Land Reform, Range Ecology, and Carrying Capacities in Namaqualand, South Africa

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In South African rangeland management, there is a long history of using the notion of carrying capacity as a central planning tool for environmental conservation and agricultural modernization. Today, in the new South Africa, the "need" for livestock keepers to adhere to a defined carrying capacity in order to conserve rangeland resources and to achieve economic development remains an institutionalized "fact." In this article, we use interviews, livestock and rainfall data, policy documents, and aerial photos to discuss the idea of carrying capacity as it is currently used in the implementation of land reform in Namaqualand in the Northern Cape Province. This article is a contribution at the interface of human ecology and political ecology, linking environmental issues to economic constraints, land rights, social justice, and values. Policymakers and extension services usually see carrying capacity as a purely technical issue. We argue that this is problematic because it gives privilege to environmental sustainability and to one particular perception of the ideal landscape at the expense of livelihood security and poverty alleviation. It also perpetuates the colonial myth that the private ranch system is an ideal one, independent of disparate production goals and unequal economic opportunities and constraints, and it ignores evidence going back more than half a century that the Namaqualand range is capable of sustaining livestock densities far greater than those recommended. The winners that emerge from the current policy focus on carrying capacity are the few emergent black commercial farmers as well as conservationist interests; the losers are the majority of poor stockowners in the communal areas. *Key Words: carrying capacity, land reform, Namaqualand, political ecology, South Africa.*

The notion of carrying capacity applied within rangeland management has a central place in South Africa's history of environmental conservation and agricultural modernization. During the latter part of the twentieth century, especially during the 1960s and 1970s, many national agricultural policies were designed to promote the interests of white farmers on private land. Such policies were derived largely from South African research that used a theoretical underpinning of equilibrium and succession, and thus led to formulations of optimal sustainable yield within a farming system based on private property, fenced camps, and conservative stocking rates. Research was motivated not only by the need to modernize agricultural production, but also by the perception that extensive soil and vegetation degradation was occurring as a result of overgrazing across the Karoo region (Beinart 2003). State infrastructure grants, stock reduction schemes, and drought relief programs promoted and supported this "commercial" system (Hoffman and Ashwell 2001). In communal "reserves" and "homelands" across South Africa, strategies to address land degradation were introduced in 1939, but only extensively implemented during the 1950s and 1960s. These often involved calculations of livestock carrying capacities, the fencing off of communal rangeland into camps, and the subsequent culling of livestock to conform to estimated carrying capacities (Beinart 1984, 2003; Jacobs 2003).

Conservation policies in South Africa (and Africa, in general) have moved from the coercive conservation of colonial days toward community-based approaches, at least at the rhetorical level (Hulme and Murphree 2001; Dzingirai 2003); nevertheless, the "need" for livestock keepers to adhere to a defined carrying capacity in order to conserve rangeland resources and to achieve economic development remains an institutionalized "fact."[1] This "fact," which is the focus of this article, is part of a broader dominating discourse[2] in southern Africa on range management, environmental conservation, and agricultural development, which is shared by a network of actors (Hongslo and Benjaminsen 2002). Such actor-networks (Callon and Latour 1981; Keeley and Scoones 2000, 2003) tend to establish, promote, and reproduce a particular discourse through their use of language and actions. Hegemonic discourses or their associated narratives have proven persistent, even in the face of "counterfacts" going against their storyline (Roe 1991, 1995). According to Masilela and Weiner (1996, 38),

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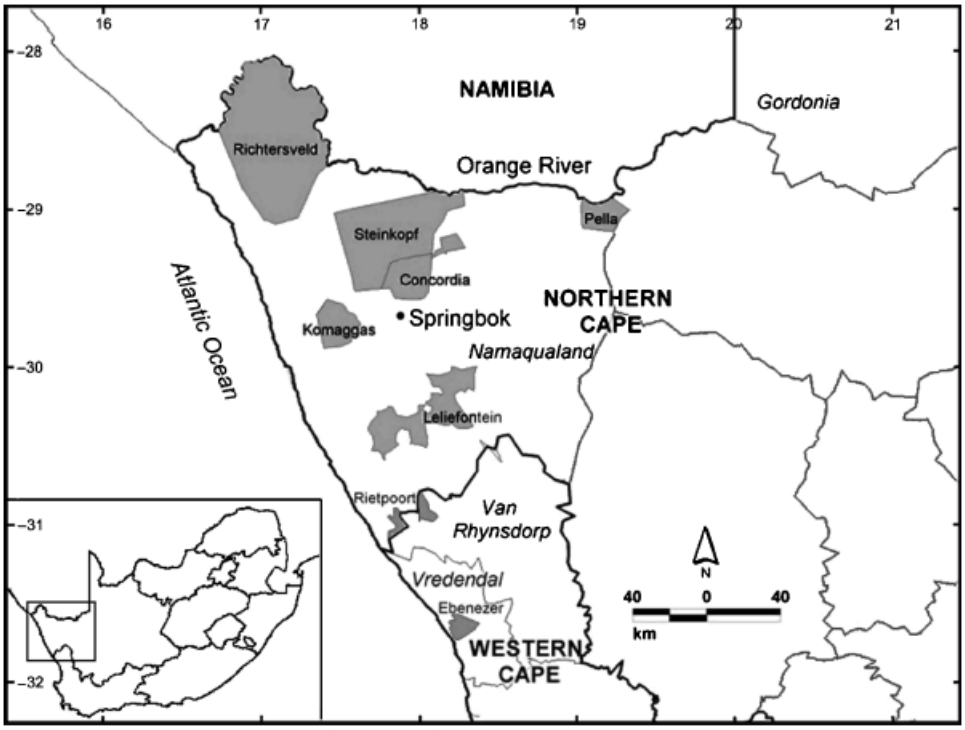
"the South African discourse on land reform is full of broad pronouncements and truths that are mostly unsubstantiated, and often wrong."

In this article we discuss the idea of carrying capacity as it is currently used in the implementation of land reform in Namaqualand, a semiarid area on the border of Namibia (Figure 1). The research is a contribution at the interface of human ecology and political ecology. It collects and analyzes data on livestock grazing and herding practices (human ecology) and it considers the policies and social power differentials that affect the definition and implementation of carrying capacity decisions (political ecology *sensu* Blaikie and Brookfield 1987) linking environmental issues to economic constraints, land rights, social justice, and values. Hence, although policymakers and extension services usually see carrying capacity as a purely technical issue, we argue that this assumption is insufficient in the present context of resilient rangelands, vulnerable livelihoods, and past injustices.

Political ecology can be broadly defined as the study of power relations in land and environmental management. In current political ecology, there is a particular interest in the ways that power relations are reinforced or contested in environmental discourses, which are maintained by powerful actors and by environmental movements (Martinez-Alier 2002). Likewise, to Stott and Sullivan (2000, 2), political ecology is characterized by "a concern with tracing the genealogy of narratives concerning 'the environment', with identifying power relationships supported by such narratives, and with asserting the consequences of hegemony over, and within, these narratives for economic and social development, and particularly for constraining possibilities for self-determination."

This article attempts to contribute to a synthesis of an understanding of political and ecological processes by analyzing the notion of carrying capacity and its policy implications in Namaqualand within a historical, political, economic, and human rights–based approach.[3] According to Zimmerer and Bassett (2003), the synthesis or "fusion" of political and ecological processes is one of the chief challenges facing current political ecology. Hence, we believe that in order to understand the interface between policy and practice and discourse and ecological processes, an empirically-based approach involving both the political and the ecological spheres is essential. Such an approach falls in line with environmental pragmatism and critical realism (Proctor 1998), implying that both the real biophysical processes in nature and nature's discursive constructions are acknowledged and studied.

The research involved repeated visits to two selected communal areas (Concordia and Leliefontein) during



Namaqualand, Northern Cape Province, South Africa
Source: Timm Hoffman, University of Cape Town. Graphics Simon Todd

Figure 1. Namaqualand with communal areas in grey.

1998–2004.[4] Semi-structured interviews were carried out with farmers on farms newly acquired through redistribution, as well as with farmers remaining on the commons. The conversations focused on the farmers' interests in access to the new farms and on their assessments of stocking regulations, grazing contracts, and management plans relating to new and old commons. Fieldwork also included participation in and observation of community and committee meetings, and semistructured qualitative interviews with "resource-persons" known to have special roles in land reform and with politicians, administrators, and other officials at the municipal level. Historical documents were consulted in the National Archives and Records Service of South Africa in Cape Town and data on livestock were obtained from Northern Cape Department of Agriculture. Rainfall records, obtained from the South African Weather Service, were analyzed in conjunction with livestock census data for each communal area. Aerial photographs, used to analyze fence-line contrasts between communal and private farms spanning 1960 through 1997, were purchased from the South African Chief Directorate of Surveys and Mapping.

After introducing Namaqualand and post-apartheid land reform in the area, we briefly review the concept of carrying capacity and some of the debate associated with it. Then we discuss livestock management in the area and the use of carrying capacity as a management tool.

Namaqualand

Namaqualand is located in the northwest corner of South Africa, bordered by the Atlantic Ocean on the west and Namibia and the Orange River on the north. To the east, its boundary runs through the plains of Bushmanland and to the south through the Kamiesberg mountains. The topography includes the arid *sandveld*, a 20–40-km wide belt of slightly undulating sandy plains along the Atlantic coast. Further inland is the central mountain area, which receives winter rainfall, usually from May to September, with annual precipitation between 100 and 350 mm. In the northwest is the mountain desert of the Richtersveld, characterized by a varied topography that causes great local variation in rainfall. The Orange River is the only perennial river, but a number of ephemeral streams and rivers run from the mountains to the coast. Toward the east are the plains of Bushmanland, a desert shrub land that receives patchy and unpredictable summer rainfall (100–200 mm).[5] Therefore, due to topographical variation the vegetation or veld comprises different types: Namaqualand Broken Veld, Succulent Karoo, False Succulent Karoo, and Mountain Renosterveld (Acocks 1975). Of the 4,849 plant species registered in the Succulent Karoo, 1,940 are endemic to the area (Myers et al. 2000). In fact, due to its high endemic biodiversity, the Succulent Karoo has been identified as one of twenty-five global "biodiversity hotspots," implying "exceptional concentrations of endemic species . . . undergoing exceptional loss of habitat" (Myers et al. 2000, 853).

The name of Namaqualand derives from the Nama or Nama-khoi people who together with the San originally occupied and used this region. European explorers visited Namaqualand in the 1660s and *trekboere*—migrating European pastoralists—entered Namaqualand from the early eighteenth century. The region became annexed to the Cape Colony in 1798 (to the Buffels River) and in 1847 (to the Orange River). Land dispossession, diseases, and economic exploitation gradually undermined Nama society and by the beginning of the nineteenth century the Nama were largely a landless proletariat, making mission stations their only places of refuge (Boonzaier et al. 1996). The Namaqualand "communal areas" were based on "Tickets of Occupation" granted to mission stations and resident populations who were trying to protect themselves against dispossession and exploitation. The government maintained these "rural reserves" through the twentieth century as reservoirs of labor for Namaqualand's cyclical mining and farming economy.

In most of the twentieth century Namaqualand was a magisterial district in the Western Cape Province, but after the post-apartheid demarcation of provincial boundaries it became part of the Northern Cape Province. Namaqualand now largely corresponds to the municipalities of Kamiesberg, Nama-Khoi, Richtersveld, and Khâi-Ma, and comprises about 48,000 km^2 with 70,000 inhabitants. Approximately 30,000 people live in the six "communal areas" (formerly "rural reserves" or "coloured reserves") of Richtersveld, Steinkopf, Concordia, Komaggas, Pella, and Leliefontein.

The major land uses are extensive livestock farming, mining, and conservation, in addition to irrigated high-value commercial agriculture along the Orange River. About 420 private farms, almost exclusively owned by "whites," cover 52 percent of Namaqualand. Redistribution of farmland from 1996 through 2000 added 245,550 ha to the communal areas, so that these currently make up 30 percent of Namaqualand. In the six communal areas an estimated 2,000 households use the commons for livestock and dryland crop farming, usually as a source of income to supplement wage labor and state welfare.

Land Reform in South Africa and in Namaqualand

Land policy has been a contentious issue in South Africa's transition from apartheid to democracy. During apartheid, and more specifically in its final years, rural communities and land organizations demanded equal access to land, as well as secure rights to it. From 1990, the African National Congress's (ANC's) Land Committee responded to rural communities and civil society ultimately giving land a prominent place in key policy documents (Klug 2000). The Reconstruction and Development Programme (RDP), part of the ANC's 1994 election platform and later official policy, held that land reform should be the "central and driving force of a programme of rural development" (ANC 1994, 19–20). It aimed to redress injustices of the past, secure tenure for rural people, generate employment, increase rural incomes, supply residential and agricultural land to the poorest, and increase agricultural productivity. Land policy debates were interwoven with the negotiation of the interim Constitution (1993) and final Constitution (1996). Section 25 in the Bill of Rights in the Constitution (1996), "the property clause," seeks to balance the protection of existing property rights against a mandate for land reform. It commits the government to ensure equitable access to land, provide tenure security or comparable redress, and offer restitution to people who lost land due to racial discrimination after 1913.

Based on the mandate in the Constitution, land reform in South Africa comprises the three programs of restitution, tenure reform, and redistribution. *Land restitution* involves returning land, or providing other compensation, to persons or communities who were dispossessed of property after 1913 as a result of racially discriminatory laws or practices. According to widely held views, the right to restitution does not apply in Namaqualand because land alienation took place before 1913, the "cut-off date" for restitution in the Constitutional property clause (see Table 1 for a brief overview of the land reform program in Namaqualand). However, recent judgments by the Supreme Court of Appeal (March 2003) and the Constitutional Court of South Africa (October 2003) have ruled that the Richtersveld community is entitled to restitution of land.

Land tenure reform aims to increase tenure security for labor tenants and farm workers[6] and interim protection for people occupying land without formal rights.[7] In Namaqualand, this process has been spearheaded by the Transformation of Certain Rural Areas Act 94 of 1998 (TRANCRAA), which provides for a process of consultation and tenure reform in twenty-three former "coloured rural areas." It aims to transfer state land to residents or accountable local institutions. The prescribed transitional phase of TRANCRAA was implemented in the six rural areas of Namaqualand between January 2001 and January 2003, having awaited the demarcation and organization of new municipalities (Wisborg and Rohde 2003, 2005). The Surplus People Project (SPP), working with locally nominated Transformation Committees, carried out the various tasks of the consultation in cooperation with the Department of Land Affairs and the municipalities. The transformation process required participatory management planning, including grazing contracts to be signed by the individual users of the new farms. Ideas of carrying capacity and fixed stocking levels played a central role in this process. From November 2002 to January 2003, five of the six rural areas held referenda over land ownership. People voted among the alternatives of Communal Property Association (CPA),[8] municipal ownership, or other options suggested by residents (including subdivision and individual title). In four of the five areas a majority voted for CPAs. One voted for municipal control, and in the

Table 1. The three aspects of the Land Reform Programme implemented in Namaqualand include restitution, tenure reform, and redistribution

Land restitution	Land tenure reform	Land redistribution
Richtersveld community claim was upheld by the Supreme Court of Appeal (March 2003) and the South African Constitutional Court (October 2003). [This aspect of the Land Reform programme is not relevant to this paper.]	**Transformation of Certain Rural Areas Act 94 of 1998** (Trancraa). Provides for tenure reform in twenty-three former "coloured rural areas," six of which are in Namaqualand. The decision on transfer of ownership from state to municipal authorities or Communal Property Associations (CPAs) is pending.	**Municipal Commonage Programme (1995)**. The main method of land redistribution in Namaqualand. Prior to the establishment of local Municipalities in 2000, commonage land was vested in Transitional Local Councils (TLCs). Since then, Municipalites have managed these new communal areas according to Department of Agriculture guidelines.

Notes: Consultation and referenda regarding tenure reform have been carried out, although no decision on the transfer of ownership from the state to either Municipalities or CPAs has yet been made by the Minister. Redistribution has been undertaken within the Municipal Commonage Programme, effectively enlarging the communal area of Namaqualand by more than 30 percent.

sixth area the consultation process was halted due to conflicts within the community. The Minister of Agriculture and Land Affairs will, however, make the final decision about the transfer of land. At the time of writing the communal areas, including the "new farms," still vest with the municipalities, and future ownership is undecided.

In terms of *land redistribution*, the goal is to redistribute private farmland and state land to people and communities who were disadvantaged under apartheid. For South Africa as a whole, the program failed to meet its initial target of a transfer of 30 percent of private farmland within five years. Subsequently, the target was revised and the target group was adjusted.[9]

In Namaqualand, significant redistribution has been carried out not under the standard programs but under a "Municipal Commonage Programme" developed from 1995. The program was implemented in collaboration among residents, the SPP, the Legal Resources Centre (LRC), and the Department of Land Affairs (DLA). Private land was purchased at market price from farmers and mining companies, drawing on funds available under land reform legislation passed by the de Klerk government. In 2002, Namaqualand accounted for 23 percent of total land area (1.35 million ha) redistributed in South Africa since 1994 (M. Anderson and Pienaar 2003). This process has increased the land available to communities in former "coloured rural areas" in Namaqualand by about 21 percent (adding 245,550 ha).

Redistribution farms (or "new farms") were transferred to the Transitional Local Councils (TLCs)[10] under the stipulation that they be used exclusively for the benefit of residents in communal areas. The deeds of transfer require that TLCs establish a Commonage Committee to assist with the management of the farms. Resident farmers in communal areas can gain access to the new farms by applying to the Commonage Committees and indicating the number of animals to be moved to new farms. In many cases, however, infrastructure on the new farms is inadequate, management responsibilities are unclear, and their location may make them inaccessible to all but those with access to motorized transportation of livestock herds (Rohde, Benjaminsen, and Hoffman 2002). Through granting permits, Commonage Committees may control the number of animals grazing a particular area within the new farms and implement recommended stocking levels identified by the Department of Agriculture based on the notion of carrying capacity. However, these regulations have not been imposed on the "old commonage" nor are they enforced as yet on many of the "new farms." From January 2001 the "new farms" were transferred to municipalities that incorporate private farm areas, towns, and communal areas.

In conclusion, land reform in Namaqualand has been a dynamic process involving cooperation and conflict between many actors. The main achievement to date is the expansion of the amount of land available to stockowners in the former rural areas, but the impact remains constrained by the arid environment, poor infrastructure, and insecure land tenure.

Carrying Capacity

The concept of carrying capacity is based on the assumption that plants and animals are in a state of balance or equilibrium. Two different notions of carrying capacity can be identified (Hiernaux 1982; Behnke, Scoones, and Kerven 1993). The *ecological* carrying capacity is reached "when the production of forage equals the rate of its consumption by animals, and the livestock population ceases to grow because limited feed supplies produce death rates equal to birth rates" (Behnke, Scoones, and Kerven 1993, 4). The *economic* carrying capacity, on the other hand, sets a theoretical limit, which marks the number of livestock units that pastoral resources in a certain area can support in order to attain a certain management objective (e.g., optimal meat or milk production).

Calculations of carrying capacity are based on assumptions of stable plant growth and predictable plant succession under a certain level of herbivory in order to eventually produce a stable equilibrium between animal productivity and plant populations. Put simply, an appropriate stocking rate will result in a balance of the opposite forces of grazing pressure and vegetation succession. Such deterministic models are generally suitable for stable environments where conditions of plant growth and reproduction are reliable. However, such stable equilibria seldom occur in African drylands (Sandford 1983; Behnke, Scoones, and Kerven 1993; Scoones 1994). In nonequilibrium systems, external factors such as climate, rather than livestock numbers, tend to determine the vegetation composition and cover. Moreover, unavailability of forage in bad years may depress livestock populations to the point where the impact of grazing on vegetation is minimal (Sullivan and Rohde 2002). Therefore, in areas of fluctuating climates, rainfall rather than density-dependent factors related to herbivore numbers may ultimately be the most significant variable determining herbivore populations. Wet season pastures such as in the Sahel in West Africa, with its short rainy season, domination of annual grass species, and high resilience, would be a typical example of a

nonequilibrial system (Hiernaux 1993; M. Turner 1993, 1998; Benjaminsen 1997). However, there is considerable discussion and uncertainty about the extent to which southern African rangelands such as the Succulent Karoo can be described in terms of disequilibrium and resilience (Hoffman et al. 1999; Illius and O'Connor 1999; Todd and Hoffman 1999; Sullivan and Rohde 2002; Riginos and Hoffman 2003).

One of the most striking differences between much of Namaqualand and other African desert and semidesert areas is its unique winter-rainfall climate, which provides relatively reliable, regular, soft, and effective rainfall, mainly in the cool period of the year (Cowling and Pierce 1999). Unlike the grasslands associated with the dominant African pastoral landscapes, much of Namaqualand is a succulent shrubland with few grasses. Because of this relative stability in climate and the particular ecology of succulent vegetation, it might be assumed that Namaqualand corresponds in character to equilibrium models of plant-animal interactions and therefore requires a management system based on fixed stocking rates. Describing "overgrazing" and "desertification" in Namaqualand, Cowling and Pierce (1999, 138) state that "the amount of land under communal use can be expanded—as is, indeed, happening today. Ultimately, however, this land will also be desertified unless some way can be found to manage it within the limits imposed by its production potential." Todd (2000) and Riginos and Hoffman (2003) suggest that the reduction in seed set due to high levels of herbivory is responsible for recruitment suppression and hence the attrition of palatable species over the long term (>20 years). Todd and Hoffman (1999), Allsopp (1999), and P. Anderson and Hoffman (forthcoming) provide evidence of the extent of transformation from perennial-dominated to annual-dominated shrublands due to long-term grazing pressure. This latter observation raises the possibility that even when rangelands can sustain heavy grazing with no detectable reduction in the *average* long-term stocking levels, there may be a transition to a more volatile ecology whereby stocks are subject to increasing fluctuations through time with negative implications for local livelihoods. Thus, although the communal system can sustain high numbers of animals when averaged out over the long term, livestock are more vulnerable to mortality during drought, giving rise to large fluctuations in total herd size (Hahn et al., forthcoming).

Jurgens, Gotzmann, and Cowling (1999) suggest, however, that Namaqualand is strongly "event-driven" and that vegetation composition is determined more by relatively rare, episodic droughts than anything else. Hendricks (2005) found that survival rates of livestock after severe droughts were independent of herd size in the Richtersveld communal area, a phenomenon often linked to nonequilibrium systems and an important argument against destocking (Vetter 2004). Richardson, Hahn, and Hoffman (2004, forthcoming) conclude that neither equilibrium nor nonequilibrium concepts are adequate for understanding the complex dynamics of Namaqualand land use and ecology.

Background to Farming on Communal and Private Land in Namaqualand

Farmers in communal areas and farmers on private farms in Namaqualand operate within the same ecological environment,[11] but with contrasting management aims. The former continue to use a system of livestock husbandry based on *kraaling*[12] and some stock post mobility, in contrast to the paddock or "camp" system used by farmers on private land. *Kraaling* is a traditional and rational way of using unfenced rangeland by multiple herds. Individual farmers move with their grazing animals during the day and return them to a pen at a stock post each night. Stock posts can be moved to take advantage of better grazing conditions elsewhere. Rangeland management has been dependent on seasonal transhumance and periodic migration in order to maximize the grazing potential of herds, which fluctuate in size in response to climatic events. *Kraaling* is usually characterized as a labor-intensive and risk-averse strategy within an open rangeland utilized by many separate herds. Coherding is common, particularly by letting smaller numbers of livestock follow the herd of a relative or friend. Some farmers employ paid herders from within or outside the community.

For most farmers in communal areas, livestock farming is but one of several livelihood sources, which often also encompass wage labor, remittances, pensions, and social security. Some of these sources will be insecure, and livestock herds represent a hedge against fluctuations in other incomes—as a "bank account" that they can dip into to make up for regular seasonal shortages or as a safety net when other sources fail. Namaqualand's communal livestock farming sector thus has multiple production objectives: milk and meat are important elements in household food security; sheep and goats provide capital storage, insurance, and cash income; and donkeys provide draft power for transport and crop operations (Anseeuw et al. 2001; Rohde, Hoffman and Allsopp 2003). Livestock densities vary considerably from year to year depending on climatic conditions and

fluctuate from 4 to 14 hectares per small stock unit (SSU).[13]

Privately owned "commercial" farms in Namaqualand are typically between 4,000 and 12,000 ha in size. Here the stocking rates vary between 10 and 14 ha/SSU depending on landscape vegetation characteristics rather than on climatic fluctuations. In the camp system, fenced portions of rangeland are managed by individual farmers whose animals are left unattended in paddocks, both day and night. Camping is relatively capital-intensive with low labor input. Farmers on private farms, with access to national markets, find it more profitable to sacrifice quantity in order to gain quality than do farmers in communal areas, whose main income from livestock is in the form of consumption and sharing meat, thus maintaining social networks (Rohde, Hoffman, and Allsopp 2003; Husum 2004).

The disparities in wealth between "coloured" and "white" farmers in Namaqualand is a legacy of apartheid policies that provided white farmers with abundant land, subsidies, soft loans, grants for fencing and infrastructure, debt relief, drought assistance, and marketing support. In addition, stocking levels on private farms were directly influenced by government destocking incentives. The national stock reduction scheme (1969–1978) came into being largely in response to the perception of degradation across the Karoo (Hoffman and Ashwell 2001). Earlier, several commissions of enquiry into the effects of drought (1923) and desert encroachment (1948) had added weight to the idea that remedial steps were necessary to halt unsustainable rangeland use deriving mainly from overstocking.[14] Compensation was paid to farmers participating in the national destocking scheme, primarily large herd owners, who could afford to reduce livestock numbers without seriously diminishing their incomes. Follow-up research at the end of the scheme, however, showed no significant improvement in veld condition or livestock production coefficients (Baard 1978).

South African "commercial" agricultural subsidies ceased in 1996. There remains, however, a strong conviction among agricultural extension officers, range scientists, environmentalists, and policymakers that stocking rate guidelines are the most effective tool to achieve sustainable livestock farming. The following view, expressed in an e-mail from an agricultural officer in Namaqualand, is typical:

> On the question of stock numbers and [the view] that the people must decide for themselves how many animals they can keep, I think it is my duty to help them with that decision. We have years of experience with the farmers on private farms that we share with the farmers in the communal areas to help them to manage the land more productively and also to ensure that there will be something left for the future generations. . . . I know it is very difficult to persuade someone that he/she can't keep animals or that he/she must reduce their numbers when it's their only livelihood, but how else can you manage a farm if there is nothing left?
>
> —(Agricultural officer, e-mail, March 2002)[15]

Both colonial and apartheid policies deliberately restricted the ability of farmers in communal areas to survive from agricultural activity alone by, among other things, limiting access to land and markets in order to increase the supply of cheap labor. By confining many farmers to small communal "reserves" and curtailing opportunities for seasonal transhumance, peasant agriculture became a relatively unimportant activity among a suite of livelihood options such as low-paid wage labor in Namaqualand's commercial farming and mining sectors. As a result, many families adopted livelihood strategies that included, but did not entirely depend on, a low-input, limited-capital, and labor-intensive livestock farming system.

Hence, agricultural policies in Southern Africa, even in the context of communal areas, have been dominated by the thinking behind the "commercial" farming model (Boonzaier 1987; Abel and Blaikie 1989; Weiner 1989; Barrett 1992; Scoones 1992). Policymakers perceive the communal farming sector as inefficient and communal rangelands as overstocked. These rangelands tend to have lower lambing rates, increased vulnerability to droughts, and somewhat lower economic output (but also lower input) per hectare than private farms (Todd and Hoffman 1999; James et al. 2005). Agricultural policies tend to focus on the control of stock numbers within a defined economic carrying capacity in order to increase the productivity of each individual animal and to cushion the output from shocks such as drought. The concept of overgrazing is defined in these terms. But livestock farmers in communal areas fiercely resist stocking rate restrictions, believing that these will only lead to greater livelihood insecurity and further impoverishment.

The communal farming system in Namaqualand has been perceived as both environmentally degrading and economically inefficient, and has therefore been targeted for reform by conservation interests as well as government planners and managers preoccupied with a particular type of economic development. The visually powerful fence-line contrasts often found between private farms and communal areas are frequently used to

support claims of environmental degradation and associated ideas of what a well-managed veld ought to look like (e.g., by Todd and Hoffman 1999; Riginos and Hoffman 2003; P. Anderson and Hoffman, forthcoming). These observers contend that differences in landscape quality and vegetation composition are obviously caused by different livestock densities and distribution of land resulting from the colonial and apartheid history of South Africa. Differences in vegetation cover and species composition would be expected between different grazing systems, but such differences do not prove any land degradation. Hence, there are no clear-cut answers to what "degradation" and "overstocking" actually imply. As Beinart (2003, 390) argues, "Measuring change in terms of movement away from a pristine environment, and calling all change degradation, is of limited analytical value." Defining degradation is a central debate within political ecology (Blaikie and Brookfield 1987; Forsyth 2003). Any discussion about whether or not an area is degraded inevitably involves actors' interests, values, and power, and requires a study of the links between science and policy.

The nuances of the political ecology of carrying capacity and livestock-keeping in the Namaqualand communal areas may also be changing. Although conservation was always a strong motivation for livestock ceilings, the main preoccupation in the past was with the productivity of the land and its long-term ability to sustain human, as well as animal, populations. Over the past ten or twenty years, however, issues of biodiversity have gained in prominence. The rapidly expanding Namaqua National Park, officially opened in 2003, employs a "fortress" approach to conservation despite the near-hegemonic discourse of community-based conservation.[16] The idea that ecotourism can fill some of the economic gaps left by the dwindling mining industry is appealing to many conservationists and local service providers. A contentious issue in this context revolves around who should have the power to decide on the use and trajectory of the Namaqualand landscape.

In addition, claims of economic inefficiency and environmental sustainability ignore the multiple objectives of livestock farmers in communal areas and the harsh economic realities that constrain their options. Cash and land constraints limit the ability to "modernize," but it is also rational for people with poor investment options to maintain higher stocking densities than those with better options. Rather than being attributable to institutional failures or "tragedies," the management system and stocking densities found in the Namaqualand commons appear to be rational adaptations to particular local objectives, constraints, and needs.

Carrying Capacity as a Management Tool in Namaqualand's Communal Ranges

Current recommended stocking levels in Namaqualand are based on a large survey undertaken in the late 1980s to identify carrying capacities of various veld types in the area (Botha 1998; Scholes 1998). The survey resulted in a map of Namaqualand divided into different units with corresponding carrying capacities. The estimated carrying capacities were based on soil types, vegetation, rainfall, and other climatic data (evaporation and wind). This exercise implied a definition of carrying capacity as economic carrying capacity related to commercial ranching. Average carrying capacity for Namaqualand was set at about 60 ha/large stock unit and 10 ha/SSU, a rate recommended for private ranches and communal areas alike. The map produced from this survey is today used by the Department of Agriculture as a general guide to what the Namaqualand veld can tolerate in terms of grazing pressure.

The following presentation and discussion are based on field visits and data from two of the communal areas in Namaqualand: Concordia, which is divided between summer and winter rainfall, and Leliefontein, which lies in the winter rainfall area. These cases provide an empirical context to the politics of carrying capacity and its implications for environmental sustainability, social justice, and human development.

In Concordia, economic carrying capacity plays a central role in the recent management plan dated September 1999. However, the Municipality and the Commonage Committee have not as yet started to implement measures to decrease the number of livestock in Concordia, perhaps because the drought in 2003 led to high mortality and rendered culling unnecessary. Since the carrying capacity for Concordia is defined as 10 ha/SSU, the total estimated carrying capacity for the communal area of Concordia is set at about 7,500 SSU. However, as can be seen in Table 2, grazing pressure has been consistently above this level, except in 1972, during the twenty-two years for which data are available, including two years from as far back as 1938 and 1909.

Ordinary least squares regression does not reveal any trend in SSU figures over time. The regression coefficients, though moderately negative, are not statistically significant for either the entire set of data (coeff. $= -36.03$, $R^2 = 0.0086$, $p = 0.6809$) or for the period 1971–1988 (coeff. $= -42.70$, $R^2 = 0.0008$, $p = 0.9140$). The main feature of the data is, instead, the high variability in SSU figures over short time periods.

Can rainfall explain this variability? Since stock numbers are generally established during March and

Table 2. Small stock units (SSUs) in Concordia and rainfall (mm per year) in Springbok, 1909, 1938, 1971–1988, 2002–2003

Year	SSU	Residual (absolute value)	Year-on-year change in SSU	Rainfall: 1-year lag	Rainfall: 2-year mean lagged
1909	18740	1323		211.2	170.00
1938	19327	308		161.4	177.05
1971	14768	3062		136.6	201.85
1972	4002	13792	10766	199.7	168.15
1973	10211	7547	6209	164.5	182.10
1974	15497	2224	5286	134.4	149.45
1975	31539	13854	16042	218.1	176.25
1976	22016	4367	9523	192.3	205.20
1977	23362	5749	1346	335.4	263.85
1978	38942	21365	15580	239.5	287.45
1979	17567	26	21375	106.0	172.75
1980	10965	6540	6602	115.6	110.80
1981	11925	5544	960	189.8	152.70
1982	20982	3549	9057	178.1	183.95
1983	23436	6039	2454	199.8	188.95
1984	20951	3590	2485	276.4	238.10
1985	13475	3850	7476	109.4	192.90
1986	12129	5160	1346	199.1	154.25
1987	11233	6020	896	208.6	203.85
1988	16672	545	5439	171.9	190.25
2002	17917	1204		151.4	194.25
2003	12235	4442	5682	192.7	208.55

Note: SSU figures for 2002 and 2003 were adjusted from the original, which included livestock also on the new Concordia farms, by multiplying the totals with the fraction of area represented by the old commonage.

April when the livestock is dipped prior to the wet season, SSU figures were correlated with rainfall figures from the previous year, providing a correlation coefficient of 0.415, significant at the 0.10 level.

The previous wet season may explain the stock mortality that influences a given year's SSU figure. An explanation of stock growth may, however, require rainfall data going further back, since kids and lambs are not counted and thus need time to mature in order to show up in the figures. Further correlation was therefore run between stock numbers and mean rainfall over the preceding *two* years. Here, the correlation coefficient was 0.604, significant at the 0.01 level despite the relatively meager number of observations.[17]

This strong correlation between stock numbers and rainfall seems to question the usefulness of defining an ecological carrying capacity for the Concordia environment. In an environment characterized by equilibrium, one would not expect such high variations in stock numbers following the annual rainfall. Instead, the data appear to support the hypothesis, following from non-equilibrium rangeland ecology, that variations in stock numbers in response to erratic spatial and temporal patterns of rainfall are integral to the long-term sustainability of the communal grazing system. It is also interesting to note that stock numbers have consistently exceeded the recommended economic carrying capacity—sometimes by 300 to 400 percent. However this is not surprising since the recommended stocking density is defined in relation to a ranching system and applied on a communal system with other production objectives. Neither net imports (purchases minus sales) nor reliance on animal feed is convincing as an explanation of the persistently high stock numbers in Concordia.

Is there any evidence of increasing fluctuations in stock numbers through time as suggested by Hahn et al. (forthcoming)? In order to gauge this, we used several methods that all measured somewhat different aspects of stability. First, we regressed the absolute value of residuals from the stock regression against time. No significant trend with regard to residuals could be identified (coeff. = 29.00, $R^2 = 0.0125$, $p = 0.6210$). Next, we regressed absolute year-on-year changes in stock numbers against time (for the years 1972–1988 and 2002); again, no significant trend could be observed (coeff. = -262.34, $R^2 = 0.1090$, $p = 0.1810$). Neither of the preceding regressions produced significant results when changes in rainfall (actual, lagged one year, and two-year lagged mean) were included in the models. In a further model, *relative* year-on-year changes in stock numbers (change divided by stock) were regressed against time, revealing a negative trend significant at the 0.10 level (coeff. = -8.49, $R^2 = 0.2084$, $p = 0.0569$). The regression result improved when changes in rainfall were included (two-year lagged mean), with time as an explanatory variable now significant at the 0.05 level (coeff. = -0.0269, $R^2 = 0.2985$, $p = 0.0365$). Finally, stability of stock numbers was compared for the periods 1972–1979 and 1980–1988, revealing a drop in the standard deviation from 10,678 to 4,800 and an associated decrease in the coefficient of variation from 0.54 to 0.30. Figures on SSUs, associated year-on-year changes, predicted SSU values, and mean rainfall over the preceding two years (measured in mm/100 for easier comparison with SSU) for the period 1971 to 1988 are presented in Figure 2.

In sum, from the data available, there is no evidence of the increase of fluctuations in stock number as a function of time. Richardson, Hahn, and Hoffman (forthcoming), using simulation models based on data from Leliefontein, have suggested that communal livestock owners, in order to avoid a livestock population crash every four decades or so, would need to reduce stock levels to approximately half of that recommended

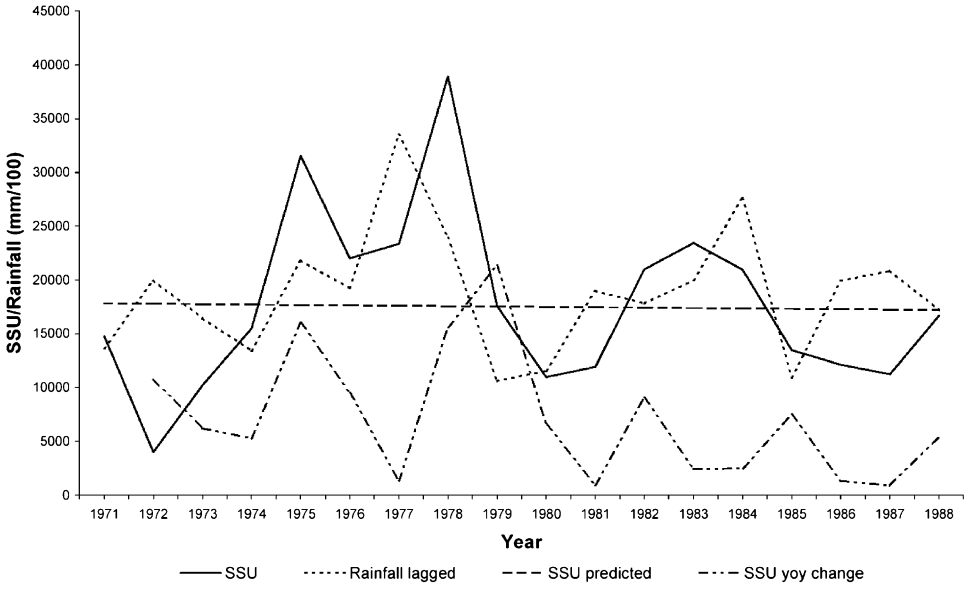


Figure 2. Small stock units (SSUs), lagged rainfall, predicted SSU, and year-on-year change in SSU for the period 1971 to 1988.

by the government. This would, in Concordia's case, entail a reduction to levels of around 21 percent of the long-term average, a figure exceeded in all years in our data set. It is fair to assume that such a strategy would find little support among the communal population. Of course, the only way to avoid any fluctuations in animal numbers is to have none at all.

The livestock population of Leliefontein has also been consistently higher than the recommended carry capacity of 10 ha/SSU, and shows no sign of decline since the establishment of the Mission station in the early nineteenth century (Table 3).[18]

However, there has been a significant shift from cattle to small stock during the past 200 years. It is possible that this was caused by vegetation change due to heavy grazing or by the combined impacts of multiple droughts, economic depression, and political marginalization. Unfortunately, we have been unable to find substantive evidence to support either hypothesis. There is no doubt, however, that significant changes in vegetation have taken place as a result of prolonged high stocking rates. Repeat aerial photographs show that as recently as forty-five years ago, vegetation cover on the private farms bordering Leliefontein was similar to the cover on the communal farm land as seen today[19] (Figure 3A). Since then, recovery or recruitment of palatable perennials on the private farm has created the fence-line contrast of today (Figure 3B). This is significant because it shows that change has occurred as a result of government policies, which subsidized infrastructure and stock reductions on privately owned commercial farms while the communal areas remained unchanged in terms of cover, vegetation composition, and stocking rates.

Today, photographs of fence-lines are often used to argue that communal farming results in overgrazed, degraded landscapes, but Figures 3A and 3B indicate that they can actually show something quite different: that recruitment of palatable plants and recovery in veld condition occurs in time frames of decades, and that high stocking rates can be maintained over a century or

Table 3. Small stock unit (SSU) equivalents in Leliefontein by year

Year	SSU	Source
1824	24,000	4,000 horned cattle (Thompson 1968)
1854	25,230	400 horses, 2,170 cattle, 9,900 sheep and goats (Cape of Good Hope 1890)
1875	24,400	600 horses, 1,400 cattle, 12,400 sheep and goats (Cape of Good Hope 1890)
1890	25,600	600 horses, 1,600 cattle, 12,400 sheep and goats (Cape of Good Hope 1890)
1909	14,700	200 draught animals, 1,100 cattle, 6,900 sheep and goats (Cape Archives 1909)
1947	34,890	(Cape Archives 1947)
1953	40,000	Carstens (1966), quoting Commissioner for Coloured Affairs Annual Report, U.G. no. 13, 1954, p. 16.
1997	36,479	933 donkeys and horses, 377 cattle, 28,619 sheep and goats (SPP 1997)
2002	23,712	(Department of Veterinary Services 2002)

Note: The two major reductions in small stock units (SSUs) are a result of multiyear droughts between 1903–1907 and 1998–2000.

Figure 3A. Aerial photo of Paulshoek communal area (top) and Rooivaal private farm (bottom), 8 August 1960. A wetland area occurs where the two ephemeral streams meet. This was used by both commercial and communal farmers to water livestock prior to the erection of a fence in 1960. (Image derived from aerial photo 443/21/6009 - 1:40,000.)

Figure 3B. Match of Figure 3A—taken on 18 January 1997. Note the fence line contrast: little change has occurred in the vegetation cover on the communal side of the fence (top), while significant increase in cover is discernable on adjacent commercial farm (bottom). Fence line contrasts are often used to "prove" that overstocking on one side of the fence has resulted in lower cover. In this instance the fence-line contrast has come about due to a reduction in stocking rates on the commercial side while the communal area has remained stable. (Image derived from 998/04/1276 - 1:60,000).

more, during which time "official" carrying capacities have been consistently exceeded.

Further evidence that vegetation cover and composition on communal grazing lands have remained stable and in a state similar to that of today can be found in repeat landscape photos. Several sites in the Leliefontein area show that conditions seventy years ago were similar to those of today and they would have been considered "degraded" by contemporary observers (Rohde and Hoffman, in preparation).

The new farms added to the Leliefontein communal area were intended as enlargements to the "chronically overstocked" grazing lands resulting from apartheid policies (May 1997; SPP 2003). Two stipulations were attached to this initiative, with important social and environmental implications. First, the beneficiaries of the new commonage were specifically identified as poorer, disadvantaged households: those earning less than R1,700 per month. Second, in accordance with the stipulations of the notarial deeds of commonage transfer, beneficiaries (farmers in communal areas) and owners (municipalities) had to agree to a binding, sustainable management plan.[20]

With respect to the first stipulation, however, from 2000 onward beneficiaries have included "black emergent commercial farmers" who will use the new farms as "stepping stones" to private farms of their own, in accordance with the national Land Redistribution for Agricultural Development (LRAD) policy. As a consequence there has been a shift in emphasis away from poverty alleviation, with the focus now being on the emergent commercial farmers, who comprise the local elite (Lebert 2004; Lebert and Rohde, forthcoming).

Given the limited investment opportunities available to local elites (both agricultural and nonagricultural), the new farms represent an important economic opportunity. Thus, the perception among farmers excluded from access to the new farms (especially the small farmers) is that the commonage committees (at both the village and municipal levels) have been dominated by the local elite and their followers. Many farmers who rely on the old commons refer disparagingly to these individuals as "*die mense wat voor staan*" ("the people who stand in front"). It is a common perception that such individuals have maneuvered themselves to the forefront of the allocation process, and now claim to speak on behalf of the community.

The capture of the new commons by the wealthier farmers in Leliefontein was facilitated by their monopolization of the newly established Commonage Committee. Since the first task of this newly established institution was to formulate a management plan for the commons of Leliefontein, the stage was set for elite control of the new commons because there was a strong intersection in the expressed interests between these

local elites and the municipal and Department of Agriculture functionaries. This intersection of interests derives from a historically rooted and shared belief relating to the inherent deficiencies of communal land tenure and associated communal farming practices. This same narrative has informed past (failed) attempts, first by the colonial state in the late nineteenth century and then the apartheid state during the 1980s, at privatizing communal land in the region (Cape of Good Hope 1890; Boonzaier 1987; Archer, Hoffman, and Danckwerts 1989).

The policy prescriptions that flow from this narrative not only propose the individualization and privatization of communal land, but are also associated with a package of prescriptions on how land should be used. That is, rangeland needs to be fenced into camps to facilitate rotation and resting, and centrally prescribed stocking rates need to be maintained to ensure long-term sustainability of the forage resources. It is in this narrative and associated policy prescriptions that a commonality of interest arises between the local elites, who seek exclusive access to the new farms, the municipality, which is bound by the terms of the commonage grant to impose a management plan; and the Department of Agriculture, which is trained to promote commercial rangeland management systems.

Not only has commonage management become institutionalized on the basis of carrying capacity used in "commercial" models of rangeland management, but this new institutional approach, coupled with municipal/user cogovernance, has allowed wealthier, more powerful individuals to gain effective control of land that was originally intended, as part of the land redistribution program, to benefit the poorest farmers. Furthermore, within two years of leasing the new farms, notional carrying capacities set out in the management plan had been exceeded, and there is no sign on the part of the municipality that sanctions will be imposed as a result.

Farmers with small herds express the view that the new grazing regulations are inappropriate to their situation because communal farming depends on being able to exceed stated carrying capacities during periods of good rainfall as well as being able to move according to personal circumstances, season, and climatic conditions (Baker and Hoffman, forthcoming). Furthermore, the shift in agricultural policy in 2000, aimed at facilitating land acquisition by "emergent black commercial farmers," is unlikely to work in Namaqualand where the economics of land prices and agricultural productivity will forestall the use of the new commonage farms as stepping stones to some commercial Valhalla (Rohde, Benjaminsen, and Hoffman 2002).

In summary, then, the land use and management system being adopted for the new commonage farms is largely in line with mainstream thinking on range management, and mimics the practices of surrounding farmers on private land, with the exception of two critical ingredients: most farmers with private land own farms ten times larger than areas available to farmers in communal areas and many farmers on private land own multiple farms spanning different ecotypes, thus enabling them to practice mobility. The utilization of the new commonage in Leliefontein has been hamstrung by the limited scale of land redistribution coupled with the ideology of the "commercial" management model, making the delivery of an expanded land base to the poorest all but impossible. Wealthier stock owners have been able to secure first access to new farms and have then proceeded to expand their herds to the point where carrying capacity has been reached, thereby squeezing out smaller farmers with potential interest in these areas.

The persistence of the carrying capacity concept within South Africa's land reform program is symptomatic of how an ideological discourse is reproduced and carried over from the old regime into the new. The rhetoric of carrying capacity continues to serve the interests of the elite, whether or not it is adhered to in practice. It reflects a conservative bias, which serves the class interests of those who hold positions of power, even if these positions are located at the lowest administrative level of Ward committees.

Conclusions

Why does the South African state persistently rely on the carrying capacity concept in its implementation of land reform? There are several reasons for this. First, reliance on carrying capacity is a legacy from colonial and apartheid policies that remains heavily embedded within the organizational culture of the Department of Agriculture. Second, this legacy is still largely unchallenged by the main actors because it continues to serve certain powerful interests, as illustrated by the current LRAD program with its focus on "emergent black commercial farmers." Third, the conservation lobby and the natural scientists who provide the research funding and the scientific arguments to support the ideas of environmental degradation in the communal areas and the need to focus on carrying capacity play a central role in maintaining this discourse.

In addition to giving privilege to environmental sustainability and to one particular perception of the ideal landscape at the expense of livelihood security and poverty alleviation, this use of carrying capacity is also

problematic for other reasons. It perpetuates the colonial myth that the private ranch system is an ideal one, independent of disparate production goals and unequal economic opportunities and constraints, and it ignores evidence going back more than half a century that the Namaqualand range is capable of sustaining livestock densities far greater than those recommended. And although high livestock densities may entail an anthropogenic landscape with less local biodiversity than ungrazed or untouched land, the same can be said of practically all cultural landscapes around the world.

The very policies that aim to rectify the effects of overcrowding are allowing wealthier individuals to benefit through exclusive access to land. This is further aggravated by the fact that those benefiting from exclusive access to land have retained their rights of access to the commons.

The continued adherence after apartheid to the notion of fixed carrying capacities reflects its broad bureaucratic appeal, far beyond the realm of political manipulation: it represents a simple yet elegant technical tool, reducing complex natural processes to rudimentary arithmetic; it "objectifies" matters related to the sound use of natural resources, abstracting natural processes from social aspirations and differentiation; and it readily provides a universal ideal against which real-world constellations can be measured in terms of their deviation.

Similar observations were made by the geographer David Simon, who wrote:

> As with so many other "scientific" concepts, carrying capacity was later applied to human activities. Nowhere is this more clearly illustrated than with respect to land husbandry in the increasingly overcrowded native reserves that had been created by colonial authorities across southern Africa. The conventional wisdom regarded peasant agriculture there as "primitive," "traditional," environmentally destructive, and so forth, with no conception that the system of "native" reserves and institutionalized migrant labour which underpinned the colonial political economy lay at the heart of the problem, rather than peasant agriculture *per se* . . . there are thus important implicit ideological assumptions in using notions of carrying capacity in the human context.
>
> —(Simon 1989, 47)

The Constitution, TRANCRAA, and the CPA Act require new land-governing institutions to be democratic and accountable to right-holding members. Therefore, it is incumbent on government to interpret and implement carrying capacity in a way that respects these principles. When communities are in charge of land governance they will have broadly shared interests in maintaining different aspects of land productivity. That may include attempts to regulate livestock numbers, through incentives (facilitated market access) and disincentives (grazing fees, sanctions against absentee owners). The incentives and the autonomy in adopting them may be more important than fixing an output target. If such a target is not met, a democratic management institution will have to abandon it or lose credibility. Department of Agriculture policy presently provides some support for locally based institutions with finance, training, and equipment. At the same time it persists with the dogma associated with carrying capacity. We suggest that communal land management will have more success if it is recognized that the continued dogged insistence on the application of rigid carrying capacity rules and concepts is both inappropriate and counterproductive.

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Notes

1. By "institutional fact" we mean a particular type of "knowledge" or scientific understanding, which has become embedded and routinized in bureaucratic institutions.
2. A *discourse* can be identified as a shared meaning of a phenomenon, which can be small or large and shared by a small or large group of people. Through written and oral statements, discourses are produced, reproduced, and transformed (Adger et al. 2001).
3. Earlier studies of the South African land reform policy using a geography-based political ecology perspective have been carried out by McCusker and Weiner (2003) and McCusker (2004).
4. Concordia was visited during December 2002, September–October 2003, and September–October 2004. Research in the Leliefontein communal area has been carried out on a regular basis since 1998.
5. Our own research was carried out in areas that span both the summer rainfall (typical African savanna system) and winter rainfall (Succulent Karoo) systems.
6. Interim Protection of Informal Land Rights Act 31 of 1996 (initially intended to apply only for two years, but renewed annually pending the application of new land tenure legislation).
7. Extension of Security of Tenure Act, 1996, and Land reform (Labour tenants) Act 3 of 1996.
8. The Communal Property Associations (CPA) Act 28 of 1996 provides a new legal framework for group ownership and democratic governance and about 500 CPAs have been established around South Africa, primarily in connection with restitution or redistribution of land to groups.
9. Through 2000 the program was mainly implemented through a Settlement/Land Acquisition Grant (SLAG) of up to R17, 000 per household. In order to be eligible for this grant, applicants had to be poor and to have an income below a certain level. From 2001, the government, with a new Minister for Agriculture and Land Affairs Ms Thoko Didiza, extended the deadline for redistribution of 30 percent to 2015. Government then introduced the Land Redistribution for Agricultural Development (LRAD) program, which gave the National Department for Agriculture and its provincial offices increased responsibility for land redistribution (S. Turner 2002). LRAD offers grants of between R20,000 and R100,000 to beneficiaries able to contribute a minimum of R5,000 in cash or labor.
10. TLCs replaced the management boards of the apartheid era and governed each of the "rural areas" from 1995 to 2001 in anticipation of a new local government structure.
11. Traditionally, Nama herders exploited the various agro-ecological zones between the coastal plain, the mountainous escarpment zone, and the summer rainfall grassland interior through seasonal transhumance. Commercial farmers mimic this pattern today through the ownership of multiple farms in different agro-ecological zones.
12. *Kraal* means "pen" or "enclosure" in Afrikaans and *kraaling* usually means to keep livestock in an enclosure at night.
13. One Large Stock Unit (LSU) = six Small Stock Units (SSUs). Generally speaking, large stock are cattle, horses, and donkeys and small stock are sheep and goats.
14. The reports of these South African commissions also inspired colonial governments in East Africa to destock rangelands used by Africans and to manage these lands using the notion of a fixed carrying capacity (D. Anderson 2002).
15. The idea that "nothing will be left" as a result of exceeding the carrying capacity is frequently expressed within this discourse on communal range management (see Hongslo and Benjaminsen 2002).
16. While the park paid lip service to ideas of participation by funding school buildings outside the park and hiring locals to erect the rhinoceros-proof park fences (there are no rhinos as yet), small stock herding and other local land uses, which are not seen as sustainable, have been excluded from the park area.
17. Note also that the Concordia commonage is located some 20–30 km from Springbok, where rainfall was measured, and that local variations in rainfall may be substantial.
18. Livestock statistics for Leliefontein prior to fencing in the mid twentieth century are derived from government records (Surveyor General; District Commissioners), apart from the first entry, which is an estimate of cattle numbers only, based on the knowledge of the resident missionary at the time.
19. This fence-line study was conducted in Paulshoek, one of the more remote Leliefontein villages.
20. *Leliefontein Bestuurplan vir die Meentgronde* (Leliefontein Management Plan for the Commons) 2000. Kamiesberg Municipality and *Kamiesberg Munisipaliteit Weidingsregulasies* (Kamiesberg Municipality Grazing Regulations) Notice 18, Northern Cape Province Provincial Gazette of 1 April 2002.

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