGHTER	10	1000			13	2600			19	4750		
TOTAL-Sales/Slaughter	18	1800			59	11800			89	22250		
TOTAL OUTPUTS	18	1800	1.0124	9.89	59	11800	6.64	64.84	89	22250	12.51	122.25
INVENTORY CHANGE												
Births	80	8000			143	28600			170	42500		
(minus)						0				0		
Deaths	86	8600			43	8600			0	0		
Sales/Slaughter	18	1800			59	11800			89	22250		
INVENTORY CHANGE	-19	-2400			46	8200			86	20250		
GROSS INCOME		-600	-0.34	-3.30		20000	11.25	109.89		42500	23.90	233.52
INPUTS												
INPUTS-Variable												
Purchases	5	500			5	1000			5	1250		
Forage		3600				1200				0		
Vet		800				600				500		
Moves	4	160			3	120			1	40		
TOTAL		5060	2.85	27.80		2920	1.64	16.04		1790	1.01	9.84
INPUTS-Fixed												
Maintenance		0				0				0		
Rams (annual cost)		33				33				33		
Labor		4800				4800				4800		
TOTAL		4833	2.72	26.56		4833	2.72	26.56		4833	2.72	26.56
GRAND TOTAL INPUTS		9893	5.56	54.36		9673	5.44	53.15		7163	4.03	39.36
NET RETURNS		-10493	-5.90	-57.66		10327	5.81	56.74		35337	19.87	194.16
NET RETURNS W/OUT LABOR		-5693	-3.20	-31.28		15127	8.51	83.11		40137	22.57	220.53
PRODUCTION COEFFICIENTS												
Sheep												
Lambing %	74				100				103			
Weaning %	60				78				100			
Goats												
Lambing %	46				115				154			
Weaning %	47				87				100			
March 99 Stock Size	182				182				182			

APPENDIX B

	Farmer No.1002-Communal											
	POOR				AVERAGE				GOOD			
	Nominal	Monetary	Per Ha	Per Animal	Nominal	Monetary	Per Ha	Per Animal	Nominal	Monetary	Per Ha	Per Animal
OUTPUTS												
LOCAL SALES	0	0			6	1200			5	1250		
MARKET SALES	10	1000			8	1600			23	5750		
SLAUGHTER	6	600			5	1000			5	1250		
TOTAL-Sales/Slaughter	16	1600			19	3800			33	8250		
TOTAL OUTPUTS	16	1600	2.93	28.57	19	3800	6.95	67.86	33	8250	15.08	147.32
INVENTORY CHANGE												
Births	19	1900			55	11000			73	18250		
(minus)						0				0		
Deaths	41	4100			14	2800			20	5000		
Sales/Slaughter	16	1600			19	3800			33	8250		
INVENTORY CHANGE	-38	-3800			22	4400			20	5000		
GROSS INCOME		-2200	-4.02	-39.29		8200	14.99	146.43		13250	24.22	236.61
INPUTS												
INPUTS-Variable												
Purchases	0	0			0	0			0	0		
Forage		3600				0				0		
Vet		600				400				200		
Moves	5	200			3	120			2	80		
TOTAL		4400		78.57		520	0.95	9.29		280	0.51	5
INPUTS-Fixed												
Maintenance		0				0				0		
Rams (annual cost)		117				117				117		
Labor		4800				4800				4800		
TOTAL		4917		87.80		4917	8.99	87.80		4917	8.99	87.8
GRAND TOTAL INPUTS		9317	17.03	172.53		5437	9.94	100.68		5197	9.50	96.23
NET RETURNS		-11517	-21.05	-205.85		2763	5.05	49.35		8053	14.72	143.81
NET RETURNS W/OUT LABOR		-6717	-12.28	-119.94		7563	13.83	135.06		12853	23.50	229.52
PRODUCTION COEFFICIENTS												
Sheep												
Lambing %	27				81				100			
Weaning %	0				90				82			
Goats												
Lambing %	50				125				200			
Weaning %	0				84				83			
March 99 Stock Size	56				56				56			

APPENDIX B

Farmer No.1003-Communal

	POOR				AVERAGE				GOOD			
	Nominal	Monetary	Per Ha	Per Animal	Nominal	Monetary	Per Ha	Per Animal	Nominal	Monetary	Per Ha	Per Animal
OUTPUTS												
LOCAL SALES	0	0			6	1200			0	0		
MARKET SALES	10	1000			12	2400			18	4500		
SLAUGHTER	11	1100			9	1800			15	3750		
TOTAL-Sales/Slaughter	21	2100			27	5400			33	8250		
TOTAL OUTPUTS	21	2100	3.2558	31.82	27	5400	8.26	81.8	33	8250	12.61	125.00
INVENTORY CHANGE												
Births	19	1900			51	10200			93	23250		
(minus)						0				0		
Deaths	29	2900			29	5800			33	8250		
Sales/Slaughter	21	2100			27	5400			33	8250		
INVENTORY CHANGE	-31	-3100			-5	-1000			27	6750		
GROSS INCOME		-1000	-1.55	-15.15		4400	6.73	66.67		15000	22.94	227.27
INPUTS												
INPUTS-Variable												
Purchases	0	0			0	0			0	0		
Forage		2400				600				0		
Vet		400				300				175		
Moves	4	160			3	120			2	80		
TOTAL		2960	4.59	44.85		1020	1.56	15.45		255	0.39	3.86
INPUTS-Fixed												
Maintenance		0				0				0		
Rams (annual cost)		188				188				188		
Labor		3600				3600				3600		
TOTAL		3788	5.87	57.39		3788	5.79	57.39		3788	5.79	57.39
GRAND TOTAL INPUTS		6748	10.46	102.23		4808	7.35	72.84		4043	6.18	61.25
NET RETURNS		-7748	-12.01	-117.39		-408	-0.62	-6.17		10958	16.75	166.02
NET RETURNS W/OUT LABOR		-4148	-6.43	-62.84		3193	4.88	48.37		14558	22.26	220.57
PRODUCTION COEFFICIENTS												
Sheep												
Lambing %		32				50				100		
Weaning %		0				71				71		
Goats												
Lambing %		31				116				203		
Weaning %		0				51				77		
March 99 Stock Size		66				66				66		

APPENDIX B

Farmer No.1004-Communal

	POOR				AVERAGE				GOOD			
	Nominal	Monetary	Per Ha	Per Animal	Nominal	Monetary	Per Ha	Per Animal	Nominal	Monetary	Per Ha	Per Animal
OUTPUTS												
LOCAL SALES	0	0			6	1200			10	2500		
MARKET SALES	0	0			10	2000			6	1500		
SLAUGHTER	0	0			3	600			6	1500		
TOTAL-Sales/Slaughter	0	0			19	3800			22	5500		
TOTAL OUTPUTS	0	0	0	0.00	19	3800	7.21	70.37	22	5500	10.44	101.85
INVENTORY CHANGE												
Births	14	1400			45	9000			65	16250		
(minus)						0				0		
Deaths	25	2500			37	7400			4	1000		
Sales/Slaughter	0	0			19	3800			22	5500		
INVENTORY CHANGE	-11	-1100			-11	-2200			39	9750		
GROSS INCOME		-1100	-2.09	-20.37		1600	3.04	29.63		15250	28.94	282.41
INPUTS												
INPUTS-Variable												
Purchases	0	0			0	0			0	0		
Forage		1200				0				0		
Vet		250				100				80		
Moves	2	80			0	0			0	0		
TOTAL		1530	2.90	28.33		100	0.19	1.85		80	0.15	1.48
INPUTS-Fixed												
Maintenance		0				0				0		
Rams (annual cost)		50				50				50		
Labor		4800				4800				4800		
TOTAL		4850		89.81		4850	9.20	89.81		4850	9.20	89.81
GRAND TOTAL INPUTS		6380	12.11	118.15		4950	9.39	91.67		4930	9.35	91.30
			0.00									
NET RETURNS		-7480	-14.19	-138.52		-3350	-6.36	-62.04		10320	19.58	191.11
NET RETURNS WOUT LABOR		-2680	-5.09	-49.63		1450	2.75	26.85		15120	28.69	280.00
PRODUCTION COEFFICIENTS												
Sheep												
Lambing %		53			100				100			
Weaning %		50			47				100			
Goats												
Lambing %		30			150				250			
Weaning %		0			33				100			
March 99 Stock Size		54			54				54			

APPENDIX B

Farmer No.1005-Communal

	POOR				AVERAGE				GOOD			
	Nominal	Monetary	Per Ha	Per Animal	Nominal	Monetary	Per Ha	Per Animal	Nominal	Monetary	Per Ha	Per Animal
OUTPUTS												
LOCAL SALES	20	2000			10	2000			12	3000		
MARKET SALES	0	0			30	6000			40	10000		
SLAUGHTER	12	1200			12	2400			12	3000		
TOTAL-Sales/Slaughter	32	3200			52	10400			64	16000		
TOTAL OUTPUTS	32	3200	1.9729	19.28	52	10400	6.41	62.65	64	16000	9.86	96.39
INVENTORY CHANGE												
Births	54	5400			125	25000			172	43000		
(minus)						0				0		
Deaths	81	8100			29	5200			5	1250		
Sales/Slaughter	32	3200			52	10400			64	16000		
INVENTORY CHANGE	-59	-5900			47	9400			103	25750		
GROSS INCOME		-2700	-1.66	-16.27		19800	12.21	119.28		41750	25.74	251.51
INPUTS												
INPUTS-Variable												
Purchases	0	0			0	0			0	0		
Forage		1200				0				0		
Vet		400				300				300		
Moves	5	200			3	120			2	80		
TOTAL		1800	1.11	10.84		420	0.26	2.53		380	0.23	2.29
INPUTS-Fixed												
Maintenance		0				0				0		
Rams (annual cost)		100				100				100		
Labor		4800				4800				4800		
TOTAL		4900	3.02	29.52		4900	3.02	29.52		4900	3.02	29.52
GRAND TOTAL INPUTS		6700	4.13	40.36		5320	3.28	32.05		5280	3.26	29.01
NET RETURNS		-9400	-5.80	-56.63		14480	8.93	87.23		36470	22.48	219.70
NET RETURNS W/OUT LABOR		-4600	-2.84	-27.71		19280	11.89	116.14		41270	25.44	248.61
PRODUCTION COEFFICIENTS												
Sheep												
Lambing %	52				77				100			
Weaning %	48				88				100			
Goats												
Lambing %	34				108				152			
Weaning %	0				86				96			
March 99 Stock Size	166				166				166			

APPENDIX B

Farmer No.1006-Communal														
	POOR				AVERAGE				GOOD			
	Nominal	Monetary	Per Ha	Per Animal	Nominal	Monetary	Per Ha	Per Animal	Nominal	Monetary	Per Ha	Per Animal
OUTPUTS												
LOCAL SALES	5	500			4	800			4	1000		
MARKET SALES	0	0			0	0			0	0		
SLAUGHTER	9	900			10	2000			10	2500		
TOTAL-Sales/Slaughter	14	1400			14	2800			14	3500		
TOTAL OUTPUTS	14	1400	2.8071	25.45	14	2800	5.21	50.91	14	3500	6.52	63.64
INVENTORY CHANGE												
Births	6	600			40	8000			72	18000		
(minus)						0				0		
Deaths	28	2800			26	5200			10	2500		
Sales/Slaughter	14	1400			14	2800			14	3500		
INVENTORY CHANGE	-36	-3600			0	0			48	12000		
GROSS INCOME		-2200	-4.10	-40.00		2800	5.21	50.91		15500	28.86	281.82
INPUTS												
INPUTS-Variable												
Purchases	0	0			0	0			0	0		
Forage		2400				420				0		
Vet		500				250				150		
Moves	10	400			7	280			5	200		
TOTAL		3300	6.15	60.00		950	1.77	17.27		350	0.65	6.36
INPUTS-Fixed												
Maintenance		0				0				0		
Rams (annual cost)		25				25				25		
Labor		3600				3600				3600		
TOTAL		3625	6.75	65.91		3625	6.75	65.91		3625	6.75	65.91
GRAND TOTAL INPUTS		6925	12.90	125.91		4575	8.52	83.18		3975	7.40	72.27
NET RETURNS		-9125	-16.99	-165.91		-1775	-3.31	-32.27		11525	21.46	209.55
NET RETURNS W/OUT LABOR		-5525	-10.29	-100.45		1825	3.40	33.18		15125	28.17	275.00
PRODUCTION COEFFICIENTS												
Sheep												
Lambing %	29				59				100			
Weaning %	0				50				94			
Goats												
Lambing %	3				100				183			
Weaning %	0				67				93			
March 99 Stock Size	55				55				55			

APPENDIX B

Farmer No.1007-Communal

	POOR				AVERAGE				GOOD			
	Nominal	Monetary	Per Ha	Per Animal	Nominal	Monetary	Per Ha	Per Animal	Nominal	Monetary	Per Ha	Per Animal
OUTPUTS												
LOCAL SALES	0	0			1	200			3	750		
MARKET SALES	0	0			0	0			6	1500		
SLAUGHTER	0	0			0	0			1	250		
TOTAL-Sales/Slaughter	0	0			1	200			10	2500		
TOTAL OUTPUTS	0	0	0	0.00	1	200	0.62	8.06	10	2500	7.76	75.76
INVENTORY CHANGE												
Births	15	1500			28	5600			40	10000		
(minus)						0				0		
Deaths	11	1100			9	1800			0	0		
Sales/Slaughter	0	0			1	200			10	2500		
INVENTORY CHANGE	4	400			18	3600			30	7500		
GROSS INCOME		400	1.24	12.12		3800	11.80	115.15		10000	31.06	303.03
INPUTS												
INPUTS-Variable												
Purchases	0	0			0	0			0	0		
Forage		3000				1800				0		
Vet		150				100				50		
Moves	0	0			0	0			0	0		
TOTAL		3150	9.78	95.45		1900	5.90	57.58		50	0.16	1.52
INPUTS-Fixed												
Maintenance		0				0				0		
Rams (annual cost)		50				50				50		
Labor		4800				4800				4800		
TOTAL		4850	15.06	146.97		4850	15.06	146.97		4850	15.06	146.97
GRAND TOTAL INPUTS		8000	24.84	242.42		6750	20.96	204.55		4900	15.22	148.48
NET RETURNS		-7600	-23.60	-230.30		-2950	-9.16	-89.39		5100	15.84	154.55
NET RETURNS W/OUT LABOR		-2800	-8.70	-84.85		1850	5.75	56.06		9900	30.75	300.00
PRODUCTION COEFFICIENTS												
Sheep-None												
Lambing %												
Weaning %												
Goats												
Lambing %	52				97				138			
Weaning %	67				75				100			
March 99 Stock Size	33				33				33			

APPENDIX B

Farmer No.1008-Commercial														
	POOR				AVERAGE				GOOD			
	Nominal	Monetary	Per Ha	Per Animal	Nominal	Monetary	Per Ha	Per Animal	Nominal	Monetary	Per Ha	Per Animal
OUTPUTS												
LOCAL SALES	0	0			0	0			0	0		
MARKET SALES	300	75000			300	75000			300	75000		
SLAUGHTER	12	3000			12	3000			12	3000		
TOTAL-Sales/Slaughter	312	78000			312	78000			312	78000		
TOTAL OUTPUTS	312	78000	15	204.72	312	78000	15.00	204.72	312	78000	15.00	204.72
INVENTORY CHANGE												
Births	260	65000			357	89250			357	89250		
(minus)						0				0		
Deaths	134	33500			45	11250			45	11250		
Sales/Slaughter	312	78000			312	78000			312	78000		
						0						
INVENTORY CHANGE	-186	-46500			0	0			0	0		
GROSS INCOME		31500	6.06	82.68		78000	15.00	204.72		78000	15.00	204.72
INPUTS												
INPUTS-Variable												
Purchases	0	0			0	0			0	0		
Forage		10000				4000				3000		
Vet		2000				1000				800		
Moves	N/A				N/A				N/A			
TOTAL		12000	2.31	31.50		5000	0.96	13.12		3800	0.73	9.97
INPUTS-Fixed												
Maintenance		1000				1000				1000		
Rams (annual cost)		167				167				167		
Land Lease		19000				19000				19000		
TOTAL		20167		52.93		20167		52.93		20167		52.93
GRAND TOTAL INPUTS		32167	6.19	84.43		25167	4.84	151.61		23967	4.61	131.68
NET INCOME		-667	-0.13	-1.75		52833	10.16	138.67		54033	10.39	141.82
PRODUCTION COEFFICIENTS												
Sheep												
Lambing %	80				110				110			
Weaning %	60				90				90			
Goats												
Lambing %	N/A				N/A				N/A			
Weaning %	N/A				N/A				N/A			
March 99 Stock Size	386				386				386			

APPENDIX C

Three-Year Small Stock Data for Paulshoek and Two Commercial Farmers Thesis Case Study Respondents in Bold								
COMMUNAL	May-96	Oct-96	Mar-97	Oct-97	Feb-98	Mar-98	May-98	Jun-98
No.1009	83	97	60	74	95	96	78	89
No.1010	193	244	229	264	228	210	141	166
No.1004	**127**	**120**	**118**	**99**	**57**	**65**	**57**	**54**
No.1011	0	0	0	0	0	0	0	0
No.1003	**151**	**203**	**178**	**261**	**296**	**150**	**115**	**165**
No.1012	89	85	88	126	155	120	113	100
No.1013	285	250	198	331	274	230	233	228
No.1014	27	59	43	36	0	0	0	0
No.1015	26	0	0	0	0	0	0	0
No.1016	150	350	180	259	0	106	96	103
No.1002	**0**	**0**	**165**	**205**	**180**	**178**	**141**	**117**
No.1006	**47**	**56**	**28**	**30**	**65**	**74**	**69**	**74**
No.1017	65	85	55	88	88	76	0	0
No.1018	238	185	192	289	249	256	242	200
No.1019	20	31	22	36	32	30	30	28
No.1020	0	0	0	118	119	91	64	54
No.1021	173	134	185	336	180	199	190	169
No.1022	65	58	42	78	59	59	57	50
No.1023	232	171	158	229	161	161	112	104
No.1024	54	74	60	79	70	68	64	55
No.1025	0	0	0	0	0	34	29	32
No.1007	**40**	**52**	**47**	**65**	**56**	**50**	**47**	**47**
No.1026	217	205	143	270	328	164	157	153
No.1027	0	0	0	0	0	53	54	52
No.1001	**365**	**350**	**319**	**385**	**306**	**310**	**234**	**262**
No.1028	40	67	60	80	85	80	75	75
No.1005	**210**	**183**	**166**	**321**	**215**	**210**	**191**	**177**
No.1029	133	124	95	119	91	80	69	82
No.1030	83	175	81	99	0	84	84	83
No.1031	45	0	23	0	37	39	37	93
No.1032	240	249	226	335	206	199	149	149
No.1033	89	97	57	65	36	51	51	50
No.1034	36	42	59	44	44	37	0	0
No.1035	289	326	266	433	359	355	337	334
Total	**3812**	**4072**	**3543**	**5154**	**4071**	**3915**	**3316**	**3345**
Median	**83.0**	**91.0**	**70.5**	**99.0**	**86.5**	**82.0**	**72.0**	**82.5**
COMMERCIAL								
No.1036	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
No.1008	**NO DATA**	**NO DATA**	**NO DATA**	**NO DATA**	**NO DATA**	**NO DATA**	**NO DATA**	**NO DATA**

APPENDIX C

Three-Year Small Stock Data for Paulshoek and Two Commercial Farmers Thesis Case Study Respondents in Bold									
COMMUNAL	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Jan-99	Feb-99	Mar-99
No.1009	91	85	83	88	70	74	30	17	13
No.1010	143	120	123	120	120	101	101	95	96
No.1004	**53**	**56**	**59**	**64**	**69**	**62**	**62**	**57**	**54**
No.1011	0	0	0	0	0	54	53	53	51
No.1003	**149**	**132**	**128**	**120**	**116**	**73**	**73**	**67**	**66**
No.1012	100	110	99	100	107	99	99	99	96
No.1013	218	215	217	221	206	201	199	152	152
No.1014	12	17	17	17	15	15	15	14	14
No.1015	0	0	0	0	0	0	0	0	0
No.1016	95	115	115	113	113	111	111	91	91
No.1002	**115**	**102**	**96**	**91**	**87**	**73**	**62**	**59**	**57**
No.1006	**72**	**75**	**65**	**64**	**62**	**58**	**58**	**58**	**56**
No.1017	0	0	0	0	0	0	0	0	0
No.1018	191	183	176	175	172	166	166	162	157
No.1019	28	30	29	29	30	25	25	25	25
No.1020	51	87	55	61	58	0	0	0	0
No.1021	159	212	215	213	210	152	152	142	142
No.1022	50	53	63	60	58	56	59	18	16
No.1023	101	106	108	108	108	91	91	85	60
No.1024	48	49	50	49	48	43	39	35	22
No.1025	0	0	57	64	64	66	66	66	69
No.1007	**41**	**48**	**44**	**44**	**44**	**38**	**38**	**38**	**33**
No.1026	293	311	271	276	260	236	236	232	228
No.1027	0	0	0	0	0	0	0	0	0
No.1001	**253**	**256**	**270**	**274**	**276**	**239**	**228**	**207**	**182**
No.1028	71	82	80	74	73	66	66	61	58
No.1005	**185**	**175**	**269**	**185**	**183**	**173**	**170**	**168**	**166**
No.1029	82	71	92	88	88	83	80	86	86
No.1030	0	0	0	0	0	0	0	0	0
No.1031	80	71	75	73	66	66	59	46	43
No.1032	140	151	146	134	119	100	100	70	55
No.1033	45	49	47	39	39	40	40	20	17
No.1034	0	0	0	0	0	0	0	31	27
No.1035	274	291	267	262	254	227	203	173	120
Total	**3140**	**3252**	**3316**	**3206**	**3115**	**2788**	**2681**	**2427**	**2251**
Median	**76.0**	**78.5**	**77.5**	**73.5**	**69.5**	**66.0**	**62.0**	**58.5**	**55.0**
COMMERCIAL									
No.1036	NO DATA	715	719	594	NO DATA	548	NO DATA	NO DATA	453
No.1008	**NO DATA**	**533**	**516**	**482**	**505**	**430**	**417**	**408**	**386**

Source: NBI
Referenced in Figures 3.3, 3.5, and Dean and Milton (1999)

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