

Property Rights, Risk, and Livestock Development in Africa

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Preface

In 1996, the International Livestock Research Institute (ILRI), the International Food Policy Research Institute (IFPRI), and the Institute for Rural Development at the University of Goettingen began a research project aimed at providing information to improve the efficiency, equity, and environmental sustainability of livestock production and land use in Sub-Saharan Africa. The project focused on semi-arid areas where mobile livestock-production and mixed crop–livestock production are competing land uses. It is estimated that a population of 87 million live in these areas, and these people are among the poorest in the world. Not only are average incomes low, but their livelihoods are also subject to a great deal of risk—environmental, tenurial, social, and political.

Furthermore, in much of Sub-Saharan Africa, grazing lands are primarily governed by common-property regimes, which enable people to pool and reduce the risks associated with variable forage production. The ability of the land to sustain increasing numbers of livestock owners without damaging the environment will be determined, in part, by the way the users themselves can govern access and use of this vital resource. Population growth, expansion of cultivated lands, new risk-management strategies, and market integration are just some of the many factors that will affect traditional management regimes.

It is within this context that the project proposal was developed. The goals of the project were to study the interaction between property rights and risk, and the impacts that changes in the external environment have on these systems. To this end, an extensive annotated bibliography was prepared, conceptual and analytical frameworks were developed to analyze the systems, and fieldwork was undertaken in 40 communities in both southwestern Niger and southern Ethiopia.

The International Symposium on Property Rights, Risk, and Livestock Development was held in Feldafing, Germany, in September 1998. The specific objectives of the symposium were to review the work undertaken in the course of the project and consider the implications for policy and program design.

This volume contains project research findings, invited papers from external experts, and results from discussions from roundtables and working-group sessions held during the symposium.

Per Pinstrup-Anderson
Director General, IFPRI

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Director General, ILRI

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Members of the German Foundation for International Development were instrumental in ensuring a very successful symposium at their facilities in Feldafing, Germany. We also thank all symposium participants for their contributions to the project through symposium papers, by providing insightful, critical commentary on this project, and by providing guidelines for future research in this area. Invited-paper presenters included Bruno Barbier, Ben Cousins, Salvador Fernández-Rivera, Rachael Goodhue, Pierre Hiernaux, Timm Hoffman, Maryam Niamir-Fuller, Rick Rohde, Pasquale Scandizzo, and Tim Williams. Discussants included Regina Birner, Jean-Paul Chavas, Nick Chisholm, Jetani Dembella, Simeon Ehui, Boubacar Hassan, Pierre Hiernaux, W. Kisamba-Mugerwe, Arie Kuyvenhoven, Steven Lawry, Ruth Meinzen-Dick, Keijiro Otsuka, Stephen Sandford, and Ian Scoones. Ben Cousins, Ruth Meinzen-Dick, and Maryam Niamir-Fuller served as facilitators for the working groups. Finally, we would like to thank Beverly Abreu and Pam Owen for their editorial assistance in preparing the proceedings.

Property Rights, Risk, and Livestock Development in Africa: Issues and Project Approach

BRENT M. SWALLOW AND NANCY MCCARTHY

This book documents the proceedings of the International Symposium on Property Rights, Risk, and Livestock Development. The symposium was held to appraise progress, review achievements, and identify remaining research gaps at the conclusion of a three-year research project led by the International Livestock Research Institute (ILRI), the International Food Policy Research Institute (IFPRI), and the University of Goettingen. The goal of the project was to support appropriate reforms of property institutions and land policies in the semi-arid areas of Sub-Saharan Africa. The objectives were

- to better understand how environmental risk affects the use and management of resources under various property-rights regimes,
- to identify circumstances under which different pathways of change in land use and property rights are followed, and
- to identify how policy and other external interventions can help communities achieve desirable pathways and mitigate negative impacts of undesirable pathways.

This introductory chapter provides a description of the research, development, and policy context that shaped the formulation of the project's goal and objectives; a summary of the research approach taken in the project; and a discussion of how the papers presented in this book relate to the project's objectives.

Poverty and Food Insecurity in Semi-Arid Sub-Saharan Africa

The total land mass of Africa covers about 29.7 million square kilometers, of which 6.7 million square kilometers (23 percent) is uninhabitable and hyperdry, 12.9 million square kilometers (44 percent) is habitable and dry, and 10.1 million square kilometers (34 percent) is wetter—subhumid or humid. As Table 0.1 shows, in Sub-Saharan Africa the habitable drylands comprise 5.0 million square kilometers of arid area, 5.1 million square kilometers of semi-arid area, and 2.7 million square kilometers of dry subhumid area (UNEP 1992). It is estimated that, as of 1994, 189 million people lived in the habitable drylands of Sub-Saharan Africa (Swallow et al. 1997; Deichman 1994).

TABLE 0.1 Land area in Africa by aridity zone (millions of square kilometers)

	North	Sahel	South	Others	Total
Hyperarid	3.85	2.76	0.08	0.0	6.70
Arid	0.98	3.49	0.54	0.03	5.04
Semi-arid	0.37	3.04	1.59	0.13	5.14
Dry subhumid	0.15	1.50	0.82	0.22	2.69
Humid	0.09	2.60	1.28	6.13	10.10
Total	5.45	13.39	4.31	6.51	29.66

SOURCE: UNEP 1992, Table 1.

Extensive livestock-production is one of the most appropriate types of land use in the arid areas of Africa because of its adaptability to the highly variable environmental conditions. Animals can be regularly moved from one location to another to follow seasonal climatic patterns (for example, seasonal transhumance in Lesotho) or within a particular location to track local variability in the quality and quantity of forage (Sandford 1982; Behnke and Scoones 1992; Niamir-Fuller [Chapter 4]). Certain patches or key resources can be reserved for particular times. Additional flexibility is possible if livestock owners split their herds into small groups, keep several livestock species, or have access to good markets in which to sell animals when forage is in short supply and to buy new animals when conditions improve (Swallow 1994; Scoones 1994).

Research conducted at the regional and local levels indicates that the productivity of arid rangelands is primarily determined by climatic conditions. Hulme and Kelly (1993) showed that 83 percent of the variation in areal extent of the Sahara between 1980 and 1989 was explained by variations in annual rainfall. Studies conducted at field sites in Kenya (Ellis and Swift 1988), Senegal (Hanan et al. 1991) and Mali (Hiernaux 1993) found that herbage yields depended almost completely on rainfall. The interannual coefficient of variation for annual rainfall is as high as 0.6 in some areas and more than 0.3 throughout most of the arid zone (Ellis 1995). Because of that high variability, rangeland ecosystems and livestock populations are in continual flux. Nonequilibrium, or state-transition, models are more appropriate than equilibrium or successional models for depicting rangeland dynamics in the arid areas (Scoones 1994).

On the other hand, the subhumid zone has a relatively high potential for agricultural development. More intensive systems of mixed crop and livestock (crop-livestock) production are expected to develop in those areas, with crop residues providing more of the feed consumed by livestock and livestock providing more of the nutrients and traction used in crop production (Winrock International 1992; Williams, Hiernaux, and Fernández-Rivera [Chapter 4]). Herbaceous vegetation is dominated by perennial species, and livestock grazing can have significant impacts on structure and function of the ecosystem.

Coppock (1993, 1994) argues that semi-arid rangelands, such as the Borana Plateau of southern Ethiopia (with 400 to 700 millimeters of rainfall), exhibit some elements of the equilibrational model of rangeland dynamics. In particular, vegetative structure depends on density and the probability of drought is relatively low. De Leeuw and Reid (1995) argue that the main difference between “equilibrium” and “nonequilibrium” rangelands is the type of grasses that dominate them (which in turn is a function of soil moisture and type). Nonequilibrium areas are dominated by annual species that regenerate from seed and produce large stocks of seed under severe environmental conditions. The bimodal rainfall pattern in East Africa means that annual grasses dominate in areas receiving less than 400 millimeters of annual rainfall; the unimodal rainfall pattern in West Africa means that annuals dominate in areas receiving up to 800 millimeters of annual rainfall.

This project focuses on the 5.1 million square kilometers of semi-arid land, particularly on the drier parts of the semi-arid region, that has potential for both extensive production of livestock or production of low-input crops—that is, systems where people are likely to rely on land resources that exhibit both equilibrium and nonequilibrium dynamics. Of the semi-arid region, about 3 million square kilometers (61 percent) is in the western and eastern Sahel, 1.6 million square kilometers (32 percent) is in southern Africa, and 7 percent is in North Africa (UNEP 1992). Most of the people living in the semi-arid areas are agropastoralists who raise some livestock and grow some crops. These regions are considered by de Haan, Steinfeld, and Blackburn (1997) to be a hot spot for livestock development in Africa. There are at least two dimensions to this. First, competition for land between pastoralists and agriculturalists, and between different pastoral groups, is intense. Second, the semi-arid area is a transition area between two main ecosystems: annual grasses in the relatively arid areas and perennial grasses in the relatively humid areas.

Quantitative measures of economic performance and human welfare depict a discouraging situation for these agropastoral areas of Africa. Gross national product per capita is below the national poverty line of \$1 per day¹ in eight of the countries with the largest areas of semi-arid land (Burkina Faso, Central African Republic, Chad, Ethiopia, Kenya, Mali, Niger, and Tanzania). In terms of the United Nations Development Programme human-development index (a composite of statistics on life expectancy, health, nutrition, education, income, and equity), five of the seven least-developed countries in the world are African countries with large areas of semi-arid land (Niger, Burkina Faso, Mali, Ethiopia, and Eritrea). Poverty and environmental variability contribute to food insecurity. Between 1990 and 1992, the Central African Republic, Chad, and Somalia were among the seven countries in the world considered to have critical food security problems. Burkina Faso, Mali, Niger, Sudan, Tanzania, Zambia, and Zimbabwe were among the 20 countries in the world considered to have low food security.

¹ Except where otherwise stated, all dollars in this book are U.S. dollars.

Agriculture continues to be the main source of employment in the semi-arid regions of Africa, with 92 percent of the labor force engaged in agriculture in Burkina Faso, 90 percent in Niger, 86 percent in Ethiopia, and 86 percent in Mali. Across Africa, 76 percent of the labor force is engaged in agriculture (Table 0.2). Strong linkages between the agricultural and nonagricultural sectors means that economic performance depends heavily on agriculture. Delgado et al. (1998) estimated that a \$1 increase in farm income would result in an increase in total income of \$2.88 in Burkina Faso, \$2.28 in Zambia, \$2.24 to 2.48 in Senegal, and \$1.96 in Niger.

Trends in the Semi-Arid Areas of Sub-Saharan Africa

An important objective of this project has been to identify how policy and other external interventions can help communities achieve desirable pathways and mitigate negative impacts of undesirable pathways in the semi-arid regions of Africa. It is thus important to consider the main forces driving communities and national economies along different pathways and to understand the context in which governments or donor agencies would consider policy options. This section describes some of the main trends in livestock production, land use, economic conditions, environmental conditions, and government policy in the semi-arid areas of Sub-Saharan Africa.

Economic Conditions

Africa experienced poor economic growth and slow agricultural development during the 1970s and 1980s. The countries of Sub-Saharan Africa experienced annual growth in per capita GNP of 1.5 percent between 1965 and 1980 and -1.7 percent between 1980 and 1989 (UNDP 1992, Table 24). Agricultural GNP per capita decreased by 1.2 percent between 1970 and 1980 and by 1.3 percent between 1980 and 1991. Between 1979-81 and 1989-90, per capita food production fell by 6 percent. Food imports increased by 185 percent between 1974 and 1990, and food aid increased by 295 percent (Cleaver and Schreiber 1994).

The growth of Africa's agriculture was in part constrained by government policies that dampened incentives to farmers. The 1980s also happened to be a period of declining prices for the major agricultural commodities traded on the world market. World markets for livestock products were destabilized by surplus production of beef and milk in Europe and other high-income regions of the world. Some of the surplus was dumped on African markets at very low prices. The meat markets of coastal West Africa (especially Cote d'Ivoire)—which had been a major source of income for traditional exporters, such as Niger, Mali, and Burkina Faso—were undermined by dumping of cheap imports from the countries of the European Union.

TABLE 0.2 Indicators of income, food security, and reliance on agriculture for countries in Sub-Saharan Africa with significant amounts of semi-arid lands

	GNP per capita (1995, U.S. dollars)	Degree of food insecurity, 1990–92 ^a	Human development ranking (1 to 174)	Percent labor force in agriculture
Botswana	3,020	n.a.	97	61
Burkina Faso	230	X	172	92
Central African Republic	340	XX	154	80
Chad	180	XX	163	83
Eritrea	n.a.	n.a.	168	80
Ethiopia	100	n.a.	169	86
Kenya	280	n.a.	137	80
Mali	250	X	171	86
Namibia	2,000	n.a.	107	49
Niger	220	X	173	90
Senegal	600	n.a.	158	77
Somalia	n.a.	XX	n.a.	n.a.
Sudan	n.a.	X	157	69
Tanzania	120	X	150	84
Zambia	400	X	146	75
Zimbabwe	540	X	130	68

SOURCE: UNDP 1988 and WRI et al. 1996.

NOTE: N.a. indicates not available. GNP is gross national product.

^a In this column, X indicates medium, and XX indicates high.

Incentives have also been constrained because of poor infrastructure—with little improvements in most countries, especially with respect to roads. Spencer (1994) reports that the density of rural roads in the humid and subhumid areas of Africa is only 63 kilometers per 1,000 square kilometers, about half of which require substantial rehabilitation. With 97 kilometers per 1,000 square kilometers, Nigeria has the highest density of rural roads in humid or subhumid Africa; in 1950, India had a population density similar to that in present-day Nigeria, but a road density of 718 kilometers per 1,000 square kilometers. Finally, the “market” for information about new agricultural techniques and management practices continues to be limited by poor linkages among farmers, extension workers, and agricultural researchers (Osborn 1995).

Structural Adjustment

The 1980s was also the period when 34 African governments launched economic adjustment programs with support from the World Bank and the International Monetary Fund. Reforms were undertaken to stabilize macroeconomic conditions, improve financial markets, devalue exchange rates, streamline government bureaucracies, liberalize markets for agricultural inputs and outputs, and expand private involvement in the supply and finance of public goods. The evidence indicates that the countries that have sustained structural adjustment programs over several years have begun to enjoy some benefits in terms of renewed economic growth (Veit, Nagpal, and Fox 1995). Using pooled data for 28 African countries for four time periods between 1960 and 1987, Savvides (1995) found that GNP growth was positively related to accumulation of physical capital, growth of the financial sector, and political freedom; it was negatively related to inflation and growth of the government sector. As a group, the countries of the CFA Franc Zone (with an overvalued currency supported by France) did not grow as fast as other African countries (Savvides 1995). Twenty-one Sub-Saharan African countries achieved positive growth in GNP per capita between 1988 and 1993; and more than half grew by 5 percent or more. 1994 appears to have been a particularly good year, with 12 countries growing by more than 5 percent and only 11 experiencing negative growth—down from 17 in 1993 (Veit, Nagpal, and Fox 1995).

Rainfall

Besides distorted local markets and unfavorable terms of trade on the international markets, the drylands of West Africa also suffered from unfavorable rainfall conditions in the 1970s and 1980s. Thomas and Middleton (1994, Figure 7.3) show that the Sahel experienced abnormally low rainfall every year (with one exception) between 1967 and 1991. Rainfall conditions generally improved in the 1990s, with above-average rainfall recorded in the 1994/95, 1997/98, and 1998/99 agricultural years, and below-average rainfall recorded in the 1996/97 agricultural year (USAID 1995, 1998, and 1999).

Livestock and Land Use

The countries of Sub-Saharan Africa differ greatly in terms of conversion of land to crop land. Between 1981–83 and 1991–93, the area under crops increased rapidly in Burkina Faso, Mali, and Tanzania. Most of these increases likely occurred in the subhumid regions of those countries. Control of river blindness and trypanosomiasis in the subhumid zones contributed to the expansion of cropland in the subhumid regions of Burkina Faso and Mali. In most other countries, and for Africa as a whole, the area under crops increased by only 1.2 percent between 1981–83 and 1991–83.

Poor rainfall conditions in the mid-1970s and mid-1980s stimulated significant migration of pastoralists and livestock from the arid to the subhumid parts of West Africa. Countries with large percentages of arid land have witnessed reduc-

tions in their cattle populations, while countries with large percentages of more humid land have witnessed substantial increases in their cattle population. For example, between 1975 and 1987, cattle populations decreased in Senegal (−1.8 percent per year); stayed constant in Mauritania; increased slowly in Mali (1.6 percent per year), Niger (2.3 percent per year), and Chad (1.3 percent per year); and increased rapidly in Cameroon (4.1 percent per year), Central African Republic (8.7 percent per year), and Cote d’Ivoire (5.8 percent per year) (ILCA 1993).

Constraints on Flexibility and Mobility

During the last 20 years, many extensive livestock producers have experienced a decrease in their ability to track forage resources across the landscape. Constraints on flexibility and mobility include shortages of knowledgeable and skilled labor. For example, White (1986) noted that migration of young males among the Wodaabé of central Niger has led to shorter herd movements, less herd splitting, poorer disease management, and greater reliance on boreholes than dug wells. Increases in absentee ownership of livestock is another constraint. The final and greatest constraint across much of Africa is restricted access to grazing resources and transhumance routes. For example, the pastoral Fulani of Mali, who once managed the Niger Delta in Mali as a dry-season grazing reserve, now have no access to some areas and restricted access to others. Creation of national parks and conservation areas in some countries (for example, Tanzania, Burkina Faso, and Kenya) and state-sponsored farms in others (for example, Tanzania and Sudan) have eliminated dry-season grazing reserves. Expansion of agriculture, while not concerning large areas of land on a continental basis, often affects key grazing resources and migration routes. In addition, the risks of theft and violence restrict use of many dryland areas. In 1988 as much as half of the Turkana highland grazing areas were declared to be “no-go” areas by the Kenyan authorities (Lane and Swift 1989).

Policies and Programs for Livestock and Range Management

De Haan (1996) discusses the way that the World Bank has modified its approach to pastoral development over the last 30 years. He outlines four overlapping phases:

- Ranching (mid-1960s to mid-1980s)—transfer of ranching technology to tropical areas with heavy capital investments on parastatal ranches
- Range/Livestock (mid-1970s to late 1980s)—development of communal areas through construction of infrastructure and adjudication of land rights to pastoral groups
- Pastoral association (ongoing since the mid-1980s)—empowerment of pastoral associations to organize public goods, such as wells; and services, such as animal health
- Integrated natural-resource management (ongoing since early 1990s)—comprehensive attention to natural-resource management with consideration for the interests of various stakeholders.

At the same time, donor support for extensive livestock and pastoral development has strongly trended downward—with the World Bank cutting its support for programs in Sub-Saharan Africa from about \$150 million per year in the 1980s to about \$25 million per year in 1996 (de Haan 1996). The U.S. Agency for International Development (USAID) essentially ceased all support for livestock and range development projects in the mid-1980s and now supports a limited number of community resource-management projects, some of which cover dryland or pastoral areas.

On the basis of a review of World Bank projects in Senegal, Mauritania, Mali, and Niger, Vedeld (1992) supports de Haan's contention that World Bank projects are tending toward greater participation by the intended beneficiaries. All of the projects have limitations, however, in terms of formal recognition of pastoralists' land and water rights, contingency plans for droughts, social-science support for development of new organizations, and definition of intended beneficiaries. Grell and Kirk (Chapter 2) note that although some results from projects demonstrate successful approaches for reestablishing or developing local pastoral common-property systems, results have been limited by the slow progress, or lack of any progress, that has occurred in tenure policy and legislation at the national level.

Participatory Natural-Resource Management

Since the mid-1980s, donor programs and government policies toward natural-resource management have gradually changed. In the Francophone countries of Sahelian West Africa, the approach of *gestion des terroirs villageois* or *aménagement des terroirs villageois* has become the norm. This concept is that agrarian communities should exercise authority over natural resources within the areas they exploit (*terroirs*) and that governments should support local communities by providing institutional, technical, financial, and political support. Donors and governments have adopted similar approaches of community resource management in eastern and southern Africa, but perhaps with more focus on particular resources. Grazing associations in Lesotho have focused on management of mountain rangelands (Lawry 1989); the CAMPFIRE program in Zimbabwe has focused on management of wildlife resources (King 1994).

While the *terroir* approach is an improvement over the rule-based approach that it replaces, it has yet to become a resounding or widespread success. One criticism is that the village *terroirs* are too confining for flexible livestock-production for those who reside within the areas or for transhumant livestock producers who would normally cross several *terroirs* (Benjaminsen 1995). Degnbol (1995) argues further that the current top-down approach to *gestion des terroirs* in Mali is fundamentally inconsistent with its avowed aims of decentralization and empowerment of local residents and community organizations. Grell and Kirk (Chapter 2) also argue that the performance of pastoral organizations is frequently poor at both the local and national levels, and that much remains to be done to promote the emergence of more substantial and democratic pastoral organizations.

Overview of the Project

Project Design

This project consists of two modules: Module A began in 1996, and Module B is being developed to build upon the outcomes generated by Module A. Module A included

- a comprehensive review and synthesis of previous studies;
- development of appropriate models and concepts to depict the relationships among the functions of common property, environmental risk, livestock development, and policy interventions; and
- a small number of field studies to study the relationships and test the hypotheses.

Module B will include further work to refine and test these tools in enough field sites to generate an empirical basis for advising policymakers on appropriate approaches under different situations. Module B will consider policies that affect property rights, among other interventions, and will be linked more firmly to case studies in North Africa and West Asia and to specific policies and development projects.

The project was undertaken as a collaborative venture of ILRI, IFPRI, and the Göttingen Institute for Rural Development (GIRD), with funding from the German Federal Ministry for Economic Cooperation and Development. The project staff included senior scientists from ILRI, IFPRI, and GIRD; a postdoctoral scientist appointed jointly by ILRI and IFPRI; graduate fellows registered with German and Canadian universities; research technicians; and scientists from collaborating National Agricultural Research Systems (NARSs). Collaborating institutions include Marburg University in Germany; CARE-International in Yabello, Ethiopia; the Southern Rangelands Development Unit; the Ethiopian Ministry of Agriculture; the Ministère de l'Agriculture et de l'Élevage, Niger; Namur University in Belgium; and York University in Canada. One component of the project—modeling of the strategic interactions among pastoralists and between pastoralists and agriculturalists—has been strengthened through collaboration with the University of California. A USAID Linkage Grant was obtained to support the travel and time of two collaborators from the University of California (Berkeley and Davis campuses). Research review and planning meetings were held two times each year. In addition, the senior scientists conducted a number of site visits before and during the community survey.

Field studies were undertaken in southwest Niger and southern Ethiopia. Both sites are in the semi-arid region. The Niger site receives 300 to 600 millimeters of rainfall per year, while the Ethiopia field site receives 400 to 800 millimeters of rainfall per year. Both sites are characterized by overlapping use of land for mobile livestock-production and crop-livestock production. Research in southern Niger builds upon a strong base of complementary research conducted by the International Livestock Centre for Africa and ILRI in Niger and adds to

in-depth studies currently underway in three villages in southwest Niger. Research in southern Ethiopia builds on the livestock systems study undertaken by the Livestock Centre between 1980 and 1991. In southern Ethiopia, ILRI is also involved in a new USAID-funded project on risk-management strategies of pastoralists. The two Ph.D. students, Abdul Kamara and Jean-Paul Vanderlinden, were responsible for the implementation of the field studies in Ethiopia and Niger, respectively, and their case studies are contained in this book.

The Theoretical Context

This project rests on a four-legged theoretical stool. The first leg is the research on common property and community management of natural resources. Particularly influential in that literature has been the work of Elinor Ostrom (1994), in which she discusses eight “design principles” for successful community management. She defines these as follows (Ostrom 1994, 4):

A design principle is defined as a conception used either consciously or unconsciously by those constituting and reconstituting a continuing association of individuals about a general organizing principle.

The eight principles are as follows:

- Membership and boundaries are clearly defined.
- Rules that govern the appropriation of the resource and provision of inputs are sensitive to local conditions.
- Collective choice arrangements allow most group members to participate.
- Individuals who monitor the behavior of group members are accountable to the members.
- Appropriators who violate rules are likely to be punished according to the seriousness of their offence.
- Resource users and officials have access to low-cost local arenas for the resolution of conflicts.
- The right of the resource users to organize is not challenged by external authorities.
- Governance activities are organized in nested layers of enterprise.

The second leg is the theoretical work on the benefits of common property for arid rangelands. Arid rangelands tend to produce forage that is highly variable in space and time. The best way to exploit such rangelands is to move animals from one patch to another in response to changes in rainfall and the availability of quality forage. The greater the number of patches available, the greater the variation in rainfall; and the less the covariation between patches, the greater the value of flexibility (van den Brink, Bromley, and Chavas 1995).

It is assumed that a common-property regime will generally be the most efficient mechanism for coordinating the movement of many independent livestock owners around large areas of rangeland. Very high transaction costs would have to be incurred to accommodate such movements if each patch of rangeland

were to be owned by a single livestock owner. It is thus maintained that flexible, ad hoc control over grazing and management is indeed the best way to manage resources in these highly variable environments (Rohde, Hoffman, and Cousins [Chapter 12]). It is worth noting that the conditions that contribute to the benefits of common-property management in semi-arid lands—uncertain production levels, large user group, and infrequent interaction—are the conditions that Ostrom (1994) notes as being detrimental to successful community management. One of the project's objectives was thus to reconcile these two strands of thought.

The third leg is the theory of endogenous technical and institutional change. This theory consists of several different strands. One strand, dubbed the "property-rights model" predicts that societies will adopt new institutions for exchange and property rights when the net benefits of new institutions exceed the net benefits of existing institutions. Changes in market opportunities, technologies, and relative prices will change the demand for new and existing institutions. When applied to crop–livestock systems in the semi-arid areas, this theory suggests that population growth will cause farmers to intensify their use of the land through more systematic integration of the crop and livestock sectors (McIntire, Bourzat, Pingali 1992). The model assumes that property rights will change to accommodate that integration.

Scandizzo (Chapter 8) posits that the allocation of bundles of rights will be a function of the riskiness inherent in the production system, and that changes in the levels of risk, as well as concepts of social fairness, will lead to changes in property rights institutions. However, other strands in the literature on institutional change focus much more on the supply side of institutional change and on the processes of institutional change. A more detailed review of the literature is presented by Swallow and Kamara in Chapter 9.

The fourth leg on the theoretical stool is the economics of risk. As noted above, environmental conditions are highly variable in the semi-arid areas of Africa. Theoretically, riskiness in production generally leads to lower inputs and outputs than those that maximize profits (Sadoulet and de Janvry 1997). However, if livestock holders hold animals predominantly to smooth fluctuations in consumption and income, this would imply that stocking levels would be greater than those that would maximize profits. While Rosenzweig and Wolpin (1993) found evidence of consumption smoothing in India, all of the available empirical evidence for Africa shows a much more limited, or no, role (see Fafchamps, Udry, and Czukas 1998; Udry 1995; and Dercon and Krishnan 1995). From the production side, to date, very little theoretical research has explicitly accounted for the effect of risk on producer behavior under alternative property-rights regimes. In the absence of strong consumption smoothing motives, stock levels may still be relatively high on unmanaged common-property pastures compared with private, or perfectly managed pastures, though they should also be relatively lower than under the riskless situation (Sandler and Sterbenz 1990). As discussed in Chapter 3, empirical evidence on the effects of feed subsidies dur-

ing drought, particularly in certain North African countries, supports the hypothesis that stock levels will increase as the downside risk is reduced.

To complicate matters, spatial mobility can offset environmental risk (van den Brink, Bromley, and Chavas 1995) but, again, the combined effects of risk and management levels on stock levels may either counteract or reinforce environmental risk. Furthermore, mobility is oftentimes associated with partial, or secondary, access rights, which themselves may be a source of riskiness.

Research Activities

Annotated Bibliography and Review Papers

A review and synthesis of literature was compiled by the project team, under the leadership of Winnie Luseno. The review and synthesis of literature focuses on six main topics: property rights, analysis of livestock-production systems, analysis of risk and livestock or household production, the role of the state, experience with program and project implementation, and definitions of key concepts. Responsibility for these topics, and subtopics, were assigned to different members of the research team. The annotated bibliography was produced before the Feldafing workshop in September 1998. Review papers on the role of the state (Chapter 1) and the role of donor agencies (Chapter 2) in influencing property rights to pastoral resources, as well as a papers on the use of trees and shrubs in livestock systems (Place 1996), the effects of drought relief programs (Chapter 3), and the evolution of crop–livestock systems (Chapter 5), have also been completed.

Conceptual Modeling

Several new conceptual models were or are being developed:

- A game theoretic model of rangeland stocking rates was developed. The model depicts strategic interactions among livestock owners under environmental risk, heterogeneity in production costs and risk preferences, and different levels of community management. (See Chapter 6.)
- A model of the spatial mobility of herders and livestock has been developed. This incorporates the possibility of noncooperation over the use of various pastures, thereby incorporating the benefits to spatial mobility (reducing risk) as well as its costs (inefficient production due to overgeneration of negative externalities). (See Chapter 7.)
- A game theoretic model of land allocation and stocking rates in mixed crop–livestock systems is being developed. This model considers both livestock production and crop production to be risky and allows for co-variation in those risks.
- An analytical framework on the “multiple products, functions, and users of natural resource systems” has been developed (Swallow 1996).

- A model of land-use change and institutional change in mixed crop–live-stock systems was developed. (See Chapter 9.)
- A model of cooperation and conflict resolution is being developed to facilitate assessments of village-level institutions in terms of their potential for fostering cooperation in natural-resource management. (See Chapter 10.)

Simulation Modeling

A dynamic, bioeconomic model of a dryland savanna village was specified for a village in the semi-arid area of Niger to simulate alternative development pathways (over 40 years) for crop and livestock production under varying assumptions about population growth, risk, and property-rights regimes. The model simulates the village's use of crop and range lands, technology choice, growth of the livestock herd, and optimal investments in land improvements, while tracking changes in soil and range condition (Chapter 14).

Case Studies

The case studies in Niger and Ethiopia adopted very similar approaches to the research to maximize complementarity of the results. The case studies consisted of selection of large study areas that would include the following:

- A range of semi-arid conditions, and selection of a sample of communities stratified according to climate and market conditions
- Community interviews in all sample communities and resource assessments in all sample communities
- Purposive selection of a small number of communities representing different conditions or pathways of development
- Qualitative research in the subsample of communities.

Areas measuring roughly 200 kilometers by 200 kilometers were chosen as study sites in Niger and Ethiopia. The study sites are large enough to include areas that receive average annual rainfall of from 300 to 600 millimeters per year, with relatively high and low levels of environmental risk. The Niger study site is located between 12 degrees 30 minutes and 14 degree 30 minutes north, and, between 2 degrees and 4 degrees east. The Ethiopia study site is located between 4 degrees and 5 degrees north and between 37 degrees and 39 degrees 30 minutes east.

Stratified random samples of 40 communities were selected in each study site. The main criteria used for stratification were environmental. About 10 communities were selected from each of four environmental classifications: high rainfall, high risk; high rainfall, low risk; low rainfall, high risk; and low rainfall, low risk. Only communities that were near weather-recording stations were selected. Communities were defined as the smallest geopolitical unit that had jurisdiction over land allocation. In Ethiopia, communities were *ardas*, each

comprising about 10 *ollas*, each of which contained about 10 households. In Niger, communities were villages, each comprising about 100 households.

A community survey was designed, then modified to account for conditions particular to the two study sites. The community survey consists of an open-ended questionnaire, a community-mapping exercise, and an assessment of the community resource base. The open-ended questionnaire and community-mapping exercise were administered to a small number of leaders or elders in each community. The resource assessment was undertaken by the researchers and community leaders using remotely-sensed images and portable Global Positioning System units.

In Ethiopia, the administration of the community questionnaires began in September 1997 and was completed in February 1998. In Niger, the community survey began in October 1997 and was completed in March 1998. Qualitative research was conducted in a small number of communities in Ethiopia between March and July 1998 and in Niger between June 1998 and December 1998. Preliminary results from these studies are in Chapters 13 and 15, respectively.

International Symposium

The International Symposium on Property Rights, Risk, and Livestock Development was held in Feldafing, Germany, in September 1998 to achieve the following objectives:

- Obtain a critical review of the conceptual models, simulation models and field studies that have been undertaken in the course of the project
- Flesh out the substance of the project with a small number of invited papers by other experts working on related issues
- Consider the implications for policy and program design
- Identify knowledge gaps that should be filled in future components of the project.

All of the workshop participants performed formal roles in the workshop as paper presenters or discussants. Discussants included Regina Birner, Jean-Paul Chavas, Nick Chisholm, Jetani Dembella, Simeon Ehui, Boubacar Hassan, Pierre Hiernaux, W. Kisamba-Mugerwe, Arie Kuyvenhoven, Steven Lawry, Ruth Meinzen-Dick, Kejiro Otsuka, Stephen Sandford, and Ian Scoones. In addition, Ben Cousins, Ruth Meinzen-Dick, and Maryam Niamir-Fuller served as facilitators for the working groups.

The papers presented roughly followed the outline of the research activities given above, and were grouped into three categories:

- The Broader Context of Pastoral and Agro-Pastoral Systems in Sub-Saharan Africa
- Development of a Conceptual Framework
- Case Studies.

The invited papers included an overview paper on mobility in African rangelands by Maryam Niamir-Fuller (Chapter 4), a theoretical model of the option value of appropriating (or not appropriating) common property by Pasquale Scandizzo (Chapter 8), and two case studies, one focusing on a comparison between communal rangelands in Namibia and South Africa, and the other on comparing rangeland management in Niger and Morocco.

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PART I

**The Context for Livestock and
Crop-Livestock Development in Africa**

1 The Context for Livestock and Crop–Livestock Development in Africa: The Evolving Role of the State in Influencing Property Rights over Grazing Resources in Sub-Saharan Africa

MICHAEL KIRK

Existing property-rights systems for pastures, as well as for key resources of pastoralists in Sub-Saharan Africa, have strongly been influenced by colonial and postcolonial state interventions that often have been abrupt and contradictory (Scoones 1995). The influence of the interventions has superimposed evolutionary dynamics relating to socioeconomic and cultural factors as well as changes in the physical environment (GRET, IIED, and L'Université de Saint-Louis 1996). According to Bruce, Freudenberger, and Ngaido (1995, 1),

In the post-independence decades, almost every African country attempted to reform its indigenous land tenure systems....The new elite who came to power...believed that these community-based tenure systems were outmoded and had to be replaced

The reforms altered these resource-tenure systems with regard to resource allocation, the efficiency of institutions to manage resources, the systems' relative transaction costs, and resource sustainability, but often in ways not anticipated by the "reformers." Although some systems retained much of their original coherence and roots in local rural society, they were severely eroded and became endangered.

Land tenure comprises the customary and legal rights that individuals or groups have to land, and the resulting social relationships (Kirk 1999; Lane and Moorehead 1995). "Land," as a single natural resource, provides several goods and services. Its productive use often depends on complementary resources, such as water, and people in rural areas do not exclusively make a living as pastoralists but are instead using many of the natural resources simultaneously. For these three reasons, the whole set of natural resources, indeed the natural-resource system, has to be the unit of reference (GTZ 1998; Swallow 1997). Land tenure, thus, is resource tenure and can be defined as the "terms and conditions on which natural resources are held and used" (Bruce 1986, xxvii).¹ Land

¹ In this sense, resource tenure corresponds to the French term *foncier*, which includes cropland and all natural resources linked to it, such as trees, pastures, water sources, or forests (Hesseling and Ba 1994).

and resource tenure is equivalent to a property-rights regime in resources, since it consists of sets of institutions that define the conditions of access to, and control over, goods and services arising from any natural-resource system (Swallow 1997).

Although an analysis of the evolving role of the state usually starts with colonial interventions, this should not ignore the fact that, from precolonial times onward, African pastoralists have attached both material and symbolic significance to land. Rights in land have been exchanged, negotiated over, and competed for in the course of political as well as demographic and economic change (Berry 1992). Were the mostly unwritten precolonial past to be reconstructed, traditional, indigenous rangeland regimes would be shown to be reflected in a considerable diversity in types of government (Swallow and Bromley 1995):

- Centralized government, as in Eastern and Southern Africa, in which chiefs performed executive, legislative, and juridical functions together
- “Diffuse” government, as in pastoral societies in today’s Kenya and Uganda, where authority is held by relatively egalitarian elders’ councils
- “Minimal” government, as in many parts of West Africa, and also in some Kenyan and Sudanese groups that are based on loose and changing coalitions.

Being aware of this and of the fact that pastoral property-rights systems have never been static or harmonious will help analysts avoid any blind idealization of indigenous, autochthonous systems when analyzing the role of the state on property rights development (Kirk 1999; Migot-Adholla and Bruce 1994). During phases of slow population growth and economic change, these tenure systems functioned well and showed a great adaptive capacity and flexibility. The pressure of modernization, combined with the opening of markets, have led them to erode and to lose their comparative allocative and cost efficiency as well as their capacity to guarantee sustainable resource management.

With these precolonial dynamics as a background, this chapter concentrates on the relevance of colonial land and resource policy for the postindependent state and on the consequences of governments’ formal nationalization of grazing land, of far-reaching land reforms, of sedentarization, and of privatization. The severe shortcomings of all approaches have given way to a new thinking on the role of the state with regard to pastoralists since the late 1980s. These new directions and developments are also discussed in this chapter.

Colonial Impact on Indigenous Property-Rights Systems

Colonial Philosophy on Land and Resource Tenure

With the final demarcation of the European spheres of influence in Africa (during the Berlin Congress in 1885), a century of rapid change in property-rights

and land-tenure systems began, dominated by exogenous influence. The most important factors continue to be effective in today's national states.

The respective "colonial philosophy" of the European powers was reflected in the newly created land-tenure and authority systems (Noronha 1990).² With their "indirect rule" and "native administration," the British recognized bundles of autochthonous rights at an early date. They thereby strengthened the position of kings, paramount chiefs, or "sheiks" in pastoral societies, which they regarded as the legitimate authority system. This indigenous enforcement system intervenes as a third party with coercive power to defend the rights of individuals and groups in any contested transaction of property rights and thus gives meaning to the triadic relationship of property (Bromley 1991) as they seemed to enforce and protect it. The focus of registration of private property for (White) settlers and some native African farmers was on cropped areas with high production potential and was aimed at increasing productivity and sustainable resource use. Since pastoral common-property systems were deemed inefficient with regard to resource allocation and lacking in management capacities, the European powers accepted that their disintegration was accelerated by these policies (Kirk 1999). This line of thinking, often characterized as being "pragmatic," was followed, however, under the primacy of the colonial state reserving for itself *de jure* unrestricted ownership of all land settled, as well as unsettled and uncultivated land not registered as state land (Noronha 1990; Kirk 1993). While the parable of the "tragedy of the commons" had not been formulated yet, the perception that only state ownership of property can ensure allocation efficiency, institutional effectiveness with low transaction costs, and resource protection (which was proved to be wrong) was widely adhered to.

Therefore, "indirect rule" confirmed and promoted the authority system of the local leaders in their spheres of influence by considering management and administration to be efficiently practiced whenever these institutions were maintained, officially recognized, and their representatives used as "native authorities" for their own interest. Often, they could retain part of their powers in lower jurisdictions, for example, on conflicts on land and water rights (Migot-Adholla and Bruce 1994). In other circumstances, the colonial state also reestablished or enlarged their powers one-sidedly by not fully appreciating the existing, deep-rooted social control of the residence groups, lineages, or ethnicities with regard to resource allocation.

On the other hand, the French ideal of "assimilation" of the colonized, which became the guiding principle for most Sahelian countries, was predominated by centralism and the submission of local leaders to the power of Paris. The colonial policy followed a consistent doctrine of land tenure (one right for

² As this chapter concentrates on pastoralists and, therefore, on semi-arid areas in Africa, it focuses on British and French colonial policy and disregards the impact of institutional environments created by other colonial powers, such as the Belgians, Portuguese, Germans, or Spanish.

all) and negated at first autochthonous rights, or *droits indigènes* (Hesseling and Ba 1994). Accordingly, the idea of promoting individual private land ownership, based on the French “Code Civil,” later on runs as a red thread right through the legal and regulatory frame of independent states (Coquery-Vidrovitch 1982).

Philosophical arguments about whether the French and the British models offered effective instruments for enforcing colonial land and resource policy interests are disputed. Was not “indirect rule” a reflection of scarce financial means and trained specialists and, thus, the expression of an ever-endangered attempt to secure efficient control of autochthonous property-rights systems in less densely populated pastoral regions (Berry 1992; Shipton and Goheen 1992)? Through indirect rule, the colonial state tried, on the one hand, to establish a workable legal and regulatory framework for resource management and development and, on the other hand, to keep transaction costs of administration and enforcement low. In retrospect, decentralized administrative procedures in marginal lands, following the principle of subsidiarity (Vanberg 1997), became daily practice long before they were reinvented in the course of structural adjustment, state divestiture and economic reforms in Africa (Elbow 1997; Swift 1995).

The philosophy on the direction of guided resource tenure changes led to a classification of resource users in rural areas into clearly separable social units that were exclusive of each other, such as ethnicities, villages, farmers, and mobile herders. It further featured institutions and organizations that could be easily delineated for enforcement mechanisms. This erroneous concept of clearly defined territories, fixed (ethnic) boundaries, and authority structures created administrative barriers, thereby endangering the mobility of pastoralists and limiting their capacity for efficient opportunistic management and for reacting flexibly to different risks (Kirk 1994; Migot-Adholla and Bruce 1994).

Throughout Sub-Saharan Africa, the colonial state focused its land policy on crop-production systems; the pastoral sector was left comparatively untouched as well as neglected. Little effort was made to enhance management efficiency under changing socioeconomic conditions, to reform rules and regulations governing pastures to foster livestock production, or to develop a comprehensive legal and regulatory framework to allow for multiple-use patterns and flexible reaction to new factor scarcities. This neglect has been shifting the balance of economic and political power between pastoralists and farmers steadily toward farmers (van den Brink, Bromley, and Chavas 1995).

In general, the existing resource tenure structures in Sub-Saharan countries are still based on these colonial philosophies. Many pastoral ethnic groups and families, divided by colonial boundaries becoming national boundaries later, still live under the influence of different legal and regulatory systems, approximating dual property systems (Okoth-Ogendo 1997; Shivji 1997). Existing unwritten customary rights became subject to and intertwined with written land legislation, causing and accelerating a general insecurity of tenure with high

transaction costs, particularly for those groups that repeatedly had to prove their customary and secondary rights.

Land Policy Instruments Based on European Concepts, and Their Effects

The postulate that economic progress can only be accelerated by encouraging (individual) private land ownership was deeply rooted in the colonial powers' way of thinking. This European concept was to materialize through direct legal interventions and programs for title registration and through the silent promotion of informal land transactions in the shadow of existing tenure-systems. Both had direct repercussions on pastoral systems. Despite differing legal systems in the "mother countries," the effects of colonial land policy of the French was very similar to that of the British (Bassett 1993; Kirk 1999).

In legal terms, cultivated or occupied land differed fundamentally from obviously free, unoccupied areas³ (Feder and Noronha 1987). Private ownership rights existed for cultivated land, held either by the immediate user or by a third party as lender or lessor. Apparently uncultivated land, such as pastures, was considered "land without master" or "abandoned land" in the French's misunderstanding of the spatial requirements of extensive production systems. It could be released for settlement, be transformed into plantations, or converted into areas for mechanized farming (Kirk 1994; Le Roy 1985). The colonial state could also take possession of the land as state land "in the public interest" without consulting or compensating former holders of rights to the land.

The term "state land," or rather "state property," can have various connotations. Depending on the preferred definition, it had various effects on land management: At times the state declared its ownership rights but de facto left the population's rights of use, exchange, or inheritance untouched, which was the case for most of the African pastures. Elsewhere, state land was reclaimed and used immediately, for example, for (White) settlements, for the establishment of state farms or irrigation perimeters, or for infrastructure (Kirk 1999), as described in the next section.

As the centralist colonial state did not appreciate the economic importance that mobility has for livestock production in arid and semi-arid areas, large discrepancies between "imported" institutions, such as private property and their applicability to existing land-use systems, came about. The conceptual problem that common-property regimes were mistakenly seen to be systems of open access was the root cause for colonial policies concentrating primarily on the avoidance of what is now called the "tragedy of the commons" and its negative impact on resource allocation, management efficiency, and sustainability (Lane and Moorehead 1995). "The consequences were disastrous for the African population..." (Noronha 1990, 785).

³ "Vacant land" or "waste land," or rather *terres vacantes et sans maître*, according to § 539 of the French Code Civil (Kirk 1999).

France secured unrestricted property rights over land with a view to enforcing market-oriented agriculture. It determined that all nonregistered land is *state property*, which was substantiated by formal juridical arguments. The government proceeded, deliberately or unknowingly, from false premises regarding resource ownership (CILSS 1988; Kirk and Adokpo-Migan 1994). The main principles on which the government based its taking over of nonregistered land were the conquest principle and the abandoned-land principle.

Under the conquest principle, colonial domination was compared with the conquest of a country: land that was property of chiefs or kings accrues to the French state as a result of conquest or contracts and becomes part of eminent domain (*domaine éminent*). This approach was, in fact, based on a wrong assessment of the position of the chiefs, who in fact only exercised the function of trusteeship.

The principle of *abandoned land* is based on the French Code Civil and says that the state exercises control over such land as part of the state's *domaine privé* (Coulibaly et al. 1991). In fact, since 1935, all land that had not been used for more than 10 years became state land (Kirk 1999). Thus, resource tenure regulations were put into effect that ignored the logic of opportunistic mobile pastoral livestock keeping and substantiated legal insecurity when, for example, agropastoralists suddenly had to prove their rights to rangeland that had been used temporarily only.

At the beginning of the twentieth century, only the record in a land register could prove tenure and could be used in court. Local groups and their authorities could, at best, claim rights of use, but never a communal title to "tribal land" (such as dispersed pastures), which the state would recognize and respect in case of development projects.

As a result of the local population's resistance, or rather of its persistent indifference to the construct of "land without master," this principle could not successfully be implemented. In contrast, in 1955, shortly before independence, autochthonous rights began, at least partly, to be recognized (Mifsud 1967). The legal instrument of "constatation" confirmed customary rights when individuals or groups applied for them. Whoever wanted to register land formally had to prove henceforth that a third party did not have a customary right to the land. This instrument, although a step forward in recognizing customary rights, was only oriented toward agriculturalists and discriminated against pastoralists.

Great Britain could already look back to the socioeconomic consequences of allotting titles in India as Great Britain began to transfer its concepts of land tenure to Africa (Feder and Noronha 1987). Compared with the French approach, the instruments seem to have been implemented in a more decentralized way but were enforced more strongly on an incremental basis in daily practice: autochthonous rights were recognized at an early date by supreme court decisions, provided, however, that they did not contradict the existing laws (Mifsud 1967). This proviso thus provided a broad margin for intervening in the prevailing land tenure when regarded as necessary. Land that was of economic in-

terest could be redeemed from the communal system and declared as “crown land,” and all autochthonous rules were thus repealed.

In pastoral societies, privatization of resource rights in the colonial era mainly concerned water rights and not so much grazing rights. Because of their complementarity, however, a lever was created by privatizing key resources, such as wells, as in Botswana since the 1930s. Slowly these exclusive property rights became extended to pasture land located in the environment of these wells (Bruce, Freudenberger, and Ngaido 1995; Lane and Moorehead 1995).

The colonial state's agricultural policies that tolerated or even supported a creeping expansion of crop cultivation into pastoralists' grazing grounds—and was intensified by the installation of large-scale irrigation perimeters in Mali, Sudan, or Senegal—had a far-reaching indirect impact on property-rights regimes of pastoralists. In Sudan, for example, the Land Settlement and Registration Act of 1926 claimed all unregistered land or land that was property of Islamic foundations as state property so that it could be used for large-scale, mechanized agriculture (Kirk 1994). The administrative basis for redistributing property rights from pastoralists to farmers was thus laid.

Technical change in veterinary treatment resulting in increased livestock numbers, and the newly drawn colonial borders in concert with this legislation promoted a pincer movement, due to which grazing land required for increasing the size of herds became inaccessible. Direct interventions of the colonial state—such as modification of traditional (written) contracts between neighboring ethnicities governing the reciprocal use-rights in times of droughts, or demarcating a “general grazing area” for land-use planning that granted open access to certain areas for several months per year—further weakened the position of pastoral groups (Kirk 1994). In Uganda, particular areas for the exclusive use by Karamojong pastoralists were separated and declared closed to other groups. As an unintended side effect, this led to marginalization and isolation from the development process and has made integrating these communities into a peaceful Ugandan environment difficult today.

In this way the colonial state enlarged its influence through key interventions and in an incremental manner. It thus gained greater influence on the management of pastoral resources, although it always had to compromise because of high transaction costs. A multilayered, loose legal and regulatory framework was established upon which the independent states built.

Postindependence Tenure “Reforms”: Impact on Property Rights over Grazing Resources

After independence, many African countries continued to work with the institutional environment inherited from the colonial powers without major modifications (Kirk 1999). Where parts were repealed or new legal texts were added by various political regimes, this happened without much effort to create coherence and continuity, and often a vision for new national land-tenure and land-use

strategies was lacking. This situation increased legal chaos in general, as in Mali, or led to confusing situations, as in Namibia (Hesseling 1994; Cox and Behnke 1996). The parallel existence of an old and a new legislation resulted in conflicts, largely smoldering below the surface but emerging when resource users in the same site adhered to different rules and regulations.

In this context again, policymakers and administrators identified indigenous pastoral common property and pastoralists' resource management as inadequate for promoting higher levels of commercial offtake, for limiting stock numbers to the carrying capacity, and for protecting the land from being over-used (Lane and Moorehead 1995). The implicit theoretical justification was the social dilemma created by common property, which became well known as the "tragedy of the commons." To overcome this market failure, the independent African states actively intervened by nationalizing rangelands or experimenting with the privatization of pastures. Both were "replacement" reforms (Bruce, Freudenberger, and Ngaido 1995) meant to replace indigenous tenure-systems as compared with "adaptation" reform models which, while not idealizing indigenous tenure, attempt to build upon their basic principles and rules.

Lane and Moorehead (1995) identify three major approaches of state influence that affect pastoralists' property-rights systems in a profound way:

- The nationalization of pastoralists' natural resources, without directly intervening in their system of labor organization and leaving the management responsibility within the group
- The sedentarization of herders, often following reforms of land ownership, through resettlement and irrigation schemes, which change the production systems and land management directly
- The privatization of rangelands.

The Primacy of Nationalization of Rangelands

The objectives of nationalization, which was most extensive in the 1970s, were fourfold: to standardize land-tenure systems on a national level, to simplify administration, to give land officially back in the hands of the African people after colonization, or to prevent land becoming the subject of commercial sale (Kirk 1999). Nationalization expressed the centralist state's fear of more decentralized, participative resource management, helped to assert the state's power over mobile parts of the population (GRET, IIED, and L'Université de Saint-Louis 1996; Lane and Moorehead 1995), gave governments control over land allocation and land use in these regions, and was intended to replace indigenous, so-called "unproductive" land-tenure systems (Traoré 1996).

The large majority of countries adopted the colonial principle of state ownership of all land that was either without formal title or constituted "abandoned land" (CILSS 1988; Coulibaly et al. 1991; Lane and Moorehead 1995; Lawry 1989). In remarkable continuity with colonial ideals, the state showed an ongoing interest in enforcing state ownership over land communally used until then. Definitely, more land was transformed into state land than into private property

(Lawry 1989). The local population, however, only became aware of this when there was a threat of expropriation in the public interest, as for example, in the case of irrigation schemes on former rangelands in the Sudan (Kirk 1994).

Although some common guiding principles with relevance to mobile livestock-keeping can be identified, an analysis of the Sahelian countries shows that questions of land tenure were treated differently in detail and are recorded in a wide dispersion in various legal texts and ordinances (Bary 1997; CILSS 1988; Ouedraogo 1995). Some natural resources are incorporated into the *public domain* of the state, such as national parks and protected areas, as well as water resources. Here, administration *and* usage is exclusively in the state's hands (Kirk and Adokpo-Migan 1994), which has led to a well-documented "tragedy of the state" (Baland and Platteau 1996)—with resource plundering, only rudimentary management and enforcement capacities, and thus high transaction costs.

The *private domain* of the state, on the other hand, is generally not always clearly defined (for example, in Mauritania, Senegal, and Niger). For it is precisely here that the distinctions between state ownership and de facto, customary, common regimes become blurred. This form of state ownership is often defined as a residual for those resources that are "freely accessible and abandoned" (CILSS 1988). It is this very construction that, with regard to rangelands, has been the object of fierce discussions since colonial times (Kirk and Adokpo-Migan 1994).

To complicate any analysis of the status of rangelands, some countries—such as Burkina Faso, Mali, and Senegal—work with the construction of a "national domain." In the case of Senegal, the state declared more than 95 percent of the country a national domain, abolishing all indigenous land rights therein (Kirk 1999) and claimed an exclusive and extensive property right to it (CILSS 1988; Coulibaly et al. 1991).

Attempts at nationalization had direct socioeconomic effects on grazing areas (Lawry, Riddell, and Bennett 1984; Kirk 1993; Knox McCulloch and Hazell 1998). It soon became apparent that nationalization undermined customary tenure regimes without replacing them with comparably effective systems of state management and administration. In some cases—for example, under President Nimeri in Sudan—pastures were regarded as a public good and it was claimed that they should be accessible to every citizen and not be monopolized by particular interests of livestock keepers (Kirk 1994). However, the subsequent influx of herds from neighboring regions caused excessive overgrazing, the breakdown of local management capacities, desertification, and, in the end, the impoverishment of the local population.

In general, legislation and administrative regimes frequently adhered to centralist bureaucratic principles, thus leaving almost no room for local initiatives that used mutual trust and common norms to keep transaction costs low (Hesseling 1994). Where countries like Senegal tried to install more decentralized structures for natural-resource management, the newly assigned rural com-

munity councils turned out to be rather ineffective in granting the promised autonomy for pastoral systems and thus contributed further to their exclusion and marginalization from socioeconomic development begun by the state (Bruce, Freudenberger, and Ngaïdo 1995; Traoré 1996).

The assessment of more than 30 years of legislation and land policy in Mali, for example, elucidates other basic inadequacies. Just how much the uniform and inflexible tenure policy has weakened social cohesion, solidarity, and resource management capacities at the local level became apparent in crises during the last droughts (Baland and Platteau 1996; Coulibaly et al. 1991; Lane and Moorehead 1995). "Modern" state law principally gives urban groups, business people, and retired civil servants greater security in acquiring and using land, since all existing regulations on land administration and land development are narrowly limited to either farm land or urban land. Regulations covering water resources, and in particular pasture land, have been systematically neglected. The consequences can be seen in the Niger Delta, where state policy seriously eroded one of the more sophisticated pastoral tenure-systems found in Africa (Hesseling 1994).

Since the droughts that affected the Sahel in the 1970s and 1980s, common-property systems have been made responsible for an insufficient protection of resources and thus have been subject to state interventions (Lane and Moorehead 1995; Lawry 1989). Thus, resource policy was, in its core, reduced to land policy. The theoretical argument that it was difficult for a centralist power to manage dispersed grazing areas was soon confirmed (Swallow and Bromley 1994). Veterinary legislation as well as regulations on the use of watering places and routes for transhumant herds turned out to be, from an administrative point of view, a far more appropriate lever of indirect control over the use of pastures.

Therefore, the construction of state-owned water-points became a second thrust in influencing property rights of pastoralists. Historically the pastoralists' right to use wells was strictly conditioned: they were temporary and revocable, the interests of most different actors were protected, and their contribution to investments and rental fees were taken into account. The control over customary wells built by the pastoralists themselves effectively controlled access to pastures (Kirk 1994). Even though governments considered water resources state property, at that time only a few West African countries dealt explicitly with water in their legislation (CILSS 1988:34; Coulibaly et al. 1991).

The provision of thousands of "public" wells and boreholes in dryland areas after independence further contributed to the destruction of the autonomous, efficient allocation of scarce water resources. The new public facilities offered all groups increased access to new pasture grounds, and access by foreign herders became uncontrollable for the local groups. In Mauritania and in Sudan, this process of undermining locally based property rights was aggravated by applying Islamic resource laws, which provided much broader access to water and grazing resources than many customary systems did (Lane and Moorehead 1995; Kirk 1994).

To sum up, the majority of African countries continued to work with an incompletely formed legal and regulatory framework and, therefore, with legal insecurity in the case of resource scarcity, and of state or private vested interests. Ironically, taking pastoral resources into state care created precisely those conditions of the tragedy of the commons that action was meant overcome. Nationalization (and privatization) of pastures and the erosion of indigenous herders' institutions

has led to the simple annulment of pastoral property rights. At best, transaction costs have increasingly been shifted onto the pastoralist production system. The undermining of pastoral property rights is probably first and foremost related to a decline in political influence (van den Brink, Bromley, and Chavas 1995, 388).

Agrarian Reforms, Sedentarization of Pastoralists, and Irrigation Programs

In African countries the most far-reaching agrarian reforms, including redistributive land reforms, were introduced with the objective of creating "modern" tenure-systems. Governments either relied on external philosophies, such as the orthodox Marxist model, which is based on a centrally planned economy (as in Ethiopia, Angola, or Mozambique); or on the re-creation of a "self-determined" type of African socialism based, at least in part, on traditional informal customs, rules, and conventions—as in Tanzania or, with a different philosophy of "African authenticity," in Senegal (Bruce, Freudenberger, and Ngaido 1995; Kirk 1998b; Shivji 1997).

The objective of the extensive Tanzanian reform was a peaceful transformation of autochthonous land-tenure systems, based on common property and a family economy (homestead), into collective agriculture practiced on state land (*Ujamaa*) by village groups (Shivji 1997; United Republic of Tanzania 1994). Communal-tenure systems of pastoralists were heavily affected, particularly since sedentarization of herders was determined as a prerequisite for "modernization" (Lane and Moorehead 1995; Shivji 1997; United Republic of Tanzania 1994). About 250,000 of them lost the best of their lands and were confronted with restrictions in movement as a risk-coping strategy; village boundaries dividing communal pastures into discrete administrative units excluded them from access to wells and pastures. The "Ujamaa" movement did not establish alternative, consistent property-rights systems for pastoralists that would have provided legal security, production incentives, and cost-effective management practices.

Yet, in 1998, the consequences of failed state policies had not been resolved. Although the Presidential Land Commission's report was based on a participatory consultation process aimed at giving pastoralists more tenure security by identifying flexible areas of use through agreements among villages to co-manage these areas and by treating all stakeholders equally in the process, its suggestions have only in part been acceptable to government and are still under discussion (Shivji 1997).

In other African regions, *settlement* has been seen as an overt policy objective, as a program in response to droughts (Sahel) or as an instrument of redistributive land-tenure reforms for pushing privatization through settlement projects and irrigation schemes, often sponsored by international donors (Grell and Kirk [Chapter 2]).

Countries promoting agricultural development through irrigation programs also heavily affected indigenous tenure-systems governing pastoral land by modifying the resource basis and institutional arrangements on which they were built. In Senegal, Nigeria, or Sudan, large-scale irrigation systems went hand in hand with the expropriation of autochthonous, jointly administered pasture land and its nationalization, which was followed by the allocation of usage rights over irrigated areas to settlers in the form of formal leasehold (Kirk 1994). Again, livestock corridors were obstructed, water points for animals were converted into sources for irrigation, and exchange relations based on reciprocal property rights between agriculturalists and pastoralists were reallocated in favor of agriculturalists.

Thus, tensions and unsolved conflicts between different user interests arose during the phase of planning as well as during implementation. Even where the monopoly of tribal-land distribution was promised to the leaders of pastoral groups, it was simple to neutralize their political opposition by granting parts of the redistributed land (Kirk 1994).

The Privatization Approach: Promotion of Registered Private Property

As Lane and Moorehead (1995, 126) wrote,

The privatization of pastoral resources is the logical policy extreme of the tragedy of the commons hypothesis, and has been rewarded by some of its most tangible failures.

Individual private property in pasture land was considered to be an instrument for promoting optimal resource allocation, management, cost efficiency, and the protection of resources (Lawry, Riddell, and Bennett 1984). The individual, voluntary limitation of animal numbers (“stinting”) according to the carrying capacity of pastures becomes possible, as competing third parties can be excluded. Only private property, as a strong indicator, shows clearly the scarcity of pastures, since users no longer can turn to alternative rangelands that are also privatized. Private property guarantees stable natural environmental conditions; it is on that basis alone that a continuous, high withdrawal for market production can be achieved. Private-property rights also create security for loans to be invested in livestock.

To assess the effects of private property, one should differentiate between *systematic registration* programs forced by the state and the state’s offer of *voluntary registration*. The refocusing on institutions in economic theory as well as transformation processes of the last decade have, again, underlined that private property is at least as sophisticated an institution as is common property (Furubotn and Richter 1997; GTZ 1998): it can only develop in a coherent institu-

tional environment consisting of contract, inheritance, and family law; an independent judiciary to protect and enforce it; and workable complementary factor markets. Moreover, benefits from private property require a clear and comprehensive land policy, including effective instruments for land administration and land development, to bind private owners to their duties, to bring private and public interests closer together, and to allow for a "social responsibility of property" (GTZ 1998). Not all of these requirements have as yet been fulfilled in African states. It has been proven that the introduction of such a sophisticated system is only suitable to equilibrium environmental conditions and not at all appropriate to nonequilibrium settings, such as found in most pastoral communities in Africa (Scoones 1995).

Consequently, after independence, only Kenya followed comprehensive registration programs for intensively used agricultural land, while the majority of former French and British colonies offer registration on a voluntary basis (Dickerman 1989; Kirk 1999). In all countries, autochthonous communal land-tenure, private property, and state property now coexist, overlap, and often contradict each other, whereby indigenous communal tenure institutions are at least tolerated (Elbow 1996; Noronha 1990). However, the cases of Kenya and Botswana, in particular, bring up one of the most debatable issues, not only for sedentary groups but also for mobile systems—namely that of coexistence of private and common property.

Where registration of agricultural land was accelerated in Africa, it secures primarily the rights of influential minorities, such as the urban elite rather than the rural population; those of farmers rather than livestock keepers; and those of male heads of households rather than women (Crowley 1991; Kirk 1999). Any consolidation or strengthening of primary rights through private property thereby has led to an erosion of secondary rights in natural resources. This applies in particular to herders' movements. Titling and the enforcement of private property on cropland restricts its use as pasture in times of drought; rights of way are extinguished; and water use is regulated by new institutional settings, such as the price mechanism. Apart from these indirect effects on pastoralists, policies directly oriented toward the privatization of rangelands have been developed.

It is widely recognized that the objectives of privatization of pastures have been attained in part only. Privatization in Kenya turned out to be very problematic for the mobility of groups with extensive grazing systems, such as the Maasai. Private rangeland owners follow a well-known double strategy: they use both the new statutory and the still applicable customary rights for their profit, while grazing their herds in both systems to increase offtake and to allow for a better regeneration of their private pastures (Lane and Moorehead 1995; Okoth-Ogendo 1997).

In Botswana the *de facto* privatization of water sources and rangelands, through the Tribal Grazing Lands Policy, was an interrelated process aimed at the commercialization of extensive livestock-keeping through private ranches. It

was based on the conviction that fenced ranching is more productive than communal-rangeland development (Bruce, Freudenberger, and Ngaido 1995; Lane and Moorehead 1995; Le Roy, Karsenty, and Bertrand 1996). Those parts of the land that were identified as commercial land were given long-term, renewable tenancy (Lawry, Riddell, and Bennett 1985). They were mainly used by wealthy livestock keepers, and the pastures were regarded as private land. The largest part of the remaining area stayed communal land. The distributive consequences of planned fencing should have been predictable: the establishment of private property for more wealthy borehole and livestock owners, and the deprivation of the poorer segment and a neglect of minority rights.

In addition to state-supported privatization, spontaneous enclosure movements play an important role. This “de facto privatization” is an endogenous institutional change aimed at strengthening property claims in areas where no effective state land-management existed—for example, in West Sudan or in parts of Namibia (Behnke 1984; Cox and Behnke 1996; Devreux 1996). To have guaranteed access to grazing and water in times of scarcity, more affluent livestock owners fenced off grazing lands. Existing alongside the no-fenced community grazing land, which still is used by all livestock keepers, these areas become depleted. Again, a vicious cycle starts where only wealthier herders can afford fencing and thus reap the rewards from better animal quality, whereas those who can not afford the investment overuse remaining land and are worse off in the end.

In Namibia the main reason for fencing was the expectation of an imminent land reform after independence, converting community land into freehold titles. Cox and Behnke (1996) consider the uncontrolled fencing as “quasi-illegal” because most of it was done with permission of local, traditional authorities only, who in turn are hardly monitoring land allocation any more on their own authority. However, the status of enclosures is still uncertain, since legislation up to now is still in the process of being drafted and revised.

For livestock keepers with small herds who could not bear the sunk costs of enclosure or the maintenance of privatized pastures and watering places, models of *group ranching* as a form of regulated communal property offered an unsatisfactory alternative solution (Lane and Moorehead 1995; Lawry, Riddell, and Bennett 1984). Its objective was not only improved market production through privatization but also to allow poorer pastoralists with small herds to establish their position against the penetration of agriculture. However, the group-ranch programs finally failed because of the lack of membership homogeneity, problems in achieving collective action within the group, lack of empowerment to exclude third parties, smoldering conflicts between customary and statutory rules of inheritance for the land and, again, the usurpation of power through wealthier parts of the society (Lane and Moorehead 1995).

Thus, nothing remains to be added to Lane and Moorehead’s (1995, 127) concluding statement on rangeland privatization:

Privatization, land titling and land-use policies in the dryland pastoral areas of Africa have clearly failed to meet the target set for them, and in doing so, have illustrated the weakness of the tragedy of the commons approach to the problems of pastoral development.

Institutional Erosion and Increasing Conflicts about Rangelands

Resource tenure is an integral part of the social fabric not only in agricultural but also in pastoral societies; therefore, the emerging role of the state in initiating radical changes is heavily affecting social structures and economic institutions. "The customary property rights which are essential for livestock production in Africa have been eroded by a long history of conflicts" (van den Brink, Bromley, and Chavas 1995). Attempts to apply uniform, centralist state law has weakened both the institutional environment and contractual arrangements on which communal land-tenure is based and has destroyed the management capacity of local institutions (Kirk 1999; Lawry 1989). This institutional erosion of management efficiency is not only a consequence of the states' incapacity to administer nationalized pastures efficiently but also of its lack of capacity to manage a complex private-property system and to protect still-existing common property from unhindered "encroachment" of private interests.

As a consequence, a variety of conflicts on several levels find their origins in attempts to effect rigid changes in tenure through state policy in pastoral areas: disputes between pastoralists and the state over land rights, between competing land users over access to diminishing resources, or between pastoral organizations over differing approaches to halt the loss of land (Cousins 1996a). These conflicts are aggravated by the ambiguous legal situation between state and autochthonous law and the increasing influence on local resources that external groups exercise. Thus, all conflicts can be said to be embedded in and aggravated by an increasing competition for land as a result of population growth, land scarcity, and a new solvency due to income earned outside agriculture (GTZ 1998).

The causes of tenure conflicts in Burkina Faso, the Niger Basin of Mali, Niger, or Uganda are typical of other African countries as well (Baland and Platteau 1996; Bruce, Freudenberger, and Ngaido 1995; Coulibaly et al. 1991; Crowley 1991; Marquardt 1997; Ouedarogo and Coulibali 1996):

- National legislation is unclear, inaccurate or even contradictory, with insufficient regulation over the demarcation of both farm land and boundaries to grazing lands, leading to conflicts even among people strictly obeying state legislation.
- Many conflicts between individuals arise over boundaries that were once allocated by customary institutions, remained unrecorded, and were subsequently overruled by new legal institutions. With old land rights being denied, double allotments of the same plot to different parties occur frequently (van den Brink, Bromley, and Chavas 1995).

- Legal arrangements for reconciling the competition of mobile and sedentary production systems over natural resources are lacking. This leads to heavy conflicts between farmers and pastoralists, with farmers' claiming anarchic use of rangelands and herders rushing their livestock onto cultivated fields. Traoré (1996), adopting the herders' viewpoint, uses the term "straying fields" into grazing lands to describe a situation in which agriculturalists are causing the conflicts and not the herders.
- Conflicts arise between the local population and immigrants, the latter having been provided with land by state authorities that in the past was used for grazing.
- Influential urban dwellers emerge who employ paid herdsmen to keep their animals and to make use of an unclarified legal situation.

Hence it follows that people are no longer willing to invest in common-property resources (Johnson 1997; Wachter 1996), and an open access situation arises with some of the commons being captured by private commercial investors, spontaneous enclosure taking place, and the environment being degraded, leading to further conflicts (Cousins 1996b; Van den Brink, Bromley, and Chavas 1995).

Traditional institutions are becoming increasingly ineffective in conflict resolution because of new challenges with land development. With their traditional instruments, they are not able to resist encroachment from market-integrated, urban-based beef producers, such as in Senegal (Bruce, Freudenberger, and Ngaido 1995).

Conflicts also emerge within local communities, if parts of the group want to make use of new statutory laws to gain individual rights to pieces of communal-grazing land, whereas the majority still regards the total land as common property. However, under statutory law they often do not have a legal argument for the assertion of this perspective (Leach, Mearns, and Scoones 1997; Okoth Ogendo 1994).

Indirectly, the state's "farmer bias" in national development policy has contributed to land conflicts (van den Brink, Bromley, and Chavas 1995). The situation further deteriorated when the state placed taxes on livestock ownership to obtain compensation for the use of grass by pastoralists. Thus, political and economic power has steadily been shifting toward farmers in the West African Savannah while pastoralists have become more and more neglected or even suppressed.

In Sudan the "race for resources" between extensive, mechanized, rainfed cultivation and traditional pastoralism increased up to the early 1990s. Since the government primarily promoted crop production, farmers were encouraged to extend their cultivated areas into traditional grazing land even in the absence of legal justification, whereas livestock keepers did not have any right or power to oppose this development (Kirk 1994).

Market liberalization and state promotion of tradable land rights aimed at the creation of competitive conditions for free enterprise and of flourishing land

markets can have a gradual eroding effect on traditional forms of tenure. In the case of Namibia, this led to conflicts between wealthier and poorer pastoralists (Devreux 1996). The latter, not able to afford fencing equipment, had to rely entirely on increasingly degraded residual communal-grazing land. The striving for commercialization undermined the legitimacy of local community leaders, since a lot of people witnessed the disposal of their communal endowments to the highest bidders, local elite, or outsiders. In Kenya a major shortcoming of the conversion was its disregard of the social role of community and family control over resources (Okoth-Ogendo 1997).

Other roots for severe conflicts over common grazing lands are to be found in inequitable land-redistribution measures implemented after the end of certain political periods, as after Apartheid in South Africa (Cousins 1996a, 1996b) or after the post-Derg period in Ethiopia. Disputes over natural resources are also likely to occur through fragmentation of responsibility, where policies concerning tenure are implemented by different government agencies without coordination through one competent ministry (Elbow 1996). This is the case, for example, in Kenya and Zimbabwe, where the agricultural and tourism sectors are closely linked to national tenure policy. On the one hand, wildlife reserves are an important source of tourism-generated income for the state. On the other hand, their expansion means decreasing grazing land for cattle. Hence basic conflicts exist between these competing sectors, for example, over compensation in case of livestock losses due to predation by wild animals or the spread of animal diseases.

Land conflicts are proving more and more difficult to solve because traditional instruments of conciliation, such as compromise and consensus, are failing. On the one hand, local leading institutions have largely lost their authority, and on the other, few institutional innovations have been developed (Hesseling and Ba 1994; Kirk and Adokpo-Migan 1994).

New Directions in the Recent Past

Guiding Principles for a Changed Role of the State in the Economic Reform Process

The political and economic processes still under way in many African countries raise hopes that a new role definition for the state versus private actors and organizations of civil society might come about (World Bank 1997). New opportunities for pastoral systems are being created, but new threats arise as well. State divestiture, the devolution of power, decentralization, economic and political liberalization, subsidiarity, structural adjustment, and aid conditionality are the key words of this Africa-wide process.

A transformation process from centrally planned to market economies started in a few African countries in the beginning of the 1990s. For the large majority of states, far-reaching reforms of their institutional environment fol-

lowed political changes, structural adjustment, and aid conditionality (Kirk 1998a). In concrete terms, certainty in law, the rule of law, economic and political participation, and a clear definition of the meaning of property in a market economy have become guiding principles in rethinking both the state's role and reforms (GTZ 1998; Kirk 1998a):

- Certainty in law is a crucial precondition for calculable risks in private decisions and must include an unambiguous and reliable legislation for resource transfer and use, enforceability of legal claims in disputes, and the predictability of government action.
- The rule of law includes a division of power as well as the strengthening of an independent judiciary and courts bound by law.
- Without the participation of all those affected by changes in resource-tenure systems, indigenous institutions and local knowledge cannot be integrated into the process, and reforms will never be accepted. Greater participation goes hand in hand with decentralization and greater application of the principle of subsidiarity.
- In the past, the definition of property was considered the fundamental difference between market and centrally planned economies. Property must now be available to all players, including the state. Privatization does not automatically mean the end of state activities, since ownership of land especially is subject to social obligations and restrictions in most countries.

In the context of institutional reforms, the land question is currently being reappraised and land and resource policy are seen as a key to future socioeconomic development (GTZ 1998). What does this redefinition of the role of the state mean to pastoral systems? It means an increasing, although not sufficient, awareness of the importance of mobile livestock-production and the rationale of extensive opportunistic grazing systems (Scoones 1995). In addition, it makes for a shift from purely technical solutions to integrating physical characteristics of resources, tenure systems, and institution building. It further presupposes a broader knowledge of the history and functioning of effective tenure and management systems for pastoral resources (Lane and Moorehead 1995) and a growing understanding that land-tenure institutions must be an integral part of development policy.

New Recognition of Resource Tenure in the United Nations Conference on Environment and Development Process

Any current tenure reforms and land-policy design have to take account of the resolutions passed by international conferences conducted in the course of the Rio Process (such as Agenda 21, the World Food Summit, and the Convention on Desertification). They are—at least in part—legally binding for the signatory nations (GTZ 1998; PNUE 1995) and imply that structural adjustment and aid conditionality as well as decentralization and devolution extend the influence of multi- and bilateral programs and projects of international donors and nongov-

ernmental organizations. All need to be accepted as players in the design and implementation of an overall national policy.

Regional Conferences as a Learning Process

Various regional conferences and workshops focusing on the role of the state and its relationship with customary tenure-systems, and on security of tenure and the arbitration of resource conflicts—such as the 1996 workshop in Gorée, Senegal (GRET, IIED, and L'Université de Saint-Louis 1996), or the 1994 Praia Regional Conference on resource tenure and decentralization (CILSS, OECD, and Club du Sahel 1994; Elbow 1997)—have elaborated preconditions for policies at different regional levels, outlined as follows:

- The design of an appropriate, accessible, and comprehensible tenure legislation requires considerable knowledge of local customary resource-management systems, to integrate them into a reformed legal framework.
- Legislation at the national level should be flexible enough to enable the decentralization of land administration, land management, and resource access to reduce transaction costs for monitoring and enforcement; for example, by preventing the abuse of power and allowing for local innovation.
- Decentralization is closely linked to democratization, which in turn requires an active participation of pastoralists concerned.
- To ensure equal access to land, the different rights of a variety of actors—herders as well as farmers—must be recognized and marginalized groups, such as pastoralists and agropastoralists, must be legally protected.
- Research must be undertaken on resource management and tenure to improve the circulation of information flows.
- New institutions for conflict resolution must be established.
- Networks should be established so information can be shared among countries.

Comprehensive National Legal and Regulatory Framework

Economic restructuring in most African countries has been accompanied in the 1990s by extensive initiatives for reforming the existing legal and regulatory frameworks (Bruce, Freudenberger, and Ngaido 1995; Elbow 1996; Ngaido 1996). Not all of them have yet been brought to an end. There is no longer any doubt that a comprehensive legal and regulatory framework and a clear national land policy have to be based on prevailing conditions; to prevent friction between the nation-state and customary law, appropriate interlinkages have to be established at all levels of administration. The task is to develop a new legal framework in dialogue with all relevant stakeholders, by making the dialogue widely known and understood in local languages and, above all, by implementing and administering these new frameworks. To this end, the universal problem of capacity building cannot be overestimated (GRET, IIED, and L'Université de Saint-Louis 1996; Kirk and Adokpo-Migan 1994). In the course of recent policy

dialogue, donors brought up the problem that national governments tended to create overregulated legal frameworks in trying to anticipate each and every eventuality. New procedures are elaborated to safeguard rights and interests of mobile livestock keepers, for example, through resource-management programs. As country-specific experiences differ widely, they can only be analyzed in brief (Bary 1997).

In Mali, a tenure policy program has been developed that aims to confine the government's role to establishing general policy and legislative framework only, while the responsibility for natural-resource management is to be placed in the hands of local institutions, governed by elected representatives. Current tenure legislation is to be completely replaced by a new legal framework setting out general principles for land and natural-resource management (Hesseling 1994).

Under the new constitution of Uganda, land is vested in the citizens and the state's role is restricted. The constitution of 1995 aims at a deliberate land policy, with the state's role being focused, among other things, on the efficient registration of records and titles and on improving tenure security through giving general directions regarding land use and planning. The increased cooperation and coordination needs at the different ministry levels are explicitly considered (Place and Otsuka 1998; Marquardt 1997). The new policy recognizes customary tenure and provides the possibility for registration and certification of individual land titles through a decentralized administration. It also provides secure tenure under customary systems without registration. However, the question remains whether a direct involvement in the process is feasible for the government or whether it has to play the role of a process facilitator (Marquardt 1997). Moreover, common-property issues are not taken into account explicitly in the texts.

Namibia's main achievement in recent government policy has been the enactment of the 1995 Agricultural Land Reform Act. With respect to grazing land, the government tries to change the present *de facto* open access into a common property regime by allocating common land to specific rural communities. However, the reform act is not sufficient as a means of comprehensive land reform, since it is not accompanied by any consistent land policy (land administration and land development) that provides tenure security. Critics of the Namibian tenure policy argue that it is the government's intention to retain the existing fuzziness of the tenure situation, because some members of the government might benefit from it (Cox and Behnke 1996). Here, as well as in other cases, a final assessment is difficult to make, as the search process is still continuing, with new land policy drafts and white papers being released.

In Niger, the *Principes d'Orientation du Code Rural* (1993) are providing the basis for a legal framework to elaborate a rural code, which aims at tenure security for rural operators, institutions for organizing and managing rural areas, promoting better natural-resource management and conservation practices, and helping to plan and manage countryside uses of natural resources (Ngaido 1997). It is stated that law making, following democratic patterns, should recog-

nize traditional resource-management systems, in particular those of pastoralists (Elbow 1996). The Nigerian land policy derives its innovativeness from the fact that customary rules and rulemakers are an integral part of the reform. Changes, although they came to a standstill after political changes in the country, have been made to increase the efficiency of customary institutions to access pastoral resources and to manage them (Ngaido 1997).

In Tanzania the government sees the need to completely overhaul the tenure system in order to remedy the deplorable conditions generated by the policies of the past decades. In its participatory approach, the Tanzanian Land Commission detected that objectives of a change in tenure should include democratizing ownership and administration of land, giving security of tenure, and devising transparent, open, and popularly acceptable procedures of land allocation, administration and dispute settlement (United Republic of Tanzania 1994). The commission also recommended creating institutional countervailing forces against monopolistic state organs in a civil society. The process of doing this actually reveals that the bureaucracy and other interest groups threaten a successful reform. One controversy arises from the fact that all lands in Tanzania are national lands except for those village lands that are under decentralized control of the villagers but without a clear legal definition of its boundaries. Hence, the demarcation of village lands creates tension between the local-government and the central-government bureaucracies, which in fact represents discord about questions of political power (Bruce, Freudenberger, and Ngaido 1995; Shivji 1997; United Republic of Tanzania 1994).

The South African government is dealing with the development of new and innovative forms of tenure on the basis of group land-holding at the communal level. The Department of Land Affairs has developed a framework for legislation and rural ownership of land that is aimed at flexibility in relation to legal structure, land usage, tenure rights, and governance to create a new type of institution, known as a "Communal Property Association" (Cousins 1996b). The acquisition of land for communities and formal registration of ownership under existing legal models is problematic because of complexity, the high administrative requirements, and the lack of institutions that would enable poor communities to have access to land.

In general, reforms are under way that consider more than ever the resource interests of pastoralists, devolve decisions regarding resource tenure to lower levels, and allow for more participation. Nevertheless, the institutional and administrative capacities to implement these reforms at the different regional levels remain a major bottleneck.

Decentralization and Devolution

In many countries, devolution of authority to the local level was planned by the state, in part at least, and some of the former power was given back to users to manage their own resources. There was a growing commitment to participatory-based approaches to development and land management, and a better coordina-

tion and consultation regarding transnational movements and transhumance routes of pastoralists was initiated. The experiences with the management capacities of international committees are mixed, for example, in the Sahel (Kirk and Adokpo-Migan 1994):

The national follow-up of the United Nations Conference on Environment and Development and the elaboration of National Environmental Action Plans and plans to combat desertification helped to start nationwide discussion forums at different regional levels that also tackled the property-rights problems of pastoralists. Furthermore, these roundtables helped to form stronger interest groups composed of those who were disadvantaged by land policy in the past. Thus more space was given to local decisionmaking and local regulations on the allocation and redistribution of property rights in rangelands and on conflict resolution.

With regard to national land policies, a single common set of rules governing land questions in all cases and at all levels is not necessarily needed at the national level (GRET, IIED, and L'Université de Saint-Louis 1996; Rochette 1993). National policy rather has to focus on providing a set of legal principles for approaching issues of tenure specifically at local levels in order to respond to the diverse social and environmental conditions in different areas. Moreover, there is pressure to decentralize resulting from the central state administrations' having shown themselves to be rather incompetent in managing land at the local level, so that a conclusion would be to shift more responsibility toward local-level institutions (GRET, IIED, and L'Université de Saint-Louis 1996). Decentralization is identified as one of the major prerequisites for sustainable management of natural resources. Despite some shortcomings of the 1995 Ugandan Constitution, as noted above, the roles of a decentralized administration concerning tenure issues, district land boards, and land tribunals were clearly defined. However, an even more decentralized mechanism needs to be established for solving problems at the local level without burdening the court structure (Marquardt 1997).

With regard to decentralization, a basis is provided by the "typical district-level bureaucracy in dryland Africa" (Behnke 1994). If resource management objectives, including tenure, are compatible with these levels' capacities, this might be a step toward decentralization within realistic limits. Moreover, with decentralization, local users should be enabled to manage natural resources, such as pastures, by using their appropriate customary management systems within the national legal framework. An example is provided by Senegal's decentralized land-tenure system, which already had been codified in the 1960s. With it, the government attempted to provide a basic legal framework at the national level, under which decentralized and democratically elected rural councils were charged with governing land allocation with rules specific to local conditions.

Discussing the practical problems of how to incorporate customary tenure into formal systems of rangeland administration, Behnke (1994) highlights some aspects that may have an impeding influence on the incorporation of customary

and formal rangeland management systems: the sheer size of management units, the independent and sometimes truculent nature of pastoral populations, catastrophically high levels of environmental variability, and the complexity of managing seminatural ecosystems.

Decentralization cannot be separated from the search for appropriate property regimes and land management at the different regional levels—in particular under spatial and temporal risks in nonequilibrium environments, such as arid and semi-arid grazing lands. However, a “simple” reestablishment of indigenous common property cannot be a solution, as socioeconomic and ecological conditions in many places have considerably changed in the last decades. Nevertheless, the creation or re-creation of workable property regimes requires taking the regional context into decisive account, as policies of decentralization should focus on the reduction of transaction costs first as a guiding principle (Van den Brink, Bromley, and Chavas 1995).

Efforts toward direct cooperation between state and customary rangeland management institutions have been made in Burkina Faso in the North Yatenga region (Sanou 1997). A management approach was proposed that comprises the Fulani chieftaincy and the general administration as appellate authorities; the general assembly of livestock keepers comprises all the clans present on the rangeland and functions as an advisory and decisionmaking authority (rangeland association). It is a precooperative group that, on the basis of traditional rangeland management, draws up internal regulations of the association. The proposed management institution requires a flexible system of state administration that allows for the area concerned to have specific status, with its own regulations governing access and use of rangeland. However, the administrative authorities do not have the requisite flexibility, and hence proposals have not been recognized. Sanou (1997) interprets the state's reluctance to recognize customary land-tenure arrangements as a fear of being supplanted by the customary authorities and of new conflicts arising thereof. The diversity of interests, including those of absentee herd owners, and the growing socioeconomic differentiation also undermined traditional systems.

Conflicts and Their Resolution

Conflicts over natural resources, especially under common-property regimes, are likely to become a key issue in policies concerning tenure, such as land restitution and land redistribution (Cousins 1996b; GTZ 1998). Thus the settlement of resource conflicts is becoming a central function of local government administrations in natural-resource management. However, the best remedy to avoid conflicts is still a clear, acceptable land policy that allows for local participation. Thus, government officials' involvement in arbitration of conflicts over access to pastures must not sidestep the general problem of how to reconcile still-existing, customary land rights and formal law to prevent conflicts. This includes a specific framework within which interested parties could legitimately

put forward alternative claims to resources rather than legislatively dictating the content of property rights (Behnke 1994).

Results from case studies on struggles over common property in South Africa (Cousins 1996b) are showing some implications to consider with reform policy:

- It is necessary to identify and understand the origins of struggles in differentiated rural livelihood systems. This is especially important in those cases where common resources, such as pastures, are a vital component of production for any household, but where access is distributed unequally between households.
- It is important to understand the economic rationale for having systems with high stocking rates—derived from the multiple-purpose character of livestock production—on communal rangeland.
- There must be awareness of the fact that disputes over common-property resources are tending to occur along several axes simultaneously, or in close succession.
- In general, attempts to develop viable common-property regimes must be recognized as being time consuming, messy, and contested.

In West Africa, a wide range of reanimated or new innovative institutions and mechanisms for better conflict management have already been developed (GRET, IIED, and L'Université de Saint-Louis 1996). As they are mostly centered at the local level, they do not necessarily meet the needs of mobile herders and still have to be complemented by instruments to cover a broader regional level. It is in the interest of most governments to encourage out-of-court reconciliation of interests, following the principle “settling before judging” (GTZ 1998). Important procedures that serve as a voluntary resolution process with all affected parties are facilitation, mediation, and conciliation. Another aspect is the further training of government and private mediators, whereby traditional conciliation structures gain ground again, although governments are often suspicious about their restrengthening. Often, working together with nongovernmental organizations, governments can fine tune existing processes for conflict resolution and further develop them to deal with new socioeconomic conditions.

Conclusions

After about a century of failed attempts of colonial and independent governments to impose uniform, centralized resource-tenure rules and regulations through nationalization and privatization of pastoral systems, a rethinking and refocusing of the state's role in land- and resource-tenure policy is under way. The learning process seems to be irreversible because of an—at least partial—democratization, economic reforms, the embeddedness in international conventions, and regional networks between the states.

Initially, a strong will existed at the national level to reform the legal and regulatory framework for resource tenure, giving pastoralists and other neglected groups of civil society a louder voice by looking in a more participatory way for more appropriate solutions that enhance allocative efficiency, that promote institutional mechanisms with low transaction costs, and that preserve the environment. In most countries, the requirements in time as well as financial and human resources to reformulate the institutional environment have been largely underestimated. Other problems that have been typical for agrarian reforms all over the world have slowed down the process (GTZ 1998): the formation of mainly urban and agriculture-based pressure groups and the resistance of parts of the bureaucracy to devolve power to lower levels, in particular to pastoralists who always have been suspected of a lack of loyalty to the state. In many countries, as in Niger or Tanzania, some of the crucial institutional innovations of a reformed legal framework have been questioned, attenuated, and eliminated in the discussion or blocked after coup d'état. Thus, the high expectations of the early 1990s could only be fulfilled in part.

In cases where the will for political reforms still exists—as for example in South Africa or Namibia—capacities are often lacking to solve the seemingly insurmountable problems in implementing new or changed regulations and empower organizations at the different regional levels in order to integrate all relevant stakeholders. Regulations of implementation—a clearer definition of the rights and duties of pastoralist associations or other collective action groups who participate, for example, in the demarcation and negotiation of boundaries and in the development of resource management plans—are not yet developed.

Competition in the allocation of tight budgets comes up (for example, between agrarian reform instruments and informal urban-settlement issues), and the costs for a workable management machinery have often not been taken into consideration, which makes every reform process dependent on donor money for a long time (Grell and Kirk [Chapter 2]). No real concepts have been elaborated yet for cost recovery of new initiatives for increasing tenure security, or they are not yet feasible. The question remains how to decentralize an historically centralist state with very limited financial resources to pay for any kind of administration decentralization.

Empowering actors at the local, decentralized levels means increasing coordination and consultation at all administrative levels—and between line agencies, which are still wary of learned experiences, and which still have different stakes in the political bargaining process. Sectoral thinking is challenged when the new legal frameworks try to follow a holistic, integrated view on resources, considering complementarities between land and water or taking into account multiple uses and multiple resource users (GTZ 1998; Swallow 1997).

Even if this more comprehensive approach is respected, new concepts for village land-use planning (for example, village territories) that are used to redefine the responsibilities and rights of local communities to manage their resources might have unintended negative repercussions on the position of pastor-

alists. The concept is mainly derived from settled farming villages with a clearly defined set of resources. Herders rarely use such a contiguous set of resources, as they rarely possess defined "territories." Thus, the approach might empower sedentary farmers to exclude again, now on a more participatory basis, pastoralists from grazing areas they previously had access to.

Subsidiarity⁴ is more often referred to as a guiding principle in structuring the relationship between the state and pastoralists' tenure institutions, although only very few experiences exist in African countries where this concept has been applied (Swift 1995). Is it only regarded as a structural principle, or as a principle for action as well? As a structural principle it can at least help to determine an optimal level of decentralization. Horizontal subsidiarity is only achieved if the state accepts its role as one player among others, such as the private sector and organizations of civil society (World Bank 1997). Vertical subsidiarity does not imply giving absolute preference to the lower level in any case; here, the dynamics and the process character of subsidiarity have to be considered as well. In some cases nongovernmental organizations, for example, have to realize that the state administration at a regional level might be the right unit. In other cases, the bureaucracy should be encouraged to give back responsibility to a lower level, for example, in cases of local boundary demarcation, as capacities have been strengthened at that level. Good working relationships, guided by trust and confidence, between state agencies and local or regional pastoralists' associations and other legal bodies is therefore necessary. However, in most countries such relationships still have to be developed as part of a long-term process.

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⁴ The principle of subsidiarity implies that power and responsibility should be devolved to the lowest institutional level that is consistent with the provision of services and maintaining accountability. In practice, this means a shift in responsibilities away from attempts at extensive state provision in pastoral areas to decentralized, local control (Swift 1995).

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2 The Role of the Donors in Influencing Property Rights over Pastoral Resources in Sub-Saharan Africa

HERMAN GRELL AND MICHAEL KIRK

The role of donors and agencies in pastoral development in general, and with respect to property rights over pastoral resources in particular, is multifaceted and has changed considerably in the last decades. This change is the result of a process that started in the 1980s, cumulated in the early 1990s, and is still going on. The writing of this chapter is part of the process.

The process of change has been marked by workshops, such as *New Directions in African Range Management and Policy*, held in Woburn (United Kingdom) in June 1993¹ and which subsequently lead to technical consultations between donors and agencies organized by the United Nations Sudano-Sahelian Office (UNSO) in Paris (December 1993); Eschborn, Germany (February 1995); Brussels (May 1996); and Ouagadougou (March 1998).

Change means learning as Scoones (1994a) formulated it: "Researchers, planners and administrators must interact closely if learning is to be encouraged." Indeed, this idea of learning has stimulated a new dynamic in African pastoral development, which was suffering from the failure of monosectoral, technically heavy projects in the 1960s and 1970s, followed by a phase of "benign neglect" in the 1980s.

In the closing plenary session of the Fifth International Rangeland Congress, de Haan (1996) stated, "One of the most powerful new insights that has emerged over the last years in Sub-Saharan Africa concerns the notion of opportunistic range management." The evidence shows that there is no sustainable alternative, economically or ecologically, to the pastoral herders' opportunistic strategies for managing natural resources in arid and semi-arid zones. (Behnke and Scoones 1991; Behnke, Scoones, and Kerven 1993; Grell 1994; Scoones 1995; Thébaud, Grell, and Miede 1995; de Haan 1996; Steinfeld, de Haan, and Blackburn 1997).

The new paradigm in range management for dryland Africa is based on the "nonequilibrium ecological theory" in range ecology (Ellis and Swift 1988; Westoby, Walker, and Noy-Meir 1989; Niamir-Fuller 1996). This theory recognizes three main characteristics of arid ecosystems: ecological variability, un-

¹ Sponsored by the Overseas Development Agency (ODA), the International Institute for Environment and Development (IIED), and the Commonwealth Secretariat.

predictability, and resilience. According to this view, arid ecosystems of Africa never achieve equilibrium because of the high degree of environmental variability. Niamir-Fuller (1996, 79) summarized the African situation in the following manner:

The classical paradigm for livestock development in Africa, based on sedentarisation, privatisation and intensification, has, after 20 years, benefited only a very small minority of elite pastoralists. A reevaluation of the value of traditional pastoral production is leading to a new paradigm based on mobility of livestock, common property management and extensive production systems.

This new paradigm postulates that the greater the unpredictability and variability of a natural resource, the more suited it is to being held and managed communally (Niamir-Fuller 1996). The main tenure implications are the devolution of authority to local groups, the ability to respond quickly, simple rules, and the need for access to or incorporation of a range of agroecological areas into the tenure system (Lane and Moorehead 1994).

The tenure systems of herders, as Behnke (1992, 910) pointed out,

can be envisaged as a matrix in which rights to different resource categories are partitioned within a hierarchy of different ownership groups ranging from the individual producer up to the largest tribal or ethnic group. Mobility is possible because these ownership groups are not territorially distinct but possess overlapping and potentially conflicting rights to different categories of resources in one area.

Ouedraogo (1997) has given a more simplified definition: pastoral tenure describes the complete benefits and the natural resources from an area.

This chapter is an attempt to analyze and evaluate the recent experiences of external, donor-guided assistance in influencing property rights over grazing resources in Sub-Saharan Africa on the basis of the new “paradigm” in pastoral development.

Changes and opportunities

A New Look at Pastoral Land-Tenure Issues in Dryland Africa

All pastoral range resources are owned in Africa under three “controlled-access” property regimes: as state (national), communal, or private property; and many pastoralists may use the whole range of these property types in pursuing their livelihood (Lane and Moorehead 1994; Barry 1997).

Table 2.1 summarizes the issues related to property rights, contrasting the “conventional” with the “opportunistic” approach to land tenure. (Moorehead 1994; Lane and Moorehead 1994; Scoones 1994a). Obviously such simple contrasts oversimplify the situation, but they show roughly how the situation now

TABLE 2.1 Comparison between the “conventional” and the “opportunistic” approach to tenure in dryland Africa

Area	Conventional approach	Opportunistic approach
Tenure	Fixed tenure regimes: privatization (or exclusive communal) Conflict issues largely ignored	Flexible tenure: complex mix of overlapping and integrated regimes Focus on negotiation, mediation, and arbitration
Objectives	Registration, land title Secure investments in open range improvement (legumes, fodder trees, paddocks, fences, and water)	Alternative and innovative mechanisms for securing overlapping claims Secure access-rights to pastoral key resources (including home area and drought preparedness)
Costs	High—for the surveying, registering, and administering of titles required with private property	Low—for effective allocation of resources under communal-tenure systems
Driving forces	National government policies: <ul style="list-style-type: none"> ▪ Nationalization of resources ▪ Sedentarization of the herders ▪ Privatization of the range 	Interests of pastoralists: <ul style="list-style-type: none"> ▪ Flexibility in resource use ▪ No restriction to mobility ▪ Reciprocity in access rights
Underlying theories of land tenure	The “tragedy of the commons” theory	The property rights school New Institutional Economics

stands in nonequilibrium pastoral Africa and the course that should be taken in the future.

From a retrospective point of view, the conventional approach to tenure has mostly ignored the social and economic motives of pastoralists (which were often not known or were ignored). It followed a top-down operating mode in decisionmaking, relying much on the theory of the “tragedy of the commons.” This dogma is still maintained by many government and donor policymakers and practitioners in Africa. It states that it would be rational for individuals to overuse any common resources and ultimately destroy them by pursuing their self-interest in ways deemed normal, or at least predictable, behavior. This misunderstanding (GTZ 1998) arises, however, from interpreting “common property” as “open access,” when in fact many, if not all people are governed by established norms and precedents—often with roles and rules that regulate access to

and use of resources (Uphoff 1998). Herders in Africa had effective and sometimes sophisticated systems of land tenure (Moorehead 1994; Barry 1997).

The nationalization of arid rangelands, and especially the water resources, which was introduced by many governments in the post colonial period, undermined the intricate fabric of customary practice by replacing an ecologically well-balanced system of communal land use with a “free-for-all,” open-access system (Steinfeld, de Haan, and Blackburn 1997). Moorehead (1994, 18) points out,

Ironically, nationalisation of rangelands has created the very conditions that policy was intended to avoid: ranges are now accessible to people who never had such rights before and who are often not pastoralists, in conditions where there is much less control than former communal ownership systems exercised.

Policies aimed at sedentarizing herders, often involving land-use-planning projects and land titling (privatization—see Chapter 1), reduced the critical mobility and flexibility in the system—the most effective strategies for managing risks in areas of great environmental uncertainty. Perhaps of greater significance has been the preference in these schemes shown to sedentary farming groups. Open access to boreholes in pastoral areas have largely contributed to overgrazing and expropriation of pastoral resources, taking away key resources from herders in their home area (Ouedraogo 1996) and in effect weakening their ability to exploit more marginal resources at other times of the year—precisely the comparative advantage herding has over other activities in these high-risk, non-equilibrium environments (Moorehead 1994).

It has become increasingly clear to development practitioners and researchers that the tragedy-of-the-commons argument on its own neither describes the evolution of pastoral-property systems, nor provides effective policy prescriptions (Moorehead 1994). The arid rangelands are now seen as containing dynamic and highly resilient ecosystems, especially under traditional management of continuous adjustment to the highly variable rainfall pattern. Flexibility and mobility are therefore key requirements for achieving sustainable rangeland use in these areas (Steinfeld, de Haan, and Blackburn 1997).

These requirements are reflected in recent approaches linking tenure systems to specific social and economic characteristics of production systems and the physical characteristics they exploit: the property-rights approach, which examines economic issues (Behnke 1991); and the New Institutional Economics (Platteau 1995).

The latter schools of thought argue, for instance, that where rural producers live in high-risk environments, such as drylands, and where income streams are uncertain, communal-property systems may be more appropriate as they allow access to other areas: tenure systems that allow flexible and mobile response to uncertainty provide insurance against environmental risk (Moorehead 1994). Central to the property-rights approach is the notion that “property does not consist of things and objects, but rather is the socially recognized right to possess

the flow of benefits that arise from the control of things or objects” (Behnke 1991).

Accordingly, these approaches focus on institutions within communities in terms of their ability to coordinate the actions of their members. They examine the conditions under which such management structures come into being, and are undermined, and how they may work in the future, given the right conditions (Moorehead 1994). These local institutions need legal support if authority has to be exercised but can start, and even work, on an informal basis. As Swallow and Bromley (1994) have shown, there can be effective internal management without any formal institutional structure within the regime if

- group members are confident that the boundaries of the regime will be effectively protected,
- the group of resource users is kept relatively small,
- future pasture potential is not overly sensitive to changes in the current stocking rate, and
- individuals do not discount future payoffs too heavily.

Taking Advantage of International Trends

A useful preliminary step in looking at the roles, policies, and themes that donors and agencies should promote in influencing the conditions for common property-rights regimes over pastoral resources in Africa is linking the subject to some international trends. In fact, important political and economic changes have provided an enabling environment for property rights issues.

With the far-reaching economic reforms and structural adjustments that followed the fall of most of the socialist economic systems, donor organizations did not restrict themselves to just technical support or human-capacity building. With the development of an appropriate institutional environment and the reformulation of the existing legal and regulatory framework toward market-oriented economic systems again at issue, interest has centered on the question of property-rights regimes of pastoralists. This new orientation was strongly backed by research results in new institutional economics, in particular on common property and collective action (GTZ 1998; Kirk [Chapter 1]).

The trend toward less and less government involvement in resource management is evident in many parts of Africa, and results from a mixture of factors (Scoones 1994b): a desire to shift the costs of maintaining responsibility for resource management from central government to local people; the current shift in development thinking, which argues in favor of decentralization and subsidiarity; and donor pressure on governments to reduce staff and cut budgets through structural-adjustment programs. Community-based natural-resource management as a strategy for serving both conservation and development has again received attention with the emerging literature on “the tragedy of the anticommens” (Uphoff 1998).

As a consequence of the United Nations Conference on Environment and Development (Rio de Janeiro, June 1992), Agenda 21, and the declaration of

Praia, the International Convention to Combat Desertification confirms the essential role of herders in resource management and in a process of sustainable development. The international conventions for the environment are valuable tools for developing sustainable pastoral management (Thébaud 1995a; Ka 1998), but apart from this general policy outline, integration of the pastoral dimension into national action plans remains a delicate task (Thébaud 1995b). As Scoones (1994b, 11) stated in 1994, “All governments have been unwilling to recognize pastoral use of land in law and, therefore, pastoral resources are still seen as empty and available for others to grab.”

Why and How—A New Role for Donors

In the past, differentiating clearly between the *role of the state* and the *role of donors* has often not been possible as, in fact, influential donor organizations formulated government sectoral policies and raised the funds to implement them. Thus, any assessment of the impact of government policies on property regimes of pastoralists has also provoked a critique of donor objectives and strategies. As a consequence, partner countries have become more and more sensitive to the impact and unintended side effects of comprehensive, mono- or multisectoral donor projects and programs than in the recent past.

The question that has arisen from the various donor conferences, roundtables, and diverse publications is whether or not the external consultants, projects, and programs should deal with this highly sensitive area at all, or whether assistance (reduced to investment) should only start once the land question has been settled.

Donors should support the development of common property regimes in pastoral land and reject policies of benign neglect for several reasons (Swift 1994; GRET, IIED, and L’Université de Saint-Louis 1996; Uphoff 1998):

- The cost of getting it wrong is high. Misguided policies and the present neglect of community-based tenure contribute to major, recurring economic and food-security crises.
- The real intrinsic ecological and economic potential of the drylands is often underrated. With flexibility, the variable primary productivity can be tracked with low opportunity cost.
- The clarification and security of tenure rights are seen as essential issues concerning investment in farm land and even in pastures and improvements in productivity.
- Natural-resource management that is community based links development with the protection of biodiversity, the maintenance of ecosystems, and the preservation of global cultural diversity.
- With regard to the rising scarcity of natural resources, common-property regimes are the best choice for negotiating and settling conflicts in rural societies.

The new role of donors was extensively discussed at the Woburn workshop in June 1993, and at the subsequent initial Donor/Agency Technical Consultation on Pastoral Development, organized by UNSO, in Paris, December 1993. Table 2.2 summarizes the major issues at different national and international levels (Scoones 1994a, 1994b; Lane and Moorehead 1994; Moorehead 1994; Behnke 1994; Vedeld 1994; Swift 1994; Niamir-Fuller 1996).

TABLE 2.2 Donors' role in influencing property rights over pastoral resources

Issues and levels	Policy formulation and adoption	Applied research	Adaptive approaches
International, intercountry	Networking among donors with respect to pastoral development Influencing international negotiations to benefit pastoralists	Demystifying the link between livestock and environment Studying the evolution of tenure systems for pastoral land	Disseminating information about "best-practice" case-studies in different countries and innovative rules governing access to natural resources
National	Influencing national-level decisions (especially large donors) Supporting the drafting and implementing of appropriate tenure policies Designing and supporting pastoral-development administration	Analyzing policy, and evaluating past experiences Integrating the "new approach" in the design of national research programs on livestock or pastoral development	Supporting pastoral organizations in lobbying and advocacy Promoting a procedural approach in lawmaking Providing teaching materials and training of professionals
Local	Integrating mobility and reciprocity in local development policies Supporting appropriate tenure frameworks and management institutions where they still exist Supporting pastoral groups in negotiation and advocacy	Selecting pilot areas for action research following policy outlines Identifying the conditions required to reestablish common property rights systems	Facilitating learning processes, roundtables, and participatory approaches Concentrating on "focal-point" management—access rights to "key resources" Supporting economic viability of pastoral institutions

The way in which the role of donors is perceived today cannot be separated from the new school of thought in development policies:

- Development is process oriented. In this process, “ownership” must be very clearly on the beneficiaries side.
- The donor role is one of a facilitator, or a moderator, in an iterative or incremental manner. In this new approach, donors must also embrace a learning role. They should be flexible, thereby being able to adapt their facilitating role to new information and circumstances.
- Since many governments and development policymakers still follow the conventional tragedy-of-the-commons approach, an important donor role is one of lobbying and developing “opportunistic” strategies in promoting pastoral policies at all levels.

On the international level, lobbying, dissemination of information, and networking are the main issues. These actions might lead, for example, to the harmonization of land-tenure codes or the facilitation of cross-border movements.

Since livestock or range specialists, and livestock or range-development administrations, in many African countries still favor development policies based on the “environmentally destructive nature of pastoral livestock systems,” demystification of the link between livestock and environment is urgently needed.

Moorehead (1994) said there is a pressing need for the research agenda to include the study of the evolution of tenure systems for pastoral land while looking into the following related factors:

- The relationship between the productivity of natural resources and tenure systems with particular reference to the switch-over points where tenure changes
- The overlapping interests surrounding key resources and, in particular, the alliances and conflicts between farming and herding, including secondary and tertiary rights
- The viability of existing pastoral institutions in nonequilibrium environments, and the role the state does play, and what it may play.

Research on the relationship between legal statutes and their effects on a community, and the actual systems functioning at the community level, is a comprehensive task, since many aspects have to be considered simultaneously. Understanding the local richness of land-tenure systems and their specific differences requires carrying out research in many different regions and at different regional levels (Leisz 1996).

With lobbying on a *national* level, the idea of a comparative advantage occurring among the various types of donors has been put forward. The larger donors, such as the World Bank and the European Commission, who are more involved at the level of national policymaking and program design and imple-

mentation, should handle the "hotter" issues and take a more activist approach in assisting with pastoral advocacy and peace keeping (UNSO 1994; Swift 1994).

Donors and agencies have an important role in supporting detailed analysis of pastoral policy. Evaluation of economic variability, documentation of past experiences, and issues of replicability would be important input to policy analysis (Swift 1994). In designing and supporting pastoral development organizations, donors should insist on more importance being placed on the development of policy, and institutional and infrastructural frameworks for local institutions and human-resource development (Vedeld 1994).

Regional development programs with strong components of land and resource law and tenure codes, rather than purely national tenure programs, provide opportunities for action. Additional research and training in those areas considered to be most neglected are also needed. Donors should help the processes that allow the relevant issues to emerge and to be discussed in an open and participatory way. The conventional donor approach characterized by the (usually) three-year project cycle needs to be replaced by far more flexible and open-ended projects. (Dalal-Clayton 1997).

In their support of the drafting of appropriate tenure policies, donors should insist on legal recognition of "pastoral-land use," or *mise en valeur pastorale* (Lane and Moorehead 1994; PRASET, Club du Sahel, and OSS 1995); and a two-tiered legal system promulgating and enforcing procedural law that specifies the framework rather than legislatively dictating substantial land law (Vedeld 1994). This would enable the development and reassurance of the conditions and elements necessary for a creating a system for common-property rights at a local level appropriate to the specific situation (Behnke 1994; Lane and Moorehead 1994).

On the *local* level—which, according to Uphoff (1998), combines locality, community or village, and group (or neighborhood)—the role of donors is to insist and to ensure that the design and implementation of projects follows the new approach to systems of common-property rights in pastoral and agropastoral areas. This may require direct support being given to marginalized pastoral groups with respect to their capacities of negotiation and advocacy associated with new policies. Such groups will even need legal recourse when their tenure rules are broken by outsiders (Wachter 1996). In defining policies for pastoral organizations, donors must insist that the economic viability of pastoral communities is ensured. Another thing to keep in mind is that, since the per-hectare productivity is low, so must be the cost of management (Behnke 1994).

Local rangeland administration should be advised on the new schools of thought and also that the transfer or responsibility and control of grazing resources to pastoral communities is now considered a viable approach. Donors should provide training to facilitate a change in the role of local government officials from regulating resource use to allocating and upholding access rights. Furthermore, a situation of chronic, endemic conflict is a central feature of many nonequilibrium settings. The arbitration of chronic conflict over scarce resources

may be the central natural-resource management function of local government officials in a nonequilibrium region (Behnke 1994; Cousins 1996).

New approaches to pastoral development must be firmly based on sound empirical research. A number of “best-chance” areas and groups of herders have to be identified in different countries where tenure agreements might be drawn up and initiatives tested in the field. These initiatives will need to be governed by a process-oriented approach that will allow definition of the areas to be managed through negotiation between herding groups and neighboring communities practicing different production systems, in consultation with government (Lane and Moorehead 1994).

Discussion over how to integrate the mobility and flexibility of pastoral systems into the planning approach to land use—for instance, as in West Africa’s *gestion terroir* (land-management) approach—is ongoing, since the *terroir* approach as it now stands may lead to the risk of further marginalization of herders (Marty 1993; Toulmin 1993; GTZ 1995; Winkler et al. 1995). One proposition is to concentrate on access rights to key resources or “focal-point management,” which according to Behnke (1994) will

- concentrate management attention on the essential resources of the production system and devote much less effort to the clarification of property rights,
- allow producers who control key natural resources to exploit more peripheral resources and exercise de facto control over these resources, and
- permit the continuation of customary tenure arrangements that encourage the shared use of resources that are not in high demand by de-emphasizing the need for strict boundary maintenance.

Finally, an important role of donors will be to feed back experiences from initiatives tested in various countries and so provide the necessary networking to bring together not only the herders themselves, but also planners and policymakers at local, national, and international levels.

Experiences and Lessons Learned

Networking and Dissemination of Information

In the past five years important activities in networking and workshops with relevance to pastoral tenure policies in dryland Africa have occurred:

- The UNSO technical donor and agency consultations on pastoral development in Paris, December 1993, hosted by the French Ministry of Cooperation; in Eschborn, Germany, in February 1995, hosted by the German Agency for Technical Cooperation (GTZ); in Brussels, in May 1996, hosted by the European Commission; and in Ouagadougou, in March 1998, coorganized by Projet Regional d’Appui au Secteur de l’Elevage Transhumant (PRASET).

- The international multidonor-funded study on livestock and environment interactions. Initiated at an international meeting of livestock advisers in Paris, in December 1992, the study was chaired by the World Bank and coordinated by the Food and Agriculture Organization of the United Nations (FAO). Study results were presented at the International Conference on Livestock and Environment in Wageningen (Netherlands) in June 1997.
- The West African regional workshops on land tenure in Praia 1994, by the Interstate Committee for Drought Reduction in the Sahel (CILSS), and Club du Sahel; in Ouagadougou and Bamako in 1995, by PRASET; in Gorée in 1996, by ODA, and the French Ministry for Development; in Bobo-Dioulasso and Dakar in 1996 by PRASET; in Saint Louis in 1997 by CILSS; and in Niamey in 1997 by PRASET, GTZ, Support for Local Development in the Sahel (PADLOS), CILSS, Club du Sahel, and IIED.

As the UNSO consultation process still considers the special needs of mobile pastoralists and also focuses on all the different forms of extensive pastoral production, the elements of the “new paradigm” have become the orientation for the planning or replanning of projects and programs (UNSO and European Commission 1996). Funding of the workshops came from participating donors. The associated consultations have opened a way for participants to familiarize themselves with new ideas and to lower the general skepticism concerning the absence of sound pastoral-development policies (Niamir-Fuller 1998).

The first three consultations, hosted by the French Ministry of Cooperation, GTZ, and the European Commission, have been especially helpful in sensitizing other colleagues at the donor level who had not been previously exposed to the new paradigm. However, a lot still has to be done; not everybody likes learning the sometimes “bitter lessons of the past” (Thébaud, Grell, and Mieke 1995).

The study on livestock and environment interactions was an important step in demystifying the link between livestock and the environment, especially with regard to overstocking and degradation in nonequilibrium, pastoral Africa. The argument of “overgrazing leading to desertification and irreversible loss of productivity”—which even today serves to blame the victims (Grell 1995)—has not been confirmed. Study results indicate that maintaining and supporting herders’ opportunistic strategies and empowering pastoral people will be the main challenge in future pastoral development (Steinfeld et al. 1997). The call to change livestock-sector policies will hopefully reach the experts and technicians responsible for planning pastoral livestock development. Their support for the new approach is badly needed, since lobbying for the new paradigm has initially come—with rare exceptions—only from the socioeconomic and ecological sciences (Grell 1992). The following factors have been put on the agenda for monitoring pastoral development in dryland grazing systems (de Haan et al. 1997): herd mobility, land tenure and recent trends in fencing and crop en-

croachment in key areas, human carrying capacity of the land, reliance on food aid, and cohesion of user groups.

At the West African regional workshop on land tenure, the donors' role in implementing declarations—referring to the Segou roundtable of CILSS and Club du Sahel in Praia in 1989 on tenure and decentralization (CILSS and Club du Sahel 1994)—was clearly instrumental in maintaining the momentum of the debate (Schoonmaker-Freudenberg 1996). In the Praia declaration, it was recognized that herders in West Africa are marginalized and pastoral-tenure rights should be secured (Ouedraogo 1997). The follow-up to a recommendation in the Praia declaration on research and training in land tenure was the subject of the Colloque International sur le Foncier au Sahel in Saint Louis, Senegal, in 1997. The results stressed a more active role of Sahelian researchers in supplying elements of the realities of local tenure to the respective government institutions working on reforms (Toure M. 1997).

PRASET was started in 1993 to promote the new pastoral policies in West-Africa. PRASET was the center of a network connecting pastoral projects (mainly GTZ) in seven countries. The essential elements of a new pastoral-tenure policy were identified as legal recognition of pastoral-land use, mobility of herds, empowerment of herders, and conflict management. The recommendation to integrate these elements into the larger framework of sustainable development in the Sahel is essentially based on the work of PRASET (Thébaud 1995a; Rochette 1997).

Workshops, such as the one held in Gorée in 1996 by ODA and the French Ministry for Development (and supported by the University of Saint-Louis, GRET, and IIED), have provided other opportunities for the exchange of experiences, information, and views among French- and English-speaking West African experts. It set out the basis for the definition of a program of collaborative work to be carried out in the future.

Donors have also covered nongovernmental organizations' costs for publishing case studies that analyze tenure issues in their own projects, and for organizing international workshops and meetings to maintain the debate on Sahel tenure issues and property-rights systems of pastoralists, keeping in mind the need to increase participation of rural people (Schoonmaker-Freudenberg 1996). SOS Sahel U.K. and IIED Drylands Program have just started to set up a regional program supporting projects in East and West African countries in the implementation of common-property management-regimes of pastoral resources (SOS Sahel/IIED 1998).

Legal Framework and the Process of Decentralization

Far-reaching economic reforms in the 1990s included a rearrangement of the institutional environment, and the legal and regulatory framework, and often a redistribution of property rights with respect to natural resources in African countries. These processes were strongly supported by international and bilateral

donors (Bruce et al. 1995; GTZ 1998; Kirk [Chapter 1]). Quite often, the donors acted cooperatively in this process, with the World Bank taking the lead. Thus, nearly no changes in national politics on land and complementary resources can be analyzed without taking into consideration the donor impact. (South Africa, Ethiopia, and Eritrea are up to now exceptions, as they have been quite reluctant in giving international donors any influence in reform policies for resource tenure.)

Despite the failures of pastoral policies in the past, some countries have started legislative reforms in the last few years and adopted laws in the domain of rural development or natural-resource management that are better adapted to the interests of pastoralism (Ouedraogo 1996; Mekouar 1997). The following national examples, far from being exhaustive, demonstrate some typical situations in the process of developing pastoral tenure legislation.

National Examples

NIGER. The 1993 Rural Code in Niger was supplemented in 1997 by the Act on Home Areas and the Act on Local Institutions. In pastoral areas, herders have priority in receiving benefits from pastoral resources corresponding to local customary practice but not to infringe on the property rights of others. In case of sedentarization, they can obtain private-land titles, as stated in Article 28 (Moussa 1997).

Pastoral leaders have appreciated the process of consultation in past years and the improvements made in the two new acts. However, the initial Rural Code of 1993, which is biased in favor of agricultural land, does not correspond to the reality of pastoral-resource management, which is directed toward access rights to natural resources and not to private ownership of land. Therefore, little change is expected in the disadvantaged situation of the herders (Dodo 1997). In line with the idea that the environment has to be protected against the herders, the recognition of "land use" in pastoral areas (Article 28) also is understood as contributing to the protection and rehabilitation of water resources, pastures, and the vegetation cover (Mekouar 1997).

The state and donors are likely to favor continuing the experiment in Niger while making adjustments through holding seminars and workshops and through preparing supplementary legislation (Alpha Gado 1996). A Pastoral Code is in preparation (Mekouar 1997).

MALI. In Mali, the legal recognition of herder organizations and the pastoral vocation of land (*domaine pastoral*) is part of the actual process of decentralization. This process is supported by several donors namely Caisse Française de Développement of France, GTZ of Germany, and FAO. Its aim is to facilitate the development of complete pastoral legislation based on habits and customs, or *us et coutumes* (Maiga 1996). Implementation of a pastoral code is being discussed (Mekouar 1997).

Decentralization is a land-oriented, rather than a resource-oriented, approach. In Mali, 10,752 villages have formed 682 rural communes and expecta-

tions for local development are high (Michel 1998). However, herders need to be mobile. It is now up to the decentralized local authorities to decide the nature of land use. Some critics (Observatoire du Foncier) now see that cutting up the country between the communes will increase sedentarization of herders in home areas (*terroirs d'attaches*) and lead to further weakening of the existing, traditional pastoral tenure with regard to transhumance movements (Soumaré 1997). Since essential conditions whereby the local communities act according to the law are still lacking, donors are recognizing that they should slow down the process of change and adopt a more careful approach (Toure O. 1998).

BURKINA FASO. In Burkina Faso, international and bilateral donors have been exerting pressure and giving enormous financial support to the reform process of land-tenure legislation (Zeba 1996). The land organization reform, *Reforme Agraire Foncière*, was adopted finally in 1997, but concrete acts on procedures for property rights, especially common-property rights on pasture lands, have not been passed. *Reforme Agraire Foncière* will hardly serve as a reference for the resolution of current conflicts between herders and farmers (Lund 1997). Help is expected to come with the ongoing process of decentralization and discussions on the necessary tenure arrangements, including a project on the development of a pastoral code (Kote et al. 1998).

Meanwhile, freedom of action has been given to donors to test local approaches favoring arrangements between herders and settled agropastoralists in community-based programs for resource management (Faure 1997; Banzhaf et al. 1998). However, the official approach on pastoral land-tenure is still orientated toward grazing reserves, or *zone pastorales* (Sanon 1996), and sedentarization of herders, with a coercive regulatory approach (Zeba 1996). In the absence of appropriate pastoral-tenure arrangements at the local level, difficulties continue to persist: lack of respect for arrangements, by the local population (who continue to clear for cropping) and by local chiefs who continue to allow the settlement of migrant farmers in these "grazing reserves" (Kote et al. 1998).

GUINEA. Guinea is the first country in West Africa that has adopted a Pastoral Code (Loi du 29 Août 1995 Portant Code Pastoral). In general, access to pastoral areas is free (Article 14). The law recognizes the pastoral use of natural resources (*à des fins pastorales*) and defines access rights (*droits réels particuliers*) with the restrictions of not overusing the resources and of respecting customary rights of other users (Articles 75–76). Article 80 of the code underlines the necessity of taking into account the herders' interest in rural-development projects; and Article 83, of advising those providing technical services to take into account the problems and special needs of pastoralism in land-use and land-tenure questions (Mekouar 1997).

SENEGAL. With respect to Senegal, Bruce et al. (1995) recommended that the role of donors should be to work with government agencies, academics, nongovernmental development organizations, and rural federations, to promote a dialogue on the changes in land legislation. However, until today this dialogue is

still under the influence of important agricultural lobbying and no substantial progress has been made in pastoral-tenure policy (Toure O. 1997).

ETHIOPIA. In the case of Ethiopia, international donors and major national institutions share a consensus on security of tenure as a function that is necessary for sustainable resource-management, but they are diametrically opposed as to the type of tenure regime that should be established. National institutions are afraid that they may inadvertently open a loophole for the displacement of farmers from their holdings through the implementation of certain tenure policies. With regard to Oromia land policy in Ethiopia, an agreement with the Ethiopian government states that "...donors will have no role in influencing the land policy; but their assistance in other areas such as cadastral survey, and compilation of the resource bases is more than welcome" (Tolossa/Asfaw 1995).

NAMIBIA. In this country, legislation is urgently required that will clarify the access to and management of land. For efficient tracking in dry, dynamic environments, large areas are usually needed. This situation is, however, far from being conducive in Namibia because of the erection of regional and national boundaries. The establishment of National Conservation Areas, commercial farms, and the new phenomenon of "defensive" fencing in the communal areas contributes largely toward this unwanted situation (Kruger and Kressierer 1995). (Similar developments have taken place in most African countries—for example, in Tanzania, Kenya, and Botswana, as reported by Chisholm [1998]).

All people of Namibia have the constitutional right to settle themselves at any place in the country. Together with the uncertainty about rights and the authority of traditional leaders and local government, this fact contributes to an uncontrolled exploitation of rangelands and resources of local communities by outsiders. A possible solution might be to distinguish between the "right to settle" and the "right to use" the resources (Kruger and Kressierer 1995). With regard to pastoral tenure, this entails, under the specific conditions present in Namibia, a combination of a private-property (ranching) model and a common-property model in areas where priority in access to pastoral resources is given to the local herders.

A rough analysis of major problems indicated by these seven examples offers several points for discussion, as described below.

Key Elements in Decentralization and Empowerment

Today land-tenure reforms and the process of decentralization are linked in many countries. In anglophone countries, the concepts of tenure introduced by the British colonial administration has always been decentralized (Kirk [Chapter 1]; Mortimore 1997). Referring not only to the Sahelian region, decentralization and empowerment for local-level management of pastoral resources must consider the following key elements in the process.

TERRITORIAL REORGANIZATION, INCLUDING PASTORAL MOBILITY. Since present administrative boundaries do not represent or coincide with the socio-economic, political, and historical realities of pastoral and agropastoral areas, a

more effective territorial organization based on inherited and existing land-use patterns, kinship relations, and the attribution of “home areas” (in French, *terroirs d’attaches*; in Arabic, *dar*) derived from customary tenure must be the aim of management policies if they are to be effective at the local level. Home areas seemed to be a good compromise, bringing together governments’ and herders’ objectives. Population pressure, 30 years of sedentarization policies, and the increasing scarcity of “good” places have created among many mobile pastoralists a reflex of settling somewhere and getting rights. This is especially important for all herders who have “settled” after the big droughts of the 1970s and 1980s to reduce risk by diversifying the household economy (cropping, gardens, and small business).

However, the wish to sedentarize the family in a “safe” home area has to mesh with the necessary mobility of their herds, the consequences of reciprocity of access to pastoral resources, and the responsibility for investments made (Diagana 1998). Decentralization alone will not solve the problem of transhumance, which affects more than one local administration and several areas (Mortimore 1997). Pastoral mobility must be ensured through negotiation and renewable accords supported by reorganization of the territories, delimitation of administrative boundaries, and the empowerment of local institutions. Because of variability in natural resources, this flexibility is required, and thus extensive pasture lands must be managed communally for the benefit of all.

The perception of pastoral tenure in the Francophone countries is much biased toward centralization, with priority being given to agricultural land use and the conventional approach of exclusive private property. As Lund (1997, 13) stated for the Burkina Faso case, “the development of a local common-property right is opposed to the tradition of law-making and risks encountering serious obstacles.” Part of these obstacles to pastoral tenure also stem from thinking guided by the idea of “protection” (Mekouar 1997) and by cultural prejudice, which continue to promote marginalization of pastoral communities (Ouedraogo 1996). “A herder (Peulh) can never take possession of land” was the statement of a village chief at a workshop held in 1996 on conflict management in Bobo-Dioulasso (PRASET 1996). Ouedraogo (1997), referring to pastoral-tenure rights, points out that West African herders in all workshops have always insisted that the goal of pastoralists is not to lay claim to private pastoral property, but rather to participate in property regimes and to secure access-rights for herders.

DIVISION OF RESPONSIBILITIES AND DECISIONMAKING. These have to be devolved to the lowest possible levels; and, at the same time appropriate roles for government, local district officials, local communities, nongovernmental organizations, villages, and other involved entities have to be clearly defined. Pastoralists must be given appropriate forms of representation and influence in such decisionmaking.

However, the issues of access to and control over resources do raise questions about the influence of external agents on pastoralists’ access, but also

about the need to include consideration of the dynamics within pastoralist "communities" (Chisholm 1998). According to Chisholm (1998), the notion of a homogeneous "community" of pastoralists, or any other resource-using group, has to be looked at critically. As commercialization opportunities and population pressures increase, the likelihood of privatization of natural resources and greater inequalities also increases. The notion of "environmental entitlements" has been used recently (Chisholm 1998) to provide a framework for addressing this issue.

DEMOCRATIC LEGITIMIZATION OF PASTORAL ORGANIZATIONS. This is another "hot" issue. The process of decentralization and democratization and the multitude of participatory events from the local to the international level have also improved the conditions for pastoral organizations. The role of PRASET in the Sahel has to be underlined in this respect. However, the question of internal democracy is still an issue (Mortimer 1997).

HERDERS' ATTITUDES. Finally, consider herders' attitudes. Pastoralists tend to avoid difficulties (if they are not directly associated with fighting for survival). This "avoidance strategy" is part of opportunistic management. However, this strategy has led to the state where any help is considered to come only from outside and is mostly considered as a chance to "get something" and not as a chance to "do something" (Ly 1998). As noted above, lobbying for pastoral development has come almost exclusively from the ranks of researchers and advisers from donor agencies. If pastoral leaders continue to cry for help without changing their attitudes, this donor-related help might in time fade away.

Searching for Local Solutions to Reconcile Pastoral Interests

Valuable experiences of local land-tenure systems have been obtained in West Africa through initiatives such as the local-planning *gestion de terroir* approach, which now serves as a model for community-level planning. This combines both technical elements and an institutional dimension (GRET et al. 1996). The typical approach of *gestion de terroir*, or land-use planning, is oriented toward a geographically well-defined area in which the land-use planning takes place. This is the right approach in environments with sufficient rainfall, and where land-use systems are based on farming or ranching. However, nonequilibrium environments differ essentially in that the mobility of herds is the crucial factor for sustaining livelihoods. The *gestion de terroir* approach and the "mobility approach" have important corresponding and diverging features with regard to pastoral development, as has been shown by Niamir-Fuller (1998) at the Fourth UNSO Technical Consultation in March 1998, in Ouagadougou.

The problems related to integrating mobility into the existing *gestion de terroir* approach instead of developing a separate management approach based on pastoralism, or *gestion pastorale*, have been a challenge to some projects working in agropastoral, nonequilibrium situations. The answer is community-based natural-resource management (*gestion des ressources naturelles à base*

communautaire), which combines both the land and the resource dimension in an approach based on common-property rights. The focus is on key-resource management and the necessary institutional arrangements that allow all user groups to participate.

On a project level, the following strategies for influencing the development of a system for pastoral common-property rights can be successful, as shown by Banzhaf and Drabo (1996) in the agropastoral environment in the Sahel of Burkina Faso:

- *Promoting the evolution of an enabling environment* through a process of learning from experience among projects funded by different donors, from local and central administration, from technical staff, and from herders—on a regional basis. An informal working group was initiated and met regularly for two years in small workshops and roundtable discussions according to the progress made in understanding each other.
- *Facilitating the development of an action research program* with all user groups that is based on their knowledge and experience. Roundtable discussions between herders and agropastoralists on common-property rights and their problems with herding and cropping contribute to this development.
- *Facilitating the development of a consultative platform* of expression and counterargument that is conducive to resolving latent conflicts between different groups.

Within three years, a system for common-property rights emerged focusing on access to key resources identified on the basis of former customary practices that had been neglected for a long time. Today, the general interest overrides individual concerns (Banzhaf et al. 1998; Bauer 1998). In 1998, the consultative platform served to negotiate and balance the interests of 25 different local groups or communities.

Another example of the facilitating role of a project in a pastoral environment comes from Northern Kenya (Haro et al. 1996). Existing local institutions and decisionmaking structures of the target communities were used as entry points. The process of community mobilization started at the neighborhood level (the smallest recognizable management unit) and later, at the territorial level (largest management unit) for conflict negotiation, where influential traditional leaders and elders were brought together. Natural-resource degradation in the area can arise from conflicting traditional resource-use strategies of different herder groups who share common resources. To the Ariaal herders, natural resources are community-controlled resources, while the Rendille herders consider them to be uncontrolled resources that are open to access by anyone. The role of development agencies in this context has been to act as a mediator between different user groups.

Another example is reported from Guinea (Diallo and Camara 1998): Conflict prevention during transhumance was part of a program in Guinea sponsored

by Fond Européen de Développement. Mixed commissions of herders and farmers meet to negotiate the itinerary of transhumance, the time table, and agreed-upon procedures to settle conflicts. The community funds collected to maintain the system are reported to exceed project expectations.

Conflict Management

“State is a polygamous husband: he must treat his wives—farmers and herders—in full equality” was the statement of a herder at a workshop held in 1996 on conflict management in Bobo-Dioulasso (PRASET 1996). Conflicts between pastoralists and agriculturists are undoubtedly on the increase, particularly in the semi-arid zone, where agriculture could be expanded, and where such expansion may be fueled by population growth but is also often aided by development projects (Chisholm 1998).

The number of techniques and methods available for trying to deal with disputes, and of different approaches to natural-resource management, are growing. Terminology and concepts are still evolving in this area (GTZ 1998). According to Uphoff (1998), “conflict management” is probably a more realistic term than “conflict resolution” in many cases, since conflicts are often not really resolved, only mitigated. It is important not to simplify conflict management as a goal-oriented activity, but to deal with it as a process-orientated approach. Since it depends on the process of negotiation and therefore on the political power of each side, strengthening conflict-management mechanisms has to become an integral part of the process of decentralization and democratization (UNSO et al. 1996).

Development programs could provide support for training and capacity building in conflict management at local levels—in pastoral and agropastoral organizations and associations, within local administrative structures, and within their own structures. This will contribute to the institutionalization of conflict management within pastoral contexts. Donors might wish to fund innovative pilot initiatives that seek to develop conflict-management techniques for multiple resource users and attempt to integrate traditional conflict-management procedures and more recent formal approaches (Cousins 1996). Such an initiative has led to the development of a training module, by Associates in Research & Education for Development Inc. (Dakar), for conflict management in the agropastoral context of the Sahel. The training module, funded by GTZ and IIED, is for developing the attitudes of a facilitator and mediator. As part of the project, a critical analysis of the current approaches to managing conflicts over natural resources in dryland Africa was presented (Hendrickson 1997). The report had a particular focus on identifying those issues critical to the success of training for conflict management in the pastoral sector.

Conclusions

The tenure question is the Achilles' heel of pastoralism.

—Rochette (1997)

Five years have passed since this role of donors was discussed in the first workshops, and in the meantime some donors have committed themselves to the task of stimulating a critical evaluation and discussion of the issue. What has been done? Has anything changed? What are the lessons that have been learned? These questions can be answered in short by the following general statements:

- The issue of property rights over pastoral resources is now well recognized at an international level.
- The importance of an appropriate pastoral-tenure system in African drylands has been confirmed, but the need for action is even more urgent.
- Some results from projects and case studies demonstrating approaches of reestablishing or developing local systems of pastoral common-property have been attained.
- Very little progress has occurred in tenure policy and legislation at the national level.

The momentum of the debates in the early 1990s has spread from a small group of researchers to the general public. Major donors of Organization for Economic Cooperation and Development and the Club du Sahel set up a broad array of programs to promote research, public-policy discourse, and public education on tenure and decentralization issues in the Sahel (Schoonmaker-Freudenberg 1996).

Research and training, policy discourse, dissemination of information, and the sharing of experiences are important and will be necessary in future lobbying. However, until now, these activities and processes have always ended in general statements or recommendations to donors and governments. Since the issue is still attractive to researchers, there is a danger of their being very active in analyzing problems and talking about change, without any advance being made on the essential issue. Donors should avoid just boosting the study and workshop industry and invest more in the process of inducing change in policies on the national level.

Lessons learned from the local project level, especially when mobility of herds has to be integrated in a management approach to common property, can be summarized as follows: If the project or donor is not biased toward the application of a national-sector policy through blueprint approaches or other fixed concepts, the project or donor can facilitate the development of a learning process that leads to an enabling environment. In such an environment, all local actors and users of pastoral resources meet and negotiate the common-property approach that fits best to ensure sustainable development.

As to the constraints to “establishing more participatory management institutions and pastoral tenure systems” (Moorehead 1994), there are indications

that, at least at the local level, heterogeneity of interests can be managed and even old alliances between herders and farmers can be reestablished. This supposes that a project has the capacity of learning and a long-term commitment to an action-research approach. Another assumption is freedom of action being giving to donors to test local approaches. The risk with the political will is that such approaches might never develop to a significant scale (Lane and Moorehead 1994).

Local initiatives need the necessary legal framework to formally replace the informal protection by the donor. The progress made with processes at the local level rarely correspond to the progress in lawmaking at the national level (Niamir-Fuller 1998). Programs of the big donors usually finance the implementation of national policies. The potential for big donors to stimulate a process toward appropriate pastoral tenure at the national level remains unexplored. Donors should avoid confining action to reserving common-property rights at the local level only and invest more into the synchronization with national tenure reforms.

Lessons learned from the public-policy discourse on tenure and decentralization issues in the Sahel confirm the persistence of major constraints:

- The wider socioeconomic structures that have an interest in the status quo, and that favor the interests of sedentary cultivators over those of transhumant and nomadic herders, do not provide support (Moorehead 1994).
- Herder empowerment is generally viewed with considerable apprehension by government institutions and employees, who are afraid to lose their own prerogatives (UNSO 1994).
- Public sector officials have a top-down attitude. Major changes in these attitudes are required but are hard to prescribe in project documents or to capture as key indicators (UNSO 1994).

The perception of pastoral tenure in the Francophone countries is especially biased by legislative and cultural traditions which see in tenure (in French, *foncier*) only the question of who owns the land (Ouedraogo 1997) or how to protect natural resources and public investments.

To reiterate, until now the issue of pastoral tenure seems to be still donor driven. The role of donors has been controversially discussed as lying between the extreme positions of direct donor interactions with rural organizations and nongovernmental organizations, and indirect interactions in cooperation with state authorities. The latter fear any co-optation of local organizations by donor priorities and funds with regard to a loss of influence and the monopoly of power (Schoonmaker-Freudenberg 1996). As already stated by Cees de Haan in 1994 (UNSO 1994, 40): "One of the most difficult issues faced by most official donor agencies is how to channel funding effectively through the public sector to empower a decentralized grassroots group."

What are the alternatives? Swift (1994) has suggested compensating those who lose by the new policies. Such compensation might be found in new roles and new benefits derived from implementing the new policies. This suggestion is still open for discussion.

A lesson learned from the PRASET experience confirms that rapid results from politically sensitive issues, such as land tenure, cannot be expected (Schoonmaker-Freudenberg 1996; PRASET et al. 1997). Lobbying for pastoral tenure as a strategy has to be linked directly to ongoing processes in tenure reforms. (The continuing negotiation in Niger might be an example.) One possible forum for such developments is the work on National Strategies for Sustainable Development emerging out of the Agenda 21 process. Since several donors are usually implicated in the policy dialogue, one donor should take the lead in concertation with the others.

Countries supporting an approach toward pastoral tenure should be privileged. Inconsistencies in donor policies and strategies that may undermine pastoralist livelihoods need to be addressed. A notorious example in recent years has been the impact of European Union beef export subsidies on the regional meat market in West Africa. Another major issue is the tendency toward a "land bias" in discussions of tenure reform that have taken place in the context of World Bank-sponsored National Environmental Action Plans (Chisholm 1998).

The perception of tenure in Francophone Africa calls for urgent action. Some study results indicate a rich tradition of common-property right-regimes exists in the agropastoral systems of the Sahel (Barry 1997), but actual legislative practice focuses on the land (agriculture) side only. Research, education, and training should provide the necessary insight for the better understanding of the essential role of common-property rights in sustainable development. In addition, it is important for the state to develop or facilitate appropriate tenure and institutional arrangements to solve access problems; donors can assist with this process.

A bitter lesson is the continuing poor performance of pastoral organizations at the local and national levels. A legal framework for appropriate pastoral tenure has to be negotiated. Donors can and will continue to provide assistance in advocacy and legal support, but the essential impulse and commitment has to come from the herders side. Donors face a big task in stimulating the emergence of more substantial and democratic pastoral organizations, so that these organizations can address policy issues affecting them more strongly.

Finally, an important role is ascribed to the nongovernmental organizations in promoting pastoral development, even though this is limited to local interventions and can rarely take off at a regional or national scale. A pursuit of their actions at a higher level and coordination with donor and government activities may be a step toward increased effectiveness (UNSO et al. 1996).

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3 Public Policy and Drought Management in Agropastoral Systems

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Agropastoral farming systems are well suited to drought-prone areas with low rainfall, where, despite harsh conditions, these systems have provided reasonable sustenance to pastoral societies for generations. Unfortunately, the levels of wealth accumulated in these societies is inadequate for providing full protection from severe droughts, and the economic and human losses in drought periods can be severe. The problem has worsened with population growth, as more and more people seek to earn a livelihood from the meager resources available in these areas. It may also have been aggravated by more frequent and prolonged droughts associated with global warming.

The high cost and the increasing vulnerability of agropastoral societies has led many governments and donors to intervene with various forms of drought assistance. Types and levels of intervention that were unheard of until recently are now common, and seem to be increasing. Many of these interventions are encouraging farming practices that increase both the extent of future drought losses and the dependence of local people on government assistance. They are also costly to governments and donors, and use resources that could otherwise be spent for development purposes. It is important to know if the net benefits from existing types of drought-relief programs justify their costs, particularly when their longer-term impacts on poverty and the environment are assessed. It is also important to know if drought-relief programs can be designed better to achieve their immediate objectives but without distorting economic incentives in inappropriate ways. This chapter addresses these issues.

Nature of Droughts

Droughts are very common in most rangeland areas. These areas have low rainfall on average and high coefficients of variation, hence the probability of rainfall falling below “critical” levels for forage production necessary for sustaining herds is quite common. What is a critical rainfall outcome? Pratt, Le Gall, and de Haan (1997) suggest a drought can be said to occur when rainfall falls below half the long-term average, or when rainfall in two or more successive years falls 75 percent below average. Rainfall failure stunts pastures, desiccates water points, and kills livestock. It leads to the liquidation of a significant part of total herd or flock in the absence of other sources of feed. Moreover, since the main

commercial output of pastoral systems is meat, prices for meat tend to be negatively correlated with drought (more animals are available for sale in drought years), which accentuates income shortfalls. As human populations grow, so do animal stocking rates; and pastures are put under increasing stress, which increases their vulnerability to drought. What used to be a manageable rainfall outcome may now be considered a serious drought that leads to significant economic and social costs.

How Herders Traditionally Manage Droughts

Agropastoral societies have developed their own strategies for reducing their exposure to losses from droughts and for coping when droughts occur. These strategies include

- diversifying into crops and livestock, particularly around settlement areas, and diversifying into different animal species (for example, goats, sheep, cattle, donkeys, and camels) and different breeds;
- carrying extra animals that can be liquidated easily during a drought, either for food or cash;
- adopting mobile or transhumant grazing practices that reduce the risk of having insufficient forage in any one location;
- adopting opportunistic grazing practices whereby herd sizes and stocking rates are adjusted as the rainy season unfolds to best match available grazing resources;
- maintaining reciprocal grazing arrangements with more distant communities for use in drought years;
- maintaining feed reserves or purchasing supplementary feed, such as hay or concentrate;
- investing in wells and cisterns; and
- diversifying into nonagriculture, particularly seasonal migration and non-farm employment.

Traditional risk-management strategies have proved effective in managing drought risk and have enabled pastoral societies to survive harsh environments for many millennia. The interplay between drought and traditional management systems also helped keep total herd sizes in equilibrium with the inherent productivity of the pastures, avoiding any long-term degradation of grazing areas. Stocking rates would trend upward between droughts, as herders bred more animals, but then would be knocked down again when the next drought occurred. Fluctuations in herd size closely followed rainfall patterns, and peak stocking rates rarely reached unsustainable levels.

However, despite their advantages, traditional drought-management strategies can also have associated opportunity costs. Thinking in terms of two types of costs is useful: the opportunity costs arising from inefficient use of resources within existing agropastoral systems, and the opportunity costs arising from

failure to exploit more productive agricultural-development pathways that could change the farming system in fundamental ways.

The first type of opportunity cost may occur, for example, when herders liquidate animals during droughts and then end up with too few animals in the immediate postdrought period—and hence miss out on important short-term production opportunities. On the other hand, given a sufficient respite between droughts, herders may build up excessive herd sizes to have a liquid asset as a hedge against the next drought. This can lead to overgrazing and the degradation of pasture, with reduced productivity. Herders also prefer to keep traditional breeds that are more drought tolerant but less productive. Herders also are often less willing to use or invest in modern inputs (for example, feeds and veterinary treatments) that could increase average profitability but lead to loss of capital investment if rainfall is unfavorable. Surprisingly, little quantitative information seems to be available about these costs, although they could be analyzed relatively easily with the aid of stochastic programming models of problems in household and community decisionmaking.

The second type of opportunity costs are more speculative. If mobility and transhumant grazing practices remain the primary strategy for managing drought risk, communities must retain large areas of land as common properties and retain reciprocal grazing arrangements with other communities for use in drought years. This necessarily restrains the enclosure and privatization of land, which in turn can impede investment in land improvements and the development of more intensive and settled farming systems. Without a shift to such intensification strategies, it is not clear how communities can continue to absorb increases in their populations (Boserup 1981; Pingali et al. 1987). One alternative is for local communities to manage grazing rights to common property more effectively, with collective investment in land improvements. However, the absence of many successful examples suggests that such collective investment is extremely difficult to organize, manage, and sustain—particularly in the context of rapid population growth and the increasing commercialization of agriculture, which make cropping increasingly attractive.

The lack of quantitative information about the opportunity costs of traditional risk-management strategies in agropastoral systems is a problem for the design of good drought-management policies, because their costs should be justified on the basis of the increases in productivity and incomes that they generate. Much more research is needed to determine just how elastic the productivity of pastoral systems are to changes in risk-management opportunities. Are there important opportunities for increasing production that could be exploited if drought risk could be more effectively managed?

Reasons for Public Drought-Management Interventions

If traditional drought-management practices are constraining growth, it is relevant to ask if the problem could be managed more efficiently. This is equivalent

to asking if the government could correct market failures. How might such market failures arise? Two possibilities seem obvious: First, the covariate nature of drought risk makes more efficient risk spreading difficult within pastoral societies; everybody suffers when drought occurs, and local sources of credit dry up just at time when they are most needed. Second, livestock prices plummet during droughts, when everybody is trying to sell, and then rise rapidly afterwards when everybody is trying to buy to rebuild flocks at the same time. Credit and insurance markets for diffusing this covariate risk are weak in many drought-prone rural areas.

Property-rights problems related to the ownership of crop and range land may prevent the spread of management practices and investments that lead to more efficient drought-management strategies. For example, incentives to plant shrubs or build up fodder reserves on range land that is communally owned but ineffectively regulated may be insufficient. Also, without adequate property rights, population growth can lead to excessive stocking rates, and to encroachment of the cultivated area into traditional rangeland areas. These changes in turn can induce degradation of range and soil and, by restricting the spatial mobility of flocks, increase herders' exposure to drought risk.

These kinds of market failures can provide a rationale for public intervention. However, governments might also be motivated to intervene with drought-management policies for other social and environmental reasons, too, including the following:

- Government has an obligation to alleviate human misery in drought years and to help protect the stock of breeding animals for the future. Drought-relief measures may be seen as cheaper than safety-net programs.
- Herders and farmers may default on loans in drought years, causing difficult problems for lending institutions.
- Overgrazing of pastures that are already drought stressed, and soil compaction in areas around water holes, may contribute to wind erosion and local climate changes that are negative externalities for a country.

Economic Aspects of Public Interventions for Drought Management

While humanitarian objectives are often the initial reason for government and donor drought-relief interventions, they can prove economically expensive in the long term if they are not designed to overcome some more fundamental problem, such as a market failure, that prevents more efficient and productive use of resources in agropastoral systems. Moreover, simply being able to fix an underlying problem is not sufficient to ensure that it is economically worthwhile. The problem must also be fixed at a cost that is less than the benefits, and in ways that give a reasonable rate of return on public funds.

Where drought relief is required as a result of market failures (for example, inappropriate property-rights systems, or a poorly developed financial market),

fixing the underlying problem (for example, reforming property rights or strengthening rural financial markets) may be more efficient than incurring the repeated costs of drought relief. Similarly, public-investment opportunities for reducing drought losses (for example, water catchment areas and wells) may also be more cost effective over time than drought relief. Unfortunately, these kinds of opportunities are typically quite limited in many drought-prone areas, and public drought-relief programs may not be an option in the near term.

The costs of public drought-management interventions are relatively easy to determine, but the benefits are much harder to assess. One-time interventions can provide significant humanitarian relief. However, once drought-management policies become institutionalized so that farmers and herders begin to take them for granted, these policies can lead to important changes in farming practices that affect productivity. Well-designed and -implemented drought-management policies can contribute to greater productivity and thereby justify their costs. However, poorly designed interventions may lead to small productivity gains or may even be counterproductive.

Any good risk-management aid should enable farmers and herders to take greater risks in their quest for higher average returns. If farmers are risk averse, they trade off some level of expected income for lower risk (for example, through diversification strategies). The amount of expected income forgone to reduce risk can be viewed as a risk premium paid, or a production cost (Sandmo 1971; Robison and Barry 1987).

If this cost can be reduced by the introduction of an improved risk-management aid, the farmer can change strategy (for example, specialize more in the most profitable activities) and obtain a higher average income for the same amount of risk. This change not only improves expected farm incomes, but can also lead to spillover benefits to consumers at an aggregate level through lower prices as the supply function shifts downward by the amount of the reduction in the risk premium per unit of output. This effect is very similar to the effect of a new cost-reducing technology and, providing the new risk management aid is not subsidized, a net gain in social welfare always occurs (Siamwalla and Valdés 1986).

However, if the new risk-management aid is subsidized, the effect is similar to a subsidy on any other farm input (for example, fertilizer or credit). The reduction in unit costs is partly paid for by the subsidy, and the dead weight loss of the subsidy is always greater than the sum of the additional producer and consumer welfare that it generates (Siamwalla and Valdés 1986). What does this mean in practice? It means that subsidized drought-management interventions reduce risk costs to farmers to below their true social value, leading to excessive risk taking and increased exposure to future drought losses. Not only is dependence on future drought assistance from the government built in, but the net social return to that assistance to the country can be small or even negative. The bottom line is that, wherever possible, public interventions should be limited to drought-management interventions that farmers pay for themselves. In the fol-

lowing section are examples of interventions that led to inappropriate and socially costly responses by herders.

Another potential problem with poorly designed drought-management policies is that they can lead to moral hazard. This is a well-known problem in the insurance literature and refers to the incentive problems that arise when an insurer underwrites risks whose outcomes can be influenced by the insured's behavior. For example, if an insurance company contracts to compensate farmers for yield losses against pest and disease damage, farmers will have reduced incentive to be diligent in protecting or treating their crops once they realize that the insurance will compensate for losses anyway. Moral hazard leads to greater losses than necessary, increases the risk exposure of the insurer, and makes calculating those risks actuarially almost impossible.

Similar problems can arise if government indiscriminately compensates for drought losses that could be reduced or avoided by herders. Unless appropriately targeted, restocking programs could, for example, lead to less-diligent care of livestock during droughts, or even to fraudulent claims for supposedly dead animals that were in fact sold. Such behavior would lead to greater losses than necessary and make restocking programs more expensive than they need be. Similar problems can arise with feed-subsidy programs if the feed is distributed indiscriminately, leading to reduced incentive to exploit remaining grazing opportunities, particularly in more remote areas that require greater time and expense to reach.

Past Experience with Drought-Intervention Policies

Many governments have intervened to help manage drought losses, but usually on the basis of crisis relief once the drought has set in (for example, food for work, distribution of subsidized feeds for livestock, and assistance with restocking). Since the primary motive is typically humanitarian assistance, not much thought is given to the longer-term impacts of drought interventions on farming practices and productivity. This has been especially true of much of the crisis aid provided by donors and nongovernmental organizations. The result is often an inappropriate set of economic signals to farmers and herders, leading to unsustainable farming practices in many drought-prone areas that increase both future drought losses and farmers' dependence on government assistance, and to moral hazard that further add to the government's cost of providing drought compensation.

A good analogy is the experience with hurricane-disaster assistance in the United States. By routinely stepping in to compensate home owners for their losses after a hurricane, the government encourages home construction in vulnerable coastal areas where prudent investors would not otherwise build and encourages fraudulent practices within the home-repair and construction industry. These problems add enormously to the cost of government assistance over time.

Since this chapter is concerned with drought-management policies as an aid to more efficient risk management in agropastoral systems, it focuses on their longer-term impacts on resource management and productivity. Two types of interventions are reviewed: feed subsidies, which have been used widely in the West Asia and North Africa region; and restocking programs, which have become popular in many parts of Sub-Saharan Africa. Both are perceived as longer-term programs rather than as simply ad hoc relief (although they often began that way), and the body of evidence on their impacts is growing.

Feed Subsidies in the West Asia and North Africa Region

Droughts have long been a significant factor in the West Asia and North Africa region, and particularly for the crop–livestock systems of the low-rainfall areas and the vast grazing areas of the steppe. The problems were severe back in biblical times, but as human and livestock numbers have increased over the centuries, the total magnitude of the economic costs caused by droughts has increased at least proportionally. Oram (1998) provides a recent review of some of the consequences of drought for livestock production in the region. In the 1945 Moroccan drought, for example, half of the national sheep flock died, and in the 1981–82 drought, 25 percent of the cattle and 39 percent of the sheep either died or were sold prematurely on a glutted market (Iovanna 1986). In a major drought between 1958 and 1962, at least 70 percent of the then considerable camel herd in Jordan died, leading to a virtual demise of camels as an economic element in livestock production there. In Syria, some 3 million sheep (about 25 percent of the flocks) had to be slaughtered during the 1983–84 drought because of a shortage of feed.

To reduce these kinds of losses, governments throughout the region introduced extensive drought-management policies during recent decades. These interventions focused on providing supplementary feeds to safeguard livestock, with the predominant expenditure going for subsidies toward the costs and distribution (usually by parastatals) of concentrates and other feeds. Barley is the most commonly subsidized feed, and the extent of the subsidy extends to as much as 32 percent in Tunisia and 50 percent in Morocco. Feed imports are also relaxed in drought years, while imports of livestock and livestock products are constrained to maintain domestic prices.

These programs have been very successful in protecting livestock numbers and production during droughts. Although the 1995 Moroccan drought was devastating—with total cereal production falling to only 17 percent of that in the good 1994 season—the ruminant livestock sector was barely affected (Laamari and El-Mourid 1998). In Tunisia, Boughanmi (1996) estimates that sheep numbers rose consistently during the droughts of the early 1990s, while the World Bank estimates that, in the absence of the drought relief measures, producer prices would have dropped by approximately 40 percent during the 1988–89 drought (World Bank 1995). According to the Bank, potential losses to producers during 1988 and 1989 could have been 119.7 million dinars (\$133 million),

and this was prevented by a program that cost 74 million dinars (\$82 million). By preventing the large-scale loss of livestock, the interventions also avoided production losses in subsequent years, too, but these are not included in the World Bank's calculation.

Although they have helped limit production losses caused by drought, the drought-management programs have also had negative impacts:

- They have accelerated rangeland degradation in the long term by undermining the normal process of adjusting flock size to interannual climatic variations. Herd sizes have increased sharply in recent years, and grazing practices have changed so that many of the animals no longer leave the rangeland areas during the dry season but have their feed and water trucked in. This practice leads to overgrazing during the dry season, prevents the natural seeding of annual pasture species, and disturbs the soil and contributes to wind erosion, particularly in areas near water and feed supply-points. The degradation of the range and soil has been exasperated by high government procurement prices for barley, which has encouraged the mechanized encroachment of barley cultivation into rangeland areas where it cannot be sustained.
- They have added to the fiscal burden on governments. During the 1994 drought, for example, some 500,000 tons of heavily subsidized concentrate were fed to livestock under the program in Tunisia. Even larger amounts were distributed during the 1988–89 drought at a cost to the government of 74 million dinars (\$82 million). In Morocco, an estimated 420,000 tons of feed were distributed during the 1992 drought—at a cost to the government of about \$30 million (Laamari and El-Mourid 1998). The same program cost the government about \$28 million during the 1995 drought. In Jordan, cumulative feed-subsidy costs between 1991 and 1996 were 168.4 million dinars (\$116 million), and \$55 million of this was incurred in the 1996 drought alone (Salem 1998).
- They have proved difficult to target, with the lion's share of the subsidized concentrates going to large herders and to commercial farms. Indeed, during the Moroccan drought of 1992, many farmers received only small amounts of subsidized feed—about 1 percent of total feed needs (Laamari and El-Mourid 1998).
- They have a tendency to become permanent. Many West Asia and North Africa countries quickly moved to permanent feed-subsidy systems and now expend considerable public resources on the distribution of heavily subsidized concentrates every year (Pratt, Le Gall, and de Haan 1997).

The high budgetary cost and the negative environmental impacts have now led some countries to reconsider their drought-management programs. Jordan recently abolished its feed-subsidy program as part of its structural adjustment program, which has led to a very sizeable reduction in the national flock of sheep and goats (perhaps by as much as 40 percent in two years). Syria main-

tains its feed-subsidy program but has now banned the cultivation of barley in many of the steppe areas.

Restocking Policies in Sub-Saharan Africa

The primary objective of restocking programs is to help herders reestablish their herd sizes as quickly as possible after a drought. Traditionally, herders often sought to contract out the management of part of their herd in drought years to nomadic herders who could take the animals to other regions for the duration of the drought. Their return with the rains had much the same effect as a contemporary restocking program. The simplest interventionist schemes amount to little more than targeted handouts of live animals during the recovery period, usually to the most impoverished herders.

However, more complete approaches seek to provide a better balance between fodder availability and livestock numbers throughout the drought cycle, as well as to help stabilize livestock prices. This can be achieved by buying up animals at some reasonable price during the drought, when fodder is scarce, and then reselling animals back to herders at the same or slightly higher price once drought recovery begins. This approach is sometimes characterized as a livestock bank, in which animals are essentially deposited into a savings account for the duration of the drought (Blench and Marriage 1998). Difficulties can obviously arise in setting targets for the number of animals to buy or sell: should the scheme simply buy or sell all the animals herders want to trade, or should a proactive attempt be made to monitor livestock numbers and the available fodder supplies and to seek a level of trade that keeps the two in rough balance (for example, Toulmin's "tracking strategy")?

Difficult questions also arise about where the purchased animals will be parked during the drought, and who will look after them and pay the costs. At least with feed subsidies, the herders continue to look after the animals themselves during the drought at no additional cost to the government. Also, if the program seeks to influence livestock prices through its market activities, what will stop animals' being brought into the region from elsewhere to take advantage of the higher purchase prices paid by the program during the drought, or of animals' being purchased at the program's lower selling prices in the post-drought period for transport to other regions?

Proponents of restocking programs claim a number of advantages, including the following:

- Restocking helps protect the capital assets of herders and enhances their food security.
- If the animals sold or given away are targeted to the more impoverished herders, restocking can help achieve a more equitable distribution of livestock and a more equitable use of common grazing areas.
- Restocking enables herders to more quickly build up their herds after a drought, and to take maximum advantage of grazing resources as they recover.

- Restocking can help get herders away from settlement areas and relief-distribution points that are overcrowded and degraded to more remote areas that are underused, with positive environmental benefits.
- If herders know that they can restock quickly after a drought and at a reasonable price, they are less likely to carry too many animals into the drought and can adjust their herd-culling practices during the drought to enhance overall productivity.
- By providing the animals and not just the means to purchase them, restocking helps to avoid inflation in livestock prices in the immediate postdrought period. This contrasts with credit or other forms of financial assistance for postdrought recovery that merely give herders the financial resources to bid for the remaining stock of live animals in the market.

In recent years, restocking programs have been widely promoted by non-governmental organizations and governments across Africa (Heffernan and Rushton 1998). Heffernan (1998) estimates that at least \$100 million has been spent on restocking programs in Sub-Saharan Africa in the past decade, although this has not all been in response to drought. However, so far, little attempt has been made to rigorously monitor the impact of restocking programs on the productivity of pastoral systems, and economic analyses of their costs and benefits are not yet available. Anecdotal evidence suggests that livestock traders have been important beneficiaries from some restocking programs, and that any equity improvements in the distribution of livestock are short lived. There is also some evidence to show that impoverished herders have increased their incomes and consumption in the short term as a result of receiving livestock, but this should hardly be surprising and typically results from any direct-income or wealth-transfer program.

New Possibilities for Improved Drought Management

A limitation of most drought-management interventions is that they inadvertently subsidize inappropriate farming practices and encourage moral hazard. They also represent a fiscal burden to governments and donors that may be hard to sustain over the years. Two newly emerging approaches offer avoidance of these problems by providing farmers and herders with the means to better manage drought risks themselves, with minimal government intervention.

Rainfall Insurance

Agricultural insurance has often appealed to policymakers as an instrument of choice for helping farmers and agricultural banks manage climate risks, such as drought. Indeed, many billions of dollars of public money is spent each year on agricultural insurance around the world. However, the experience has generally not been favorable (Hazell, Pomareda, and Valdés 1986). Publicly provided crop insurance has without exception depended on massive subsidies from govern-

ment. Even then the performance of such insurance has been plagued by the moral hazard associated with many sources of yield loss: high administration costs, political interference (especially with compensation payments in election years), and the difficulties of maintaining the managerial and financial integrity of the insurer when government underwrites all losses (Hazell 1992).

Livestock insurance that compensates for loss of animals or reduced productivity because of drought has rarely been offered, and seemingly not at all for herders in traditional pastoral systems. There are good reasons for this: the incidence of drought losses is usually too high to make the insurance affordable; opportunities for fraud and moral hazard are too great; and there is little opportunity for on-farm inspection of management practices or loss assessments, particularly when the animals are on the move.

However, given the frequent occurrence of drought and the widespread damage that it causes, some form of insurance against drought losses is clearly needed. Indeed, if such insurance could be successfully designed, it might well displace the need for public drought-management policies. What is needed is a form of insurance that is affordable; is accessible to all kinds of people, including the poor; compensates for total income losses to protect consumption and debt repayment capacity; is practical to implement given the limited kinds of data available; and can be provided by the private sector without the need for government subsidies.

Area-based rainfall insurance offers a promising new alternative that in principle can meet all the requirements listed above (Skees, Hazell, and Miranda 1999). In this approach, rainfall insurance contracts are written against specific rainfall outcomes (for example, drought or flood) at a local weather station. The rainfall events should be defined at catastrophic levels, and they should be highly correlated with the value of regional agricultural production or income. For example, an insured event might be that rainfall during the most critical month of the growing season falls 70 percent below normal. In years when the insured event occurs, all the people who purchased the insurance receive the same payment per unit of insurance. In all other years, no payments are made.

Insurance is sold in standard units (for example, \$10 or \$100), with a standard contract for each unit purchased, called a Standard Unit Contract. Purchasers decide how many of these contracts to buy. The insurance is sold on a full-cost basis, and the price of the Standard Unit Contract is the premium. The insurance must be sold before season-specific information about the insured risk becomes available. This requires a purchasing deadline (such as a month before the normal arrival of the rainy season), after which new contracts are not sold.

Area-based rainfall insurance has a number of attractive features:

- It avoids all the moral hazard and adverse-selection problems that plague crop-insurance programs.
- It could be very inexpensive to administer.
- It uses only rainfall data, which are available in most countries for long periods of time.

- The insurance can be sold to anyone, including agricultural traders and processors, farm-input suppliers, banks, shopkeepers, and agricultural workers.
- It would be easy for the private sector to run.
- As long as the insurance is voluntary and unsubsidized, it will only be purchased when it is a less-expensive or more-effective alternative to existing risk-management strategies.
- A secondary market for insurance certificates could emerge that would enable people to cash in the tradable value of a Standard Unit Contract at any time.

In designing an area-based rainfall insurance scheme, a number of difficulties need to be overcome, including the following:

- The insurer faces high risk because of the covariate nature of the insured risk. When a payment is due, all those who have purchased insurance against the same weather station must be paid at the same time. Moreover, if the insured risks at different rainfall stations are highly correlated, the insurer faces the possibility of having to make huge payments in the same year. To hedge against this risk, the insurer can either diversify regionally by selecting weather stations and risks that are not highly (positively) correlated, or seek reinsurance in the international financial markets.
- Rainfall stations must be protected to prevent possible tampering of rainfall measurements. Possible approaches include more secure, tamper-proof stations and instruments.
- The actuarial soundness of the insurance could be undermined by El Niño weather cycles that change the probability of the insured events. It may be necessary to adjust the cost of the insurance whenever an El Niño event is confirmed.
- The volume of insurance sold could be too small to be profitable. The insurance will only appeal to people whose economic losses are highly correlated with the insured rainfall event. If the basis risk (the uninsured part of a person's risk) is high, the insurance will not sell. Also, if the probability of the insured risk is high, the cost of the insurance could be prohibitive. To overcome these problems, the insurance should be limited to truly catastrophic droughts that significantly affect agricultural production in a region.

The private sector might be expected to take the initiative in developing rainfall insurance, but several setup problems might require government intervention to jump-start activity in developing countries. These include paying the research costs of identifying key catastrophic rainfall events that correlate strongly with agricultural production and income, educating rural people about the value of rainfall insurance, ensuring secure rainfall stations, establishing an appropriate legal and regulatory framework for rainfall insurance, and under-

writing the insurance in some way (perhaps through contingent loans) until a sufficient volume of business has been established that international reinsurers or banks are willing to come in and assume the underwriting role. These roles need not be costly but could prove crucial in launching rainfall insurance. However, it is also important not to launch the insurance on a subsidized basis, so as not to distort incentives for private insurers or farmers and herders.

Early-Warning Forecasts of Drought

In principle, the ability to provide early-warning forecasts of drought could be a powerful tool for avoiding many of the economic costs associated with the misallocation of resources that arise because farmers, herders, and other decisionmakers have to commit resources each year before key rainfall outcomes are known. For example, decisions about planting crops (including the date of planting, the seeding rate, and initial fertilizer treatment) often have to be made at the beginning of the wet season—before knowledge about rainfall outcomes is available. The economic value of season-specific forecasts really depends on the degree to which farmers can adjust their plans as the season's rainfall unfolds. If decisions about planting and cultivation practices—and the feeding, culling and seasonal movement of livestock—can be sequenced, with key decisions being postponed until key rainfall data are available, forecast information will be less valuable. However, if most decisions have to be made up front each season, the scope for mistakes will be much larger and the potential economic gains from reliable forecast information will be greater.

Stewart (1991) examines how the date of onset of the rainy season can provide a useful forecast of the ensuing seasonal rainfall pattern for Niamey, Niger, and shows how this information could be used to adjust planting and input decisions more optimally for the season (his “response” farming approach). Barbier and Hazell (Chapter 14) use a stochastic programming model to show how many of the decisions in a typical agropastoral community in Niger can be optimally adjusted to rainfall outcomes.

Reliable drought forecasts could also enable governments and relief agencies to position themselves each year for more effective and cost-efficient drought interventions. This possibility has already been realized, and several early-warning drought-systems are already in place in Africa that have proved successful in giving advance notice of emerging drought situations. However, these programs are really monitoring systems that track emerging rainfall patterns within a season rather than true weather-forecasting systems that predict rainfall outcomes before they even begin.

Reliable multiyear rainfall forecasts are not yet possible, but seasonal (from three to six months out) forecasts have become more reliable, particularly where an important part of the year-to-year variation in seasonal rainfall can be attributed to the Pacific El Niño Southern Oscillation weather patterns. As the ability to model these phenomena at the global and regional levels improves, it seems plausible to expect that more-reliable seasonal forecasts will be available

at more local levels (Gibberd et al. 1995). This may prove to be one of the most exciting developments for drought management in the next few years. Private weather-forecasting services are likely to expand and become more available to developing countries. However, this is also an area where government could play a catalytic role, and even subsidize many of the development costs without having to worry that this would distort resource-management incentives at the farm level.

Conclusions

The need to provide improved methods for managing drought risks in agropastoral systems has increased in recent decades as population growth and climate change have contributed to greater demands on the resource base and accentuated both the incidence and severity of drought losses. Government and donor interventions have typically been initiated on an ad hoc basis in response to crisis situations, and little thought is usually given to their long-term impacts on the way farmers and herders manage resources and the productivity of agropastoral systems.

Evidence is now accumulating that shows that, once drought-management interventions are institutionalized, they do lead to changes in the way resources are managed, including increased cropping and privatization of rangeland resources. These interventions also lead to more-settled patterns of livestock production. These changes can contribute to greater productivity and improved livelihoods. However, if drought-management interventions are subsidized, they can also lead to the adoption of excessively risky farm-management practices, with increased losses in drought years and a growing dependence on government assistance.

Many drought-management programs also contribute to moral hazard because they reduce incentives for prudent management by farmers and herders. Drought-management interventions need to be designed so that they assist farmers and herders to better manage risk and to improve their productivity and incomes, but without distorting incentives in inappropriate ways. The experience with feed-subsidy programs in the West Asia and North Africa region and with restocking projects in Sub-Saharan Africa have had mixed results. While they have helped protect incomes and food security in drought years, they have also had negative impacts on the way resources are managed. Better alternatives could be area-based rainfall insurance, particularly if offered by the private sector, and the development of more accurate and accessible drought-forecasting information.

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4 Managing Mobility in African Rangelands

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In recent years, a clearer understanding of the complexities of pastoral development has been arising on the basis of work done by African and international researchers and development practitioners. They are refuting the causality of notions normally attributed to pastoralism, such as land mismanagement and degradation. They are also showing how extensive pastoral production has been underestimated, not only in terms of its economic contribution, but also in terms of its environmental benefits. The current paradigm, also called the “mobility paradigm,” supports the notion that extensive, mobile pastoral production can be both sustainable and environmentally friendly, if the social, economic, and political constraints to its full development are lifted.

The objectives of this chapter are to review briefly the current paradigm in terms of the benefits it attributes to mobility, to show what happens when mobility declines, to provide a brief diagnosis of what impact development assistance has had on pastoral mobility, and finally, to provide recommendations on how pastoral mobility can be effectively supported.

The focus of this chapter is on arid lands, where crop production is a marginal, and usually ecologically inappropriate, activity. However, the concepts and recommendations can be applied to semi-arid lands to improve the already fast-growing trend of integration of crop and livestock systems. In some cases—for example, in western Niger—as the percentage of cropped land increases beyond a certain threshold, livestock become more mobile, rather than more sedentary. This is because of the lack of sufficient pasture around villages, the need to avoid damage to crops, and inadequate access to industrial or other supplementation (Pierre Hiernaux, in a personal communication).

The term “pastoralist” is defined as a mode of production where livestock make up 50 percent or more of the economic portfolio of a smallholder (Sandford 1983). This chapter focuses on mobile or transhumant pastoralists. The term “transhumance” refers to regular seasonal movements of livestock between well-defined pasture areas (dry to wet season, or low to highland). It can cover a wide range of pastoral production systems, ranging from fully transhumant systems, such as among the northern Mauritians and Namibians, to systems such as used by the Nilotic tribes of east Africa, the Berber of the High Atlas, and herders in Morocco and Ethiopia. Transhumance also applies to settled populations who send their livestock short distances to pasture, such as in Zimbabwe. All these systems have several elements in common:

- They rely on common property (pastures, forests, and natural waters).

- They normally occupy arid lands with less than 400 millimeters of annual rainfall.
- Mobility is managed by herders, rather than by fencing.

The recognition of the importance of mobility for pastoral systems is not new. Transhumants have known it all along, and early ethnographers catalogued its various manifestations and adaptive mechanisms. What is new is a convergence of several scientific fields (ecology, anthropology, economics, and institutions) into a more or less holistic paradigm, matched by the ability of researchers and development workers alike to conduct integrated discourse and actions, and supported by greater possibilities for participation in this discourse by mobile pastoralists themselves. The mobility paradigm, therefore, should be seen as the current culmination of a historical evolution of ideas and actions, amalgamated into an approach quite different from what, for convenience sake, can be called the old or “classical” paradigm.

On the Importance of Mobility to Pastoralists

Livestock mobility is one of the major ways in which African pastoralists have historically managed uncertainty and risk in arid lands (Bassett 1986; Scoones 1994). The literature and evidence on other adaptive mechanisms, such as herd diversification, stratification, and drought-buffering mechanisms, is quite extensive and will not be discussed here (see, for example, Bovin and Manger 1990). Rather, the focus is on the mobility of animals, as this provides pastoralists with effective ways to meet many needs. Mobility can address socioeconomic objectives, such as access to a diverse range of markets, symbiotic interactions with farming communities (for example, exchanging manure for feed), and cultural gatherings where livestock are part of the sociopolitical transactions.

Mobility is also an adaptive tool that serves several aspects of livestock production simultaneously. One benefit is the provision of fodder to livestock at minimal labor and lower economic cost. Extensive livestock-production, taking livestock to feed and water, is less costly than bringing feed and water to livestock, because of lower labor demand, and lower inputs (for example, housing and troughs). Mobility (and the other side of the coin, dispersion) have been correlated with increasing the resistance of animals to diseases, and decreasing their vulnerability to outbreaks (Roeder 1996). Since the arid ecosystem’s productivity is spatially and temporally variable and to a large degree unpredictable, mobility enables the opportunistic use of resources. This includes moving to minimize the effects and impacts of droughts, and being able to use underused pastures distant from settlements, or those that are only seasonally available.

However, it is the growing understanding of the relationship between mobility and ecological health that has contributed the most to the mobility paradigm. Ecological studies undertaken in the arid lands show that climate appears to be a more significant factor in determining vegetation structure, function, and

dynamics than either grazing or internal ecological processes (for example, Walker et al. 1981; Behnke, Scoones, and Kerven 1993; O'Connor and Roux 1995; Behnke and Abel 1996; Hiernaux 1996). This does not mean, however, that grazing does not affect vegetation dynamics; only that its impact is very much determined by climatic variability. Continuous, sedentary grazing in the wet season has been shown to result in lower pasture palatability and productivity in Sahelian vegetation (Hiernaux, personal communication from International Crops Research Institute for the Semi-Arid Tropics, or ICRISAT, Niger data). There is also evidence that in some areas undergrazing of remote pastures, as a result of sedentarization, is a more serious problem than overgrazing (Galaty 1988; Warren and Rajasekaran 1993). For example, piosphere (vegetal zones related to watering points) studies around agropastoral villages in north-eastern Senegal show that undergrazing of distant pastures results in lower palatability of primary productivity, lower phosphorus content of topsoil, lower herbaceous density, and lower biomass production (Niamir 1987). Thus the new range ecology postulates that, for grazing to have little or no negative impact on arid rangelands, it must follow or "track" climatic variability.

The recently emerging "new ecology" questions the core assumptions of the science of ecology, including that of equilibrium ecological theory (Botkin 1990; Allen and Hoekstra 1992). Classical equilibrium theory is unable to capture the uncertainty and variability in arid ecosystems (Westoby, Walker, and Now-Meir 1989; Behnke, Scoones, and Kerven 1993; Scoones 1994), making such concepts as carrying capacity and stocking rate ineffective in predicting ecosystem productivity and dynamics at the scale necessary for local-level management. These concepts may be useful only at larger spatial and temporal scales, such as at the level of national and international policymaking.

The arid ecosystem appears to be constantly changing from one state or level to another, making the defining of a stable, equilibrium state difficult or even impossible. Whether the system can be characterized as "multiple equilibrium," "dynamic equilibrium" or "nonequilibrium" is still a matter of debate, and perhaps of disagreement over semantics. However, for the sake of convenience, the term "nonequilibrium" is used as a generic term to mean any kind of system that is not in equilibrium, according to I. Noy-Meir (in personal communication, 1997).

Defining conditions of land degradation under a nonequilibrium theory is more difficult than under an equilibrium one. Remote-sensing work has found that interannual variations in rainfall and vegetation structure are so high that they require decades-long monitoring to detect expansion or contraction of the Sahara (Tucker, Dregne, and Newcomb 1991). More recent research (Ellis and Swift 1988; Behnke 1997) has provided support for the following arguments:

- The scale and magnitude of *persistent* environmental decline in dryland Africa has been overestimated.
- The role of livestock grazing in these changes has been overestimated.

- The pattern of anthropogenic land degradation is much more severe around permanent settlement sites than it is in open rangelands because of concentration of pressure (deforestation, overcultivation, and overgrazing).

The lower the rainfall is, the higher is the spatial and temporal variability of primary productivity (IUCN 1989). Temporal variability is manifested by seasonal and yearly changes in rainfall, which in arid lands can have a coefficient of variability as high as 40 percent. Spatial variability refers not only to different ecozones and their transition zones, but also to heterogeneity at the microlevel, or “patchiness” (de Angelis and Waterhouse 1987; Scoones 1991). In the Mediterranean climates of northern Africa, temperature (cool moist winters, hot dry summers) is an added factor.

An ecosystem that may be functioning according to a nonequilibrium theory would require a different management style than an equilibrium system. In the absence of economically feasible technologies for controlling environmental forces, land-use patterns would have to adapt to the variability and uncertainty of rainfall using strategies that are “opportunistic,”¹ flexible, and mobile (Behnke, Scoones, and Kerven 1993). Transhumants are well aware of these forces and manipulate the two factors of space and time through their mobility and common-property regimes.

Common-pool resources, because of the difficulty or high cost to divide, exclude, or bound them, are often considered as common property (Ostrom 1990). The drier the ecosystem is, the greater is the incentive to manage the natural resource communally.² In arid lands, uncertainty is high, and the risks of production and survival are higher. The risk burden is too much for an individual to bear; therefore, common-property regimes are devised to share the risk and spread the burden. The productivity of arid and semi-arid lands is both marginal and variable, and therefore these areas have a benefit–cost ratio that discourages investment in exclusionary, private, mechanisms (Dyson-Hudson and Smith 1978; Bromley 1989; Ostrom 1990; Behnke, Scoones, and Kerven 1993).

An opportunistic stocking strategy requires that mobility patterns adapt to both herd sizes and variability in primary productivity. High primary productivity in good years provides an incentive to herders to reduce mobility, but they have to balance that with the needs of a larger herd. A smaller herd could be kept closer to home, but in bad years may need to be taken further afield to reach pockets of good feed.

¹ The term “opportunistic” is used in this context not in its negative sense (exploiting opportunities without regard to ethical or moral principles), but in the positive sense of taking advantage of opportunities as they present themselves.

² See, for example, papers from the Property Rights and Performance of Natural Resource Systems Workshop, The Beijer International Institute of Ecological Economics, September 1993.

One important mechanism that allows opportunistic use is the “tracking” of ecological variability, both spatially and temporally. Herders and scouts track the ecosystem by constant monitoring and adjust the behavior of their animals accordingly (Scoones 1994; Niamir 1997). Tracking is possible if there is freedom of movement, and specialized labor and talent for tracking and evaluating ecological processes. Scouts must monitor indicators that are sensitive to ecological changes. Indigenous African indicators are sensitive to both the variability in the ecosystem, and its condition at any point in time. Table 4.1 provides some examples of indigenous indicators.

Recently various studies are showing that mobile production systems in Africa appear to be more economically efficient than sedentary systems, even more so than commercial ranching. If flexible access to different habitats and resources is ensured, higher populations of herbivores can be maintained in any given area (de Ridder and Wagenar 1984; Westoby, Walker, and Noy-Meir 1989; Scoones 1993). For example, studies in Zimbabwe, Botswana, Uganda, and Mali show that overall returns per hectare (counting all products, not just meat) are higher in mobile pastoral systems than in agropastoral or commercial systems (Sandford 1983; Scoones 1994). However, productivity per animal is lower, primarily because of the lack of external supplementation and low veterinary input.

Another benefit of mobility is its deliberate use for contributing to pasture sustainability and improvement. The mobility of neighboring pastoral herds is a form of spatial and temporal choreography determined by the nutritional needs of the livestock portfolio, informal rules that determine precedence, degree of concentration and length of grazing (that is, effective grazing pressure), and “safe” distance or dispersion between herds (disease or social relationships). Many examples of macro-scaled movements can be found in the literature, for example, among the Twareg (Winter 1984), the Tswana (Schapera 1940), and the Somali (Rabeh 1984). However, the detailed choreography, or day-to-day dynamic mapping of movements, has not been effectively studied yet. This choreography of movements resembles rest-rotation schemes, albeit less strictly organized, and because of the twin factors of dispersion and frequent movement, contributes to pasture sustainability.

Traditionally, range-improvement techniques relied on fire (for example, Ware 1977); modifying the grazing behavior, and therefore the animal-plant relationship; and changing the herd composition. For example, goats were used to control bushland (Legesse 1984). Many transhumant groups had range reserves that were used as fodder banks for bad times, or as deliberate exclosures for ensuring spontaneous regeneration (Odell 1982). None of these techniques is feasible unless herds are mobile. Mobility is an effective tool for range improvement, as it provides the herder flexibility to modify herds, and access to alternative pasture areas, while waiting for spontaneous regeneration of degraded pastures.

TABLE 4.1 How transhumants track ecosystem processes—some examples

Ecological processes tracked	Examples of descriptive and trend variables	Examples of indicators	References
Climate	Calendars that are more flexible than western	Behavior of fauna	Gulliver 1970
	Wodaabé Fulani's having 8 seasons or years combining climatic variation with changes in plant phenology	Changes in plant phenology	Knight 1974 Jackson 1982
	Turkana's memory of drought patterns: one in every 4 or 5 years being a good wet season	Changes in meteorological conditions (for example, air temperature, and lightning patterns)	Ba 1982 Maliki et al. 1984
Soil agricultural potential	Soil described according to type, moisture content, geomorphology, mineral content, color, and topography	Specific plant indicators	Knight 1974
	Soil described according to potential for forage or crops or trees	Topography	Tubiana and Tubiana 1977
		Shade	Maliki et al. 1984
		Disease and parasites	Winter 1984
		Soil color and texture	Oba 1985
			Stiles and Kassam 1986
Ground-water availability	Water table described according to water pressure, depth to water, and soil profile	Specific plant indicators and vegetation community types	Tubiana and Tubiana 1977
		Topography	Ba 1982
	Water location described according to forage availability	Specific wild fauna as indicators	
		Forage quality (leafiness, greenness, no trampling)	
		Tree cover	
	Presence or absence of wild fauna indicator species		

TABLE 4.1 (*continued*)

Ecological processes tracked	Examples of descriptive and trend variables	Examples of indicators	References
		Water quality and quantity	
		Livestock behavior (restlessness and stampedes, luster of coat, feces quality, and number of cows in heat)	
Temporal environmental variability	Changes with drought and other rainfall variation in plant community described Future changes predicted Morphology and phenology of plants that allow resistance to stress and adaptation to drought determined	Vegetation diversity	Knight 1974
		Specific indicator plants	Benoit 1978
		Vegetation cover	Bernus 1979
		Livestock behavior	
		Preceding season's meteorological conditions	
Environmental degradation	Types of degradation classified Stages of degradation are classified Causes determined	Specific indicator plants	Spencer 1965 Marchal 1983
		Plant composition	Benoit 1978
		Soil cover and compaction	Clyburn 1978 Niamir 1982
		Grazing pressure (trampling and feces)	Western 1982
		Livestock behavior (especially milk yield)	Homewood and Rodgers 1984

SOURCE: Niamir 1997.

The Decline of Mobility and Its Impact on Pastoralists

Pastoral ecosystems in the last century were relatively healthy despite several severe drought episodes (Cissoko 1968; Waller 1985; Gritzner 1988; Smith 1992). A combination of important factors explains this phenomenon, among which can be cited lower human population density, land-tenure security's being

vested in customary communal institutions and mobility of animals, traditional adaptive mechanisms, and indigenous techniques for natural-resource management and improvement.

The events of the last century have modified these systems sometimes to the point of not being recognizable. Livestock mobility has declined, as evidenced by high rates of sedentarization, a reduction in daily grazing radii around encampment points, reduction in movements among encampment points within a pastoral area, and decrease in the frequency and distance of historic transhumance movements. Spontaneous sedentarization has been driven by a combination of factors that interact and reinforce each other:

- Major droughts
- Differential government support of agriculture
- Lack of government support for transhumance
- The “benign neglect” syndrome (Swift 1993)
- Population- and policy-driven extension of cultivation into rangelands
- Increased individualization and disruption of political structures within pastoral societies
- Central-government claims to “vacant” pastoral land (government-owned farms and national parks)
- Increased competition and conflicts over land
- Increased ownership by investors outside of the pastoral sector
- Growing economic vulnerability of transhumant groups.

The major droughts of the 1970s and 1980s forced a mass movement of herders in the Sahel toward the south, with most converting into agropastoralists and some completely settling, but it is not known how many have been able to return to their previous transhumance system since then. According to Thébaud (1998), if after 10 years a sedentarized household has not been able to amass enough capital to reinvest in livestock, it will probably never be able to return to transhumance.

Among pastoralists who have managed to remain mobile, the decline in the frequency and distance of livestock mobility is due largely to agricultural encroachment onto rangelands, by both farmers and agropastoralists, leading to a general shortage in pasture area and blocking of traditional transhumance routes.

Government policies since colonial times have favored crops over livestock. High import duties aimed at protecting domestic cereal prices, and subsidies on fertilizers and fuel (acting as an indirect subsidy on tractors), have stimulated the expansion of crops into rangelands (Little, Horowitz, and Nyerges 1987; Lane 1991; Niamir, Lugando, and Kundy 1994; Steinfeld, de Hahn, and Blackburn 1997). The more productive pastures are the first to go. The exclusion of transhumants from these “key pastoral resources” can lead to significant disruption of the annual transhumance cycle. These policies have upset the economic balance that existed between crops and livestock, making the latter far

less profitable, and discouraging investments into improving the range and livestock sector.

The earliest forms of livestock development in Africa involved incentives for settlement, such as ranching, destocking, and specialization (often called “stratification”) between reproduction and fattening (Ndagala 1982; Oxby 1982; Joof et al. 1988; Peluso 1993; Neumann 1995). Settlement schemes are justified by governments with a promise of socioeconomic benefits (services, inputs, water, markets, and infrastructure). However, these services rarely materialize, because they are implemented as public goods that are too costly for most governments.

Settlement schemes have failed not just on economic grounds, but also on ecological grounds (Sandford 1983; Homewood and Rogers 1987; de Haan 1994). Sedentarization of pastoralists, whether forced or spontaneous, has resulted in severe land degradation in the semi-arid zones. Decreased mobility of animals means increased continuous grazing around the settlements, resulting in reduced vegetation diversity and soil degradation. At the same time, as mentioned earlier, lower grazing pressure in distant pastures results in an invasion of unpalatable plants. Settlement also results in a loss of traditional knowledge about and controls on range use, leading to less-efficient management of the arid resources (Jacobs 1980; Farah 1993). Sedentarization does have positive results—such as providing access to local authorities, education, and health—but the benefits are not as evident for all. Only those elites with means can escape the negative impacts of sedentarization.

Customary sociopolitical systems have been subsumed under the hegemony of the central state (nation), leading to a weakening of the traditional leadership, and a fragmentation of authority. The customary judicial system has been relegated to deal with relatively minor internal conflicts. Communally held land (the ownership of which was generally vested in a deity) has been abrogated by the nation-state, often under the pretense that they are not being put to productive use, resulting in a breakdown of common-property regimes.

In addition, the growth of rural labor markets and commodification of agriculture have in part contributed to individualization, increased stress between elders and juniors or between the elite and other members of society, and reduced the cohesiveness of transhumant social formations (Dalli and Ezeomah 1988). Since pastoral mobility requires management and political coordination, these changes have led to a reduction in transhumance movements that are coordinated at a higher level in areas affected by agricultural encroachment and political instability. Pockets of “resistance” can still be found in remote, mostly marginal areas, where customary systems survive (for example, northern Sudan and southern Morocco), but they are becoming fewer and fewer.

Lowering of standards of living and a decapitalization of livestock wealth are increasingly common among mobile pastoralists. Between 1900 and 1990, the average livestock holding per household in Karamoja decreased from 100 to 28 (Niamir-Fuller forthcoming). Part of the loss has been compensated with al-

ternative income sources, especially crops and hired labor. The continuing decline in living standards among most mobile pastoralists is manifested by the high rate of outmigration toward smaller towns and cities (Ole Kuney and Lendiy 1994), or toward large-scale sedentarization, as in Tunisia (Bedrani 1987).

Another trend since the 1970s is the increasing concentration of wealth in the hands of a few. It is common to find that about 15 percent of the population controls 80 percent of the livestock (Little 1985; Sutter 1987; Ndagala 1991). Increasingly, the large owners are investors from outside the traditional transhumant sector, who entrust livestock to mobile families or hire herders for a wage (Little 1985; Turner 1992; Bassett 1994). Often these new owners, to maintain oversight of their wealth, place limits on the mobility of the herd.

The gradual disintegration of customary institutions responsible for managing natural resources has provided the opportunity for proponents of privatization to push through their particular agenda of land reform, resulting in widespread alienation of land. Evidence can be cited from Uganda, in Bazaara (1994); Kenya, in Fratkin (1994); and Namibia, in Cox et al. (1998). The rate of land expropriation is so severe now that it has been labeled a "land crisis." Many pastoral advocates and organizations are calling for an immediate moratorium on land titling until land rights can be equitably regularized (for example, Niamir 1994; Salzman 1994).

Impact of Development Assistance on Pastoral Mobility

Pastoral development as such is a relatively new paradigm that began in the mid-1980s in Africa with the advent of "natural-resource management projects." Before that, and going back to the colonial era, the focus was mainly on the development of livestock productivity rather than on the enhancement of livelihoods.³ The main objective of the livestock-development paradigm was to increase exports of products to urban centers and international markets. The main interventions were the application of the classical "ranching" model from the United States, water-point development, and vaccinations against contagious diseases and epidemics.

The ranching model encouraged sedentarization, destocking, and water development. However, these were unsuccessful in increasing livestock productivity, at best, and in some cases were very destructive in the long run (Sandford 1983). The success of veterinary interventions is subject to debate. Claims have been made to the effect that these interventions were so successful that they resulted in an increase in livestock populations beyond the carrying capacity of the

³ Every rule has exceptions. As early as the 1940s the British Colonialists introduced pastoral development in Kenya and Rhodesia; however, the schemes were not very successful.

land, thus contributing to land degradation (for example, Mamdani, Kasoma, and Latende 1992). Others believe that the interventions were neither so effective, nor so widespread, as to make such an impact (Roeder 1996). Most tanks for dipping livestock in pesticides have fallen in disrepair, and veterinary medicines are hard to come by for those living in remote areas.

At the same time, in Francophone West Africa, efforts were made to regularize transhumance by creating official routes. Transhumance permits were issued, and cross-border movements were supervised, although most transhumants avoided these bureaucratic measures. Some investment was put into building watering points and quarantine stations along the official routes, but the efforts were underfunded (therefore too dispersed to make an impact) and not maintained in the long run.

In recognition of these problems, the classical “range and livestock development” projects were transformed into “integrated rural development” projects in the early 1980s. Interventions in the health and education sectors, as well as roads and other infrastructure, were added on to a blueprint for range and livestock development essentially similar to the classical approach. While less coercive and more service-oriented than previous programs, they continued an implicit sedentarization agenda with a nodding appreciation for local perspectives. Most of these projects were deemed only partially successful: water points, roads, schools, and clinics were built, but livestock productivity did not increase, and the infrastructure fell into disrepair once the projects terminated.

By the mid-1980s, the new generation of projects, usually called “natural-resource management projects,” emerged. These recognized the need to focus on the ever-increasing land degradation problem, and the difficulties of managing multisectoral, integrated development projects. The focus shifted away from livestock to rangelands and all of its resources. The approach adopted by these projects was still a “blueprint” approach. Remote sensing was used to determine carrying capacities and agroecological zoning, and land-use “guidelines” were discussed with mobile and sedentary land-users only after the blueprint was created.

However, these projects did break new ground by attempting to modify institutional structures for natural-resource management. Many projects created and legally registered Pastoral Associations, to which the responsibility (but not ownership) for managing a defined land area was given. The main problems faced by this approach were that it was too “topdown” and not subject to consensual agreement by land users. The relationship of new institutions to customary ones were left undefined, leading to a lack of effectiveness, at best; or to a further breakdown of customary institutions, at worse.

The *gestion de terroirs villageois* approach in West Africa, which is similar to land-use-planning efforts in East and South Africa, was the next generation of projects. It followed the natural-resource management principles of previous projects, but at a more localized (village) scale and was strongly influenced by common-property theory. After about two decades of experience, it

has had partial success in building local-level institutions for natural-resource management. The following shortcomings have been identified in the literature (Marty 1993; Painter, Sumber, and Price 1994; Engberg-Pedersen 1995):

- Existing informal local institutions for decisionmaking are often overlooked.
- Significant differences between the interests of leaders and nonleaders is ignored.
- There are inconsistencies between the approaches' goals for natural-resource management and villagers' goals for infrastructure and social development.
- Government was unable to provide adequate incentives for people to undertake resource-conservation activities that are labor intensive and have noticeable returns only in the long run.
- The high spatio-temporal variability of resource endowment in dryland areas is underappreciated, as evidenced by the focus on promoting exclusionary mechanisms in land-tenure systems.
- The focus on the village (or groups of villages) is spatially myopic.
- Mobile pastoralists are ignored or delegated to a secondary "receptive," rather than proactive, position.

The 1990s' community-based natural-resource management approach is a further step in that it intends to devolve greater resource-management authority to the local level, acknowledges the role played by customary institutions that manage common-property regimes, attempts to allocate common-property tenure to local institutions, and facilitates more participatory forms of development.⁴ However, very few of these projects have tackled the "problem" of mobility. Only a few projects have attempted to implement this approach among mobile pastoralists. These include the projects using the *terroir d'attach* approach, sponsored by the United Nations Sudano-Sahelian Office (UNSO) of the United Nations Development Programme (UNDP) in the Bourgou of Mali, and German Agency for Technical Cooperation's (GTZ's) Dori project in Burkina Faso. Mobility is still seen by the majority of national decisionmakers as a problem to be done away with, rather than a trump card to be strengthened.

As this brief summary suggests, the evolution of pastoral-development paradigms itself has been one of the causes of fundamental change in transhumant systems, although this impact has not been as direct or strong in all cases. This evolution has been largely led by factors exogenous to transhumant systems rather than, ideally, by the dynamics of pastoralism. Such factors include trends in international-donor funding, regional and international market-forces,

⁴ The World Bank's Holistic Resource Management Projects in Mauritania, Mali, and Chad would probably fall in this category, although they do not use the same terminology. However, these projects as yet do not work with mobile pastoralists.

national political systems, and changes in the perceptions of development workers and the theories of researchers.

Since the mid-1990s, mobile pastoralists have started to demand their own share of the “political space.” Transhumants, especially in West and East Africa, have been able to find opportunities to express their opinions and lobby for their interests through regional- and national-level nongovernmental organizations. Although they have had their share of internal friction, political difficulties, and poor organization, in almost all cases, they are unanimous in demanding that mobility of livestock and security of common-property regimes, far from being curtailed, should be encouraged and supported.⁵

Next steps

Environmental analysts have been prone to characterizing the grazing of domestic livestock as destructive to the environment—but the relationship of grazing to the environment in Africa is much more complex. With the long history of coevolution of livestock and the African environment, livestock should be seen as an integral part of both conservation and development (Steinfeld, de Hahn, and Blackburn 1997). The new paradigm not only argues that transhumance is not an archaic remnant of the past, but even asserts that it is a necessary precondition to sustainable development in arid lands.

A holistic and integrated analytical framework is needed that can incorporate all the new developments in each of the contributing scientific fields (economics, sociology, anthropology, ecology, and political science) and provide a sound basis upon which development activities can be designed. Concerted and simultaneous actions are needed on several important aspects of pastoral development, including building capacity, determining appropriate forms of service delivery, developing and strengthening rules and regulations for common-property management, managing key sites, developing socioeconomic safety nets, and developing drought-contingency measures. For the sake of brevity, and in line with this symposium’s objectives, this chapter concentrates on the issue of institutional change for enhanced mobility.⁶ Institutional change is particularly relevant in terms of common-property regimes and in conflict management.

⁵ For example, discourse of Ould Taleb, the President of the Mauritanian Pastoral Association at the 4th International Technical Consultations on Pastoral Development, Ouagadougou, March 24–27, 1998 (organized by UNSO, GTZ, French Cooperation, and Danida); and efforts by David Pulkol, Member of Parliament for Karamoja in Uganda.

⁶ The term “institutional” is used in its wide sense of relating to the rules, social norms, and regulations in a society. Marriage, for example, can be defined as an institution.

Common-Property Regimes

The term “common-property regime” amalgamates the issues of property rights with that of institutions for managing those rights. Experience to date from projects aimed at natural-resource management at the local level shows that, in practice, projects tend to concentrate more on the structure rather than the function of management regimes. This leads to overly static community organizations that rarely are able to achieve the project’s self-imposed objectives, let alone leave behind a sustainable result.

In addition, projects usually are unable to tackle the issue of property rights for several reasons. Very often, customary tenure-systems are too complex, dynamic, and disaggregated to be easily comprehensible to the outsider, or worse yet, have already broken down. Secondly, projects are confined to working in their “target” areas and are not in a position to deal with cross-boundary (whether international borders, or interethnic boundaries) issues. Furthermore, where the state is not able or ready to alter its legal instruments, projects in isolation cannot hope to bear the necessary pressure to alter them.

A clearer understanding of common-property regimes would help in designing more appropriate short- and long-term programs in this regard. A series of fundamental design principles can be distilled from the evolution of both traditional transhumant societies and from lessons learned from development assistance. This evolution has been a progressive and iterative process and should continue to provide new insights and tools. This chapter focuses on those design principles most directly related to managing institutions for mobility: nested property rights, fluid boundaries, inclusivity, flexibility, reciprocity, negotiation, and priority of use.

Customary land-tenure is often composed of a hierarchy of *nested property-rights* (Peters 1987; E. Ostrom 1990; Vedeld 1993). A sovereign might grant land to a chief who then will allocate cultivation rights to individual households, while giving management control over pastoral areas to a subchief, clan head, or camp or village chief. Individuals may gain more exclusionary rights by investing their labor into the development or maintenance of water points or other specific resources (for example, beehives or farms). Therefore, most rangelands are mosaics of private, common, and open-access resources as mediated and reinterpreted by local political systems.

Careful attention needs to be paid to the distinction between sovereignty (for example, all common lands are vested in the state), ownership (local communities own and use the resource) and usufruct (local communities neighboring groups, or both only have use rights). Table 4.2 categorizes the types of nested rights typical of pastoral systems. The customary pastoral territory is the land claimed by the tribe or other higher social unit as its home base, as distinct from other claims. The boundaries of these territories are relatively fixed from year to year and identifiable by landscape features. Each clan, subtribe, or fraction has an annual grazing area, covering its seasonal movements, that usually includes and extends outside the home base. The geographical boundary of this area is

extremely fluid from year to year because of variability in rainfall. In a good array of key sites (special areas of relatively high value), each annual grazing area is intended to be self-sufficient. However, in times of need access by other clans or fractions is defined the same way as access to annual grazing areas, that is, through negotiation.

TABLE 4.2 Typology of customary property rights and management regimes

Nested property right	Type of boundary	Management regime
Overlapping territories	Relatively fixed	Tribal council
Buffer zones	Relatively fixed	Tribal council
Customary pastoral territory (home base)	Relatively fixed	Tribal council
Annual grazing area	Extremely fluid	Clan, fraction, subtribe (mixture of primary and secondary rights)
Range reserves	Fixed	Clan, fraction, subtribe, tribe
Key sites	Fixed	Clan, fraction, subtribe
Cropland, special resources	Relatively fixed	Camp, village
	Fixed	Individual

SOURCE: Niamir-Fuller forthcoming.

Depending on the customary political system, secondary access-rights are established either through dictum from the higher-level institution, or through yearly negotiation at more local levels. Buffer zones and overlapping areas refer to resource systems that are in between customary pastoral territories. Overlapping areas are zones over which neighboring tribes have dual rights; these zones are subject to negotiation and cooperative management, or to conflict (Spencer 1965). Buffer zones are contested areas where permanent claims are not recognized, and the area is rarely used except in times of need (for example, drought and epidemics).

As mentioned earlier, most mobile pastoral groups establish well-defined range reserves within their annual grazing area to provide a “savings bank” of forage. Most reserves are communal, such as drought reserves (for example, Odell 1982) and sacred sites (Schlee 1987), but some are also private, such as the immediate surroundings of Maasai camps (Ole Kuney and Lendiy 1994). These reserves perform the dual functions of reducing risk and maintaining ecosystem resilience.

The literature on western common-property regimes usually assumes that clearly defined boundaries are a necessary condition for long-enduring institutions of common-property regimes (for example, Ostrom 1993). Pastoral territorial boundaries today are still characterized by the flexibility of their boundaries

(Moorehead 1993; Salzman 1994; Turner forthcoming). Since transhumants often are required to move over vast distances, they must negotiate the boundaries of authority over resources that are owned versus those that are used—much more so than sedentary cultivators. Fluid boundaries are based on a flexible geographical definition of the territory's boundary related both to ecological exigencies and political power plays, an acceptance of inclusivity rather than exclusivity, opportunistic use of boundary resources within certain agreed sociocultural bounds, and a system of priority users.

The inclusive (or porous) nature of transhumant tenure institutions has often been misread as evidence for the lack of institutions governing resource access—for example, a resource open to all. Such conclusions confuse a lack of rigid exclusion (a defined membership) with the lack of exclusionary powers. In fact, outsiders can only use resources with the permission of the group with usufruct rights (for example, Tubiana and Tubiana 1977; El-Arifi 1979).

The variable and unpredictable ecosystem requires flexible response mechanisms for long-term sustainability, be they transient institutions, flexible rules and regulations, or flexible property boundaries. The scientific paradigm, and efficiency-led administrations, are ill-equipped to deal with the concepts of uncertainty and flexibility. Despite the rhetoric in the last two decades, flexibility is still not fully practiced.

In the transhumant context, customary institutions rely on negotiation for their maintenance and evolution. The variable environment necessitates continuous reallocation of access rights that define macromobility (or long-distance routes and seasonal grazing areas). Traditional African processes of reciprocity and negotiation are used in three basic kinds of resource management decisions: conservation, regulation, and allocation.

Reciprocity has been shown to be the backbone of interdependence and collective action in pastoral societies (Potkanski 1994). Is traditional reciprocity of no use in the context of modern, individualistic behavior that is ruled by market forces? Exchange of favors, political alliances, gift giving, and other forms of reciprocity still survive as a necessary part of collective action even in our modern lifestyles. Reciprocity is fundamentally the basis of market exchanges, which is codified into contracts and monetary transactions. In the context of managing mobility, therefore, transactions can be negotiated either through customary institutions of reciprocity and political alliances, or they can be based on a system of reciprocated fees and permits. Both reciprocation, and the threat of denial of reciprocation, are powerful tools for ensuring respect of collective rules and regulations.

“Priority of use” is an important concept that can be used to mediate between the requirements of resource inclusivity and exclusivity (Niamir 1997). The community to which a common resource is vested has the primary right and responsibility for using and managing the resource flow from the “home base” (or *terroir d'attache*, the term now being used in West Africa). Each institution within the hierarchy of customary institutions has its own home base. For exam-

ple, the home base of the entire tribe geographically encompasses the home bases of the lineage, clan, or subtribe. Secondary users are defined as those who regularly seek access to the resources in the home base of the primary user, but subject to the conditions and requirements imposed by the primary right holder. Tertiary users are those who need to use this resource flow infrequently (for example, during droughts). Governance by a community is applicable to its own home base, while access rights are negotiated to someone else's home base. In other words, the social and administrative boundaries of a community need not coincide with its ecological ones.

In recent years, the dual sides of the coin—right to use and responsibility to manage—have become separated. The concept of priority of use—that is, the “splitting” of tenurial rights into primary, secondary, or tertiary—can be translated into a legal mechanism to reinstate effective governance. It is applicable not only to transhumance areas, but also to other areas with systems that govern multiple uses of land, such as community forests.

In defining the system of priority of use, it is important to be able to define the social boundaries of a community. Experiences with both decentralization and popular participation have shown that the definition of the “community” is one of the more important, and yet, more difficult tasks. Internal heterogeneity makes it difficult to define membership boundaries (questions arise concerning, for example, whether sociocultural minorities and newcomers are included). In addition, in nonegalitarian societies, it is difficult to ensure full representation by all socioeconomic groups. In cases where customary institutions no longer persist, the community behind those institutions is difficult to identify. Needless to say, the identification of the “community,” to which the responsibility for designing a common-property regime and establishing priority of use would be given, should be made by mobile pastoralists themselves. However, outsiders also have a role: ensuring that a minimal package of internationally accepted human rights is also incorporated into the new institutions.

The pitfalls of most projects have been in rigidly, and very often arbitrarily, defining the boundaries of a particular community, and then in ignoring participation by surrounding people. Isolated projects that focus on only one or two communities create more harm than good, since they increase the chances of conflict in the long run. Having a concerted, nationwide definition of social units that does not rigidly classify people into ethnic categories, but into an agreed-upon set of sociogeographical communities would help.

A nested hierarchy of sociogeographical units, reflecting the nested nature of communal property, would ensure that a series of institutional structures, from local to regional or federal, are in place to accommodate the needs of mobility. Exclusive and inclusive land-tenure can then be assigned accordingly. This is a long process of administrative reorganization that only a few countries up to now, notably Senegal, have attempted. In Morocco's Middle Atlas region, such an attempt in defining transhumant communities has opened up old wounds and rivalries. Establishing an appropriate, neutral forum to allow negotiation of

not only existing rights, but also what are perceived to be future entitlements,⁷ may reduce the inherent conflicts in this process.

Customary institutions are not necessarily egalitarian organizations (Ouedraogo and Rochette 1996; Ribot 1996). They sometimes reflect the interests of only the elite or are used as vehicles for promoting intertribal enmity and competition, and have been known to protect members who violate state or ethnic laws (Catley 1996). Strengthening local decisionmaking processes—in the form of selectively building capacity, creating new structures, and imposing new rules and regulations—is appropriate only when it ensures sensitivity to social dynamics and full participation of all relevant stakeholders.

There is an inherent contradiction, however, in asserting on the one hand that sustainable development should be based on participatory processes and existing structures and dynamics, and on the other, pushing from the outside for issues of social sensitivity and equity. How far can the western worldview of human rights be imposed before the process is labeled, once again, “top-down”? Development workers, too, should be seen as stakeholders in the process of “negotiating” pastoral development.

Land Reform

Land reform in its generic sense is much needed to increase the security of transhumant claims to land. In doing so, the institutional requirements of livestock production on arid lands, most notably the need for livestock mobility and common-property management, need to be seriously considered. In considering reforms, policymakers should consider carefully the roles that more informal institutions have played in providing controllable but flexible resource access in arid rangelands. A significant hazard is the imposition of overly rigid regulations. Increased security is necessary, but that security should not be attained through prescriptive rules that actually increase the exclusivity of mobile pastoral resources. Resource holders should retain authority to grant temporary use-rights to secondary and tertiary users. Flexibility can be maintained by the legal recognition and development of appropriate legal language for nested property rights, communal stewardship rights and duties, fluid boundaries, inclusivity, and the concept of priority of use.

Within this overall legal umbrella, procedural laws more consistent with the requirement of flexibility should be strengthened. Procedural law would include developing administrative and judicial institutions at the local level to manage common property, recognizing temporary rights of usage, establishing through local dialogue and participation the principles and guidelines for judging claims, and creating the means and procedures for enforcing rules (Vedeld 1993).

⁷ The term “entitlements” is used here as it is simply defined in a standard dictionary as a title, right, or claim to something, rather than as it is used recently in the context of a theory of entitlements and endowments (Leach, Mearns, and Scoones 1997).

Conflict Management

Environmental variability results in a high degree of conflict and competition among groups of land users, particularly during years of drought and shortage, or because of economic and political gain. In the past, conflicts were either resolved through customary resolution mechanisms, such as elders' councils and tribunals, or through warfare. The main objective of conflict resolution in a traditional system is not so much to restore the patrimony of the individual, but to restore stability and social cohesion. In the case of internal conflicts, customary judges attempted to maintain a precarious balance between the interests of the individual and the needs of the community. They did not necessarily follow "precedence" nor a host of detailed legal texts and rules, but enjoyed considerable liberty in shaping each decision to the needs of the situation, using a few grand cultural principles or religious codes recognized by the social group (Ouedraogo and Rochette 1996).

External conflicts—that is, intergroup conflicts—in the past were resolved either through mediation of a neutral ethnic group, or through the creation of an ad hoc "parliamentary" body. For example, conflicts among the Afar and Issa in the Horn of Africa are mediated by a group of men and women who have intermarried into each group, thus representing a relatively neutral body with vested interest in keeping the peace (according to Rashid Hersi, in personal communication in 1995). If external conflicts could not be resolved peacefully, war was the last recourse.

In recent times, the adoption of European codes of law in Africa has not only perturbed the functions of the customary system, but has favored sedentary modes of production over mobile ones. This is not only because of a cultural bias, but also because of the fact that sedentary rights can be more easily quantified: they have definite boundaries, are fixed in space and time, and produce easily measurable products per unit area (crops) for the purpose of calculating compensation.

Those using the recent community-based natural-resource management approach have also spent considerable energy on developing appropriate conflict-resolution mechanisms to fill the gap left by disintegrating customary systems and inappropriate western systems. "Conflict management" is a term used to refer to both conflict prevention and conflict resolution (Cousins 1996). Conflict prevention is possible through development and enforcement of rules over natural-resource use, collective acceptance of such rules, and continuous negotiation of conflicting demands. The principles upon which conflict resolution are based include dialogue, consensus, facilitation, reconciliation, arbitration, mediation, and adjudication (Penzich 1994; Anderson et al. 1996).

Co-management

Ever since the Earth Summit of 1992, there has been a strong momentum toward systems of common-property regimes that combine government decentralization with community participation in what has often been called "co-management."

This term is more common in forestry and fisheries literature than transhumant ones (for example, Berkes 1995; Borrini-Feyerabend 1996), but nevertheless is still as applicable. Co-management can be defined as an appropriate sharing of responsibility for natural-resource management among national and local governments, civic organizations, and local community (Leach, Mearns, and Scoones 1997).

Co-management arrangements form the basis of the newest experiments in common-property regimes in Africa. The state has an important role in initiating and fostering co-management. It must assist with the internal workings of the local institution to confer legitimacy for local-level decisionmaking, and with law enforcement and conflict management wherever necessary. Through substantive and procedural laws at both the national and local levels, the state must ensure that the boundaries of management regimes, however fluid, will be protected against expropriation and violation. Management of livestock mobility requires multiple institutions working at multiple spatial scales, authorities, and functions.

Conclusions

Some elite pastoralists consider, somewhat nostalgically, that transhumance is a distinct way of life, a culture that breeds autonomy, inner strength, and hardiness. However, it is not necessarily an activity that withstands the pull of modern amenities, such as schools and markets. Even if the people settle, however, it does not mean that the animals should. Managing the mobility of animals can be seen as separate from the mobility of people. This chapter has tried to show that the mobility paradigm is not a romantic view of traditional transhumance, nor is it a regressive trend toward the past. It is based on theoretical and practical advances in several social and physical scientific fields.

The Community Based Resource Management approach is far better suited to mobile pastoralism than any other approach; however, it must deal with the issue of scale. Mobile pastoralism requires large-scale management of contiguous land. The previous section has highlighted some design principles that are necessary for modifying or creating the institutional structure necessary for a legitimate, locally controllable transhumance. Of particular importance is a shift of focus to the function of new institutions, not just their structure.

The call to recreate the "local community" and common-property regimes is not confined only to pastoralists, nor only to Africa. In both developing and developed countries, a trend is growing toward devolution of authority, decentralization of administration, and local-level empowerment. In Europe, herders and livestock owners of Spain, Italy, and France are returning to common-property management. Natural-resource management at the local level is seen as a necessity, as is a revival of transhumance between summer (high) and winter (low) mountain environments (Besombes 1996; Buffière 1996; Raffin 1996). For example, the association *Pastoralisme du Monde* is active in lobbying for changes in land-tenure laws in Europe to accommodate transhumance.

In former communist countries, where the traditional transhumant system was presumed to have been destroyed by the collectives and communes, parts of the traditional systems have experienced spontaneous revival. In Buryati (a Russian republic) mobility managed by the extended family has increased (Humphreys and Sneath 1996). In Mongolia, local authorities have recognized this trend, and are relying on it for administrative activities, such as services, provision of inputs, and famine relief (Mearns 1993). However, poverty is a constraint to the revival of mobility in Central Asia, much as it is for postdrought African mobile pastoralists. Privatized, small-scale pastoral units do not have enough family labor and transport to effect the long-distance transhumance needed for efficient production, and their small herds are not economically viable enough to pay for hired shepherds (Kerven, Lunch, and Wright 1998).

Many pastoral advocacy groups in Africa have also emerged in the last two decades to champion the needs of pastoralism, for example, the Miyetti Allah Association of northern Nigeria, advocating for the Fulani (Ezeomah and Egbe 1988); Association pour la Promotion de l'Élevage au Sahel et en Savane (APESS), in Burkina Faso; and AREN, in Niger—just to name a few. The research community has a role to play in supporting this movement, by providing the necessary analytical tools, databases, and terminology important for institutional change and policy reform. Several research priorities related to the previous discussion can be highlighted as immediately useful and necessary:

- *Indigenous indicators and monitoring systems.* How do transhumants monitor the variability of primary productivity, and how do they track the resources? How can mobility enhance this dynamic feedback process, for greater sustainability of land use patterns?
- *Ecological and economic valuation of rangelands.* What is the true cost of plowing rangelands (in terms of modeling the opportunity cost of all livestock products, changes in nutrient and energy cycling, carbon flux, biodiversity conservation, land degradation and erosion, and other environmental factors)? How can herders be compensated adequately when their land is expropriated either through privatization, or state-sponsored land transfers (state farms, national parks)?
- *Analysis of informal institutions for common-property management.* What is the nature of that informality and what functions can it perform? Issues that should be researched include the degree of transience and flexibility, informal or common-sense rules, relationship and interactions with formal institutions, division of responsibilities, process of formation and destruction, and cost of change.
- *Multiple-use mapping.* What are the multiple claims, rights, and entitlements over resources (spatial and temporal variations)? What are the underlying principles, and how can these be translated into substantive and procedural laws adapted to the local level? Issues that should be researched include nested hierarchy of institutions for common-property

regimes, degrees of inclusivity and exclusivity, priority of use, overlapping claims, and buffer zones.

- *Conflict-management mechanisms.* What are the existing conflict-management mechanisms (traditional and modern), how do they function in parallel, and what are the perceived gaps? Issues that should be studied include conflict prevention, conflict resolution, and contradictions and complementarities between the customary and modern systems.

This chapter has attempted to clarify some of the concepts and guidelines emerging from one of three “trends” in livestock research: the new range ecology. Such an exercise is valuable because national policies and legislature are rarely able to accommodate the needs of livestock mobility, and major changes need to be introduced before sustainable models can be found for arid lands. By helping to clarify the implications of the new range ecology, this chapter also hopes to forge linkages with the other two research “trends”—in crop–livestock interactions, and in use of common property.

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5 Crop–Livestock Systems in Sub-Saharan Africa: Determinants and Intensification Pathways

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Mixed farming systems involving varying degrees of crop–livestock integration are found in many parts of Sub-Saharan Africa.¹ Increasing population combined with climatic, economic, social, and institutional changes are transforming systems for producing crops and livestock—from systems based on extensive, shifting cultivation and grazing to ones that are more intensively managed and are based on mixed farming systems.

A variety of economic and biological interactions between crops and livestock make mixed farming systems attractive to farmers. Mixed farming is a risk-coping strategy, with livestock providing an important avenue for farm diversification and consumption smoothing. Animals furnish manure to sustain crop yields, while crop residues and forage on fallow lands provide feed for livestock. As demographic pressure increases or new market opportunities arise, more intensive modes of agricultural production that involve increased use of labor per unit of land are sometimes adopted. The use of animal power at this stage can alleviate labor shortages, improve the quality and timeliness of farming operations, and increase farm productivity. Viewed in this way, the integration of crops and livestock facilitates the exploitation of economies of scope and represents an important step in the process of agricultural intensification.

However, the increased level of exploitation of natural resources often associated with crop–livestock integration may also lead to undesirable outcomes. Environmental degradation can result from the excessive removal of vegetation through grazing or harvesting of fodder and the tillage of some soils using animal traction. The adoption of integrated crop–livestock farming may also have negative implications for property rights, equity, and risk management within a farming community. As concern about poverty, food security, and environmental degradation in Sub-Saharan Africa increases, it is important that crop–livestock systems are transformed and intensified along productive and sustainable pathways.

¹ Mixed farming or integrated crop–livestock systems are defined as those in which crop and livestock production activities are managed by the same economic entity, such as a household, with animal inputs (for example, manure or draft power) being used in crop production and crop inputs (for example, residues or forage) being used in livestock production.

The objectives of this chapter are to analyze the ways in which social, economic, institutional, and technological factors influence the development of crop–livestock systems across Sub-Saharan Africa, and to identify the conditions under which policy and institutional reforms would lead to sustainable improvements in crop–livestock production. In subsequent sections, the following questions are explored:

- What are the determinants of the evolution of crop–livestock systems?
- What patterns of crop–livestock intensification are currently seen in Sub-Saharan Africa?
- What are the institutional structures associated with the different patterns?
- What are the implications of the different intensification patterns for resource use, technology adoption, income distribution, and risk management?
- What lessons and insights can be derived from the literature and case studies reviewed and how can they be applied to improve policy decisions and promote sustainable development of crop–livestock systems in Sub-Saharan Africa?

Answers to some of these questions have been provided before in the context of population or market-driven models of agricultural intensification. The relevance of these models is confirmed where appropriate. The goal of this chapter, however, is to present a broader conceptual framework to explain the evolution of crop–livestock systems and the different patterns of intensification seen across Sub-Saharan Africa. For this review, agricultural intensification is defined as increased average inputs of labor, manure, draft power, crop residue, inorganic fertilizers, feeds, veterinary drugs, pesticides, or capital on a farm for the purpose of increasing the value of output per unit of land.

Factors Influencing the Evolution of Crop–Livestock Systems

Crop–livestock systems in Sub-Saharan Africa are socially, economically, and technologically diverse. This diversity stems partly from differences in agro-ecological conditions, population densities, and economic opportunities, and partly from the varied nature of the institutions that govern production relations in different agricultural systems. Underestimating this diversity hampers the identification of constraints and opportunities for sustainable intensification of crop–livestock systems. The contrasting systems of crop–livestock production also suggest that any analysis of the evolution and development of these systems must be broad based and must encompass the wide variety of economic, political, institutional, and ecological processes that have influenced the observable patterns seen across Sub-Saharan Africa. In the rest of the chapter, previous studies of the evolution of farming systems and related literature are reviewed to highlight, respectively, the contributions they have made to our understanding of

the agricultural intensification process and to underline certain limitations and questions that other analysts have noted.

Most of the earlier explanations of the process of agricultural intensification have been largely based on the seminal work of Boserup (1965, 1981), who established the main arguments about the effects of population density on agricultural growth. She described in great detail the ways in which population growth has historically led societies to invest in land improvements and to adopt technologies that resulted in higher agricultural production per unit of land. According to this explanation, as population density increases, changes occur in cropping techniques that at first involve expanding the area under cultivation or, when that is no longer feasible, shortening fallow periods and increasing the labor input to satisfy the higher demand for food.

In direct contrast to the Malthusian perspective, Boserup's hypothesis was that the problem of population pressure gives rise to its own solution. The scarcity of land, by altering factor prices, results in its more intensive use (Lele and Stone 1989). This view of intensification, with its central tenets of factor substitution and technological change, is also consistent with the "induced innovation" model of Hayami and Ruttan (1985), who contend that changes in factor proportions will lead to the conservation of the more scarce resource (in this case, land) and to increased use of the abundant resource in production (in this case, labor).

The ideas propounded by Boserup have been supported by Ruthenberg (1980), who provided even much greater technical detail about the evolution of farming systems and the obstacles and opportunities that farmers are likely to face as they intensify their systems. Farming intensity in this literature is defined mainly in terms of the length of fallow periods between plantings. Pingali, Bigot, and Binswanger (1987) used this approach to explain technical change in African agriculture. McIntire, Bourzat, and Pingali (1992) extended the ideas in seeking to explain the evolution of crop-livestock interactions. They argued that, as population density increases, the evolution of crop-livestock interactions follows an inverted "U" shape, with integration being weak at the beginning, then increasing and finally decreasing. Intensification comes about in response to population growth and changes in markets and involves the use of more animal power, manure, and crop residue per unit of land and output. Turner, Hyden, and Kates (1993), in a series of case studies covering densely populated areas of Africa, and Tiffen, Mortimer, and Gichuki (1994), in a study of the Machakos district of Kenya also explored Boserup's hypothesis and found much support for it.

Nonetheless, the stagnant or declining trends in food production per capita over the last decade in most African countries (World Bank 1989) also suggest that not all societies experiencing population growth and increased market access have shown growth in agricultural productivity. This implies that the process of intensification is far from automatic and that other variables may impede the theorized progression. Lack of institutions, policies, and infrastructure favor-

able to farmer investment may not only slow down the evolution of farming systems, but may actually lead to environmental degradation (Lele and Stone 1989; Binswanger and Deininger 1997).

The relative importance of population density compared with the other exogenous drivers of agricultural intensification is being debated. Gass and Sumberg (1993) contend that the effects of population growth on the intensification of livestock systems have been overemphasized. They pointed out that an equally important source of change is the expansion in the demand for livestock products brought about by growth in urbanization and income, and by improved market infrastructure and intraregional trade. Adams and Mortimore (1997) concurred with this view and posited that intensification is a process driven by economic factors, but that these factors do not lead to the same outcomes in different places and at different times. The case studies reviewed later on in this chapter shed light on the relative importance and the distinguishing features of the population- and market-led models of crop–livestock intensification.

Another debate that is of relevance to a discussion of crop–livestock intensification concerns the structure of property rights in land. Some economists have argued that private-property rights are necessary to give individuals the long-term incentives to invest in resources and use them efficiently (Demsetz 1967; Alchian and Demsetz 1972). Hopcraft (1981), in support of this view, argued that common-property regimes are a constraint to intensification and investment that should be removed by systematic privatization of land.

Others, however, have pointed out that, in environments where information costs are high and markets for credit and insurance are imperfect, private-property rights do not always produce the most efficient farming arrangements (Larson and Bromley 1990). For example, the absence of exclusive land rights in many parts of Sub-Saharan Africa enables livestock to make efficient use of grazing resources that are highly variable both temporally and spatially, and these resources provide a mechanism for the management of locally covariant risks (Sandford 1983; Swallow 1994; Scoones 1995; van den Brink, Bromley, and Chavas 1995).

Nonexclusive land rights thus tend to favor current systems of livestock production and help to even out inequality in land distribution and access to fodder, including crop residues on privately cultivated fields (Williams, Fernández-Rivera, and Powell 1997). This advantage applies with equal relevance to livestock kept under pastoral systems as well as to livestock under mixed farming systems, since animals in the latter also depend on grazing resources outside the farm boundary. Abandoning communal-land rights for private-property rights may lead to the loss of safety nets for the poor or measures to diversify risk (Jodha 1992; Nugent and Sanchez 1993; Wilson and Thompson 1993).

Rural households in many parts of Sub-Saharan Africa typically face considerable risks because of weather and price variability, crop and animal diseases, and pest attacks. As noted by Binswanger and McIntire (1987), explicit

insurance contracts for handling risks typically do not exist in rural areas in developing countries because of problems of asymmetric information, adverse selection, and moral hazard. This implies that risk allocation must be handled either privately or through implicit insurance schemes. Private management of risk can occur at two levels through income and consumption smoothing (Mor Duch 1995).

First, farmers can smooth the flow of income to the household through making conservative production choices, combining production enterprises that generate returns during different times of the year, and diversifying economic activities. Farmers do this in practice through the use of low-yielding, but locally adapted, crop varieties; and by intercropping—using several dispersed crop fields and pastures and combining crop and livestock enterprises. In this way, farmers take steps to protect themselves against adverse income shocks before they occur.

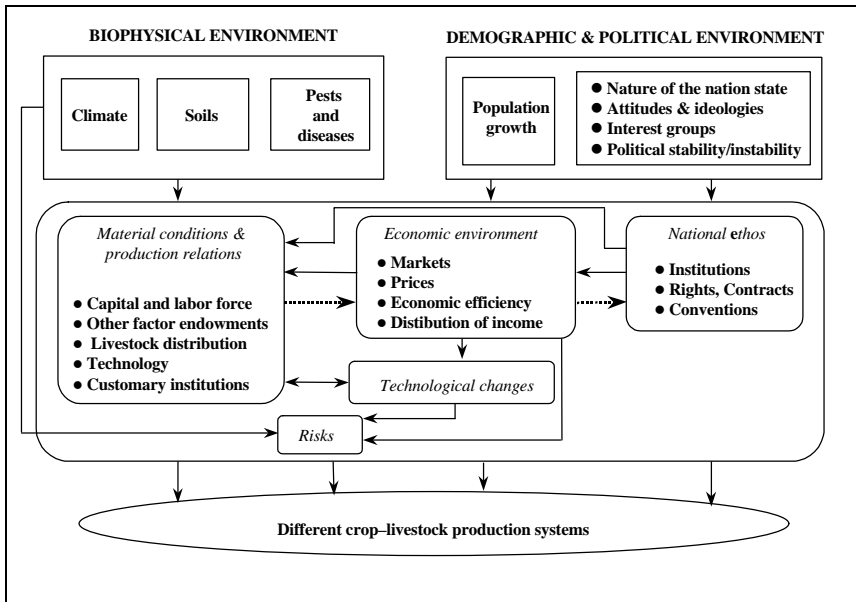
Second, farmers can smooth consumption by borrowing and saving; depleting and accumulating nonfinancial assets, including livestock; undertaking temporary migration; and relying on implicit or informal insurance arrangements. These mechanisms take force after shocks occur and help insulate consumption patterns from income fluctuations.

Livestock can play important roles in both risk-coping strategies (Rodríguez and Anderson 1988; Dercon 1998; Kinsey, Burger, and Gunning 1998). Furthermore, as Carter (1997) has pointed out, some of the risk-management devices outlined above are, in general, endowment dependent and are conditioned by social phenomena (for example, property rights and kinship ties). For example, to use diverse crop fields or pastures, a farmer must have access to particular kinds of land and this may necessitate negotiations with other members of the community. In sum, the way in which risk is handled will not only affect the farm enterprise combination but also the overall efficiency and development of the farm.

A different type of uncertainty that may also have important implications for crop–livestock development is strategic uncertainty associated with imperfect knowledge of the response of other members of a community to collective action. For example, livestock, even in sedentary systems, depend on common-pool resources (for example, rangeland and water points) found around villages. Farmers using these resources may respond to growing scarcity by engaging in cooperative action to rationalize use and improve their management. This could be through restraints on fodder harvesting or through schemes for controlling the timing and intensity of grazing. The extent of cooperation will, however, depend on the nature and degree of strategic uncertainty. Collective action would be more likely to take place in situations where strategic uncertainty is relatively small (Bromley and Chavas 1989). The specific action taken, whether cooperation or noncooperation, will have long-term effects on the common-pool resources and livestock production.

Figure 5.1 shows a conceptual model of the key factors influencing the evolution of crop–livestock systems in Sub-Saharan Africa that is based on the insights derived from the literature reviewed above. In this model, exogenous influences come from both the biophysical environment as well as the demographic and political environment. The political environment, including the nature of the nation-state, the power of interest groups and the way these interests are articulated through the political system influences the national ethos.² The latter includes the institutions—contracts, property rights, conventions, and authority—that define the structure of economic, legal, and social interaction³ (Matthews 1986).

FIGURE 5.1 Determinants of the evolution of crop–livestock systems



National ethos, including the institutional environment, defines the economic environment. Economic conditions, however, also influence the structure of institutions. For example, when new economic and technological opportunities arise, new institutional arrangements may have to emerge to foster the de-

² Although the political environment can be considered endogenous from the viewpoint of a national system, it is exogenous to any economic agent within the system.

³ The institutions just referred to may be considered as exogenous from a local perspective since they have their origins outside the domain of the local community. Such institutions should be distinguished from endogenously evolved institutions developed through voluntary cooperation of individuals who share common problems and interests and seek to arrive at mutually beneficial solutions (Shanmugaratnam 1994).

velopment of those opportunities. Conversely, failure of new institutions to emerge when existing ones have outlived their usefulness may lock a society into a historical path that may hinder economic growth. Agroecological, demographic, institutional, and economic factors influence the material conditions and production relations at the farm level. It is the interaction of all these factors, including the way in which risk is handled, that determines the type of crop–livestock systems that will emerge.

Intensification occurs in a dynamic response to these factors. The trajectories of intensification will, however, vary depending on the policy, institutional, and technological options available at a particular location. In the following section, three case studies representing different types of crop–livestock systems are reviewed and the relative importance of the different factors outlined above in determining their development pathways are analyzed.

Examples of Crop–livestock Systems in Sub-Saharan Africa

Crop–Livestock Systems in the Southwestern Region of Niger

The southwestern region of Niger is located in the Sahelo-Sudanian zone, with an annual rainfall of 400 to 600 millimeters. Rainfall is unimodal and is distributed over a four- to five-month period extending from May to September. The interannual fluctuation in rainfall is high, with a coefficient of variation of 25 to 30 percent (Sivakumar, Maidoukia, and Stern 1993). This area has historically been populated by the Djerma ethnic group, who are primarily farmers; however, over a century ago other ethnic groups, particularly the livestock-rearing Fulanis, have also settled in the area—either in their own villages or in Djerma-dominated villages. Population density varies from about 22 persons per square kilometer in the dry areas to 88 persons per square kilometer in the relatively wetter and more fertile areas close to fossil river beds (République du Niger, 1988).

Soils are predominantly sandy and are deficient in phosphorus and nitrogen (Bationo and Mokwunye 1991). The poor fertility of the soils has always ensured a role for animal manure in the traditional soil-management practices. In the past, farmers obtained manure by arranging contracts with transhumant herders. These arrangements involve farmers' granting grazing rights to crop residues to herders in exchange for the manure deposited by the animals owned by the latter. The farming systems have, however, evolved over the years as a result of population growth and declining rainfall, which have exerted pressure on arable land. The predominant systems now involve various combinations of cereals, legumes, and ruminant livestock within the same production unit.

The principal cereal crop is pearl millet, which is grown either in sole stands or intercropped with cowpea. Where the land quality permits, sorghum and maize are also grown. Cereal production is principally geared toward the satisfaction of household needs, although periodic sales occur when money is

needed to meet household obligations. The main cash crops are cowpea and groundnut.

Livestock, including cattle, sheep, goats, and donkeys, are kept by most farmers to complement crop activities. The ruminants provide manure for crop production and are valued as assets that can be readily liquidated to meet household and farm financial obligations. Donkeys are mainly used to transport people, and farm inputs and outputs. Unlike other mixed crop–livestock systems in semi-arid West Africa, animal traction is not widely used for crop cultivation. The reasons for the nonuse of animal traction in this region have been well documented and include the lack of appropriate agroecological and economic conditions to promote intensive and profitable use (Williams 1997).

Average farm size varies within the region, reflecting differences in population density. Surveys conducted by Hopkins and Berry (1994) in the densely settled villages around southern Boboye and the Dallol Maouri showed that average farm size was about 5 to 6 hectares per household—the equivalent of approximately 0.8 to 1 hectare per adult. Another survey in the thinly populated villages around Ouallam found the average farm size to be 10 to 15 hectares per household—the equivalent of 1.3 to 1.8 hectare per adult (McIntire et al. 1989). Surveys conducted by the authors showed that the average herd size of farmers was about 4 cattle, with a range of 0 to 27; 7 sheep, with a range of 0 to 30; and 14 goats, with a range of 0 to 40 (ILCA 1993).

Land-tenure systems within the region contain elements of both private- and common-property regimes and can be delineated along ethnic lines. Historically in the Djerma culture, land clearing establishes definitive property rights for the farmer regardless of the subsequent use to which the land is put (Breitschuh 1990). Such land can be inherited, lent, rented, pledged, or left fallow without fear of being reclaimed. This system comes closest to private ownership, since the owner has full use, modification, and transfer rights, including the legitimate, but highly discouraged, right to sell land (Gavian 1993). The role of the village chief is to settle disputes and allocate land, held in common or from his own stock, to newcomers.

In the Fulani system, ownership of all arable land is vested in the community, under the trusteeship of the village chief. The chief sets long-term use-rights for household heads. Each family head has full rights of modification and inheritance, but does not have the right to lend, rent, or sell the land. Land left in long-term fallow reverts to the community to be allocated to another user.

In both systems, fallow or unallocated fields are open to animal grazing, as are cultivated fields after harvest. For members of a community, there are very few restrictions on the exploitation of grazing resources on lands held in common. Conversely, voluntary cooperative action aimed at improving the management of these resources, with the exception of wells, is not common. Although various attempts have been made by the government to influence land-use systems in Niger, the customary tenure-systems still hold sway in the rural areas (Ngaido 1993; Elbow 1996).

Farmers in this region have traditionally relied on long fallow periods for regenerating soil fertility. Fallow practices have, however, changed in response to increased pressure on arable land. Surveys conducted in Hamdallaye district, an area still not considered to be densely settled, showed that fallow periods last for 2 to 3 years on borrowed land and 3 to 5 years on owned land—instead of the previous practice of 10 years or more. Thirty-five percent of the respondents leave portions of their fields fallow, instead of leaving whole fields fallow to ensure that land-use rights are not lost (Taylor-Powell et al. 1991).

Institutional support in the form of extension and credit is weak in the Sahelo-Sudanian region. Rural infrastructure is also limited, making the supply of inputs and marketing of farm produce difficult. As a result, farmers make minimal use of purchased inputs, such as fertilizers and feed supplements. However, demand-side constraints due to fluctuations in profitability under existing agronomic and economic conditions have also contributed to the low level of use of purchased inputs.

Declining soil fertility arising from reduction of fallow periods and farmers' lack of access to mineral fertilizers have created a heavy reliance on animal manure for soil fertility maintenance. Table 5.1 presents data on land use and manure deposition rates in 1995 in three villages—Bani, Tigo, and Kodey—studied by the authors. The three villages share the same climate and soils but differ in terms of the proportion of land cropped and livestock population density. Data in the table show that the proportion of village land manured varies from about 3 percent in Bani to 8 percent in Kodey. The special care taken by farmers to concentrate manure on cultivated fields can be appreciated by comparing the amount of manure deposited on such fields (last column of Table 5.1) with manure deposited fortuitously over the entire village land. Average millet yields in the three villages in 1996 were 713 kilograms per hectare on manured fields, compared with 396 kilograms per hectare on unmanured fields.

Manure is obtained from farmers' own animals and through contractual arrangements with transhumant herders. Unlike in the past when contracts between farmers and herders were based on the exchange of crop residues owned by farmers for manure deposited by the pastoralists' herds, manure is now mostly exchanged for millet grain and cash. This trend has curtailed the ability of poor farmers to enter into manuring contracts with pastoralists and increased their reliance on manure from their own herds.

Additional evidence from on-station experimental results and on-farm surveys indicates, however, that reliance on manure alone will not be sufficient to maintain long-term soil productivity (Breman 1990; Williams et al. 1995). Nonetheless, it is clear that the crop–livestock interactions seen on mixed farms in this region are largely driven by the need of farmers to maintain soil fertility and stabilize cereal yields, diversify farm production, and make efficient use of crop residues.

TABLE 5.1 Village land area, land use, stocking rate and manure deposition levels in 1995 in three villages of southwest Niger

Site	1995 land use (percent of area)					Amount of manure deposited (kg/ha/yr)		
	Land area (km ²)	Range	Fallow	Un-manured cultivated land	Manured cultivated land	Stocking rate (TLU/km ² /yr)	Village land	Cultivated land
Bani	122	12	58	27	3	7.2	59	761
Tigo	109	15	49	32	4	7.7	62	612
Kodey	75	7	31	54	8	11.8	94	503

SOURCE: Surveys conducted by the authors.

NOTE: TLU indicates tropical livestock unit.

Crop-Livestock Systems in the Subhumid Zone of Burkina Faso and Mali

The subhumid zone of Burkina Faso and Mali⁵ covers what has come to be known as the cotton belt of West Africa. Average annual rainfall in this zone is about 800 to 1,000 millimeters. With higher rainfall, the agricultural potential is higher compared with the Sahelo-Sudanian zone. Until recently, the agricultural potential of this area was largely unexploited because of the higher incidence of human and animal diseases, such as malaria, river blindness, and sleeping sickness. Improved public health and modest investment in infrastructure have opened up these areas and facilitated the growth of agricultural production.

The predominant crops in this area are cotton, maize, sorghum, millet, cowpea and groundnut. The introduction of new cultivars of cotton and maize has been quite successful and has been combined with rapid introduction of animal traction and improved crop-management practices, including increased fertilization, plant density, and pest control. This success story has been attributed to a combination of technological and institutional support provided, first, by a French cotton company (Compagnie Française pour le Développement des Fibres Textiles), and later continued by national research agencies and cotton parastatals in the two countries.

The essential elements of the strategy included supplying farmers with fertilizer on credit, and providing technical recommendations and purchase of cot-

⁵ The zone of interest covers the southwest of Burkina Faso and the southeast of Mali.

ton on a timely basis and at a price known before planting (Lele, van de Walle, and Gbetibuou 1989). As a result, cotton yield increased rapidly from about 200 kilograms per hectare in the mid-1960s to about 1,300 kilograms per hectare in the mid-1980s. These high yield levels were associated with high inorganic fertilizer and pesticide use. Average NPK fertilizer use on cotton in southwestern Burkina Faso in the mid-1980s ranged from 130 to 148 kilograms per hectare, while it was about 190 kilograms per hectare in southern Mali (Savadogo 1990; Girdis 1993). However, inorganic fertilizer use declined with the elimination of subsidies in the late 1980s. This, together with the worldwide price collapse of cotton in 1986, led to a decline in cotton yields after 1986. However, since then—through greater use of manure and mineral fertilizer—cotton yields have picked up again.

In both southwest Burkina Faso and southern Mali, the yield-increasing cotton technologies substantially increased the demand for labor and area expansion. Land cropped with cotton, which was about 94,100 hectares in Burkina Faso in agricultural year 1985/86, increased to 160,000 hectares by 1995/96. Comparable figures for Mali were 145,950 hectares in 1985/86 and 336,225 hectares in 1995/96 (Afrique Agriculture 1998). This led to a rapid introduction of animal traction into cotton-growing areas to ease labor bottlenecks and ensure timely land-preparation and weeding operations. Savadogo (1990) reported that 38 percent of the farmers in the cotton zone used animal traction in 1983, but a decade later animal traction had increased to almost the same levels found in the cotton zone in Mali, where 80 percent of the farmers own a plow. In both countries, intensification of cotton and other agricultural production progressed, as indicated by the rising number of animal-drawn seeders, harrows, and donkey and ox carts—the last increasing by 14 percent per year in southern Mali.

The increased incomes from cotton also enabled farmers to increase their livestock herd. Sanders, Shapiro, and Ramaswamy (1996) cited a report that estimated that from 1977 to 1986 the cattle herd in southern Mali increased by about half a million head, to 4.6 million, increasing the regional share from 23 to 39 percent of the national herd. The same source cited another survey conducted by the Institut d'Économie Rurale of Mali in the Koutiala region that showed farmers' average herd size to be 4.2 oxen for animal traction, 13.8 cattle, 8.3 sheep, and 3.4 goats. The ready availability of cotton-seed cake—a byproduct of seed cotton processing into lint, which is rich in protein—facilitated more intensive livestock operations, such as animal fattening and dairying. Manure obtained from these animals, often improved by adding bedding of maize straw and cotton stalks in corrals, are applied to the cotton fields. The increased availability of animal-drawn carts facilitated manure transfer to the fields.

The traditional staples in southern Mali, sorghum and millet, benefited from the technologies used in cotton production. Sorghum, which follows cotton in the crop rotation pattern recommended for this zone, benefited from the residual effect of fertilizer applied to cotton and from better land preparation. As

farmers became wealthier, they could afford to use inorganic fertilizer on their staple crops.

The ready availability of animals in this region and the increased quest by farmers to extend land area has meant that distant fields that were previously unmanured are now being regularly manured and fertilized. As a consequence, settlement patterns in the cotton zone in Mali is decentralizing, with isolated farmhouses replacing villages (Sanders, Shapiro, and Ramaswamy 1996).

Dairying in the Kilimanjaro Region of Tanzania

The agroecological conditions in the eastern African highlands, characterized by moderate temperatures, ample rainfall, fertile soils, and absence of tsetse flies, provide a favorable environment for smallholder dairying on mixed crop–live-stock farms. The example presented here draws on a study conducted in the Hai district, in the Kilimanjaro region of Tanzania, and reported in Mdoe and Wiggins (1997). The study area covers the densely settled highlands, with population density of more than 190 persons per square kilometer and lying between 1,000 to 1,600 meters; and the adjacent lowlands, at 800 to 1,000 meters. Rainfall is bimodal, falling from March through May and again from September to November, with amounts varying from 1,000 to 1,500 millimeters in the highlands and from 500 to 900 millimeters in the lowlands.

Coffee planting was introduced in the 1920s and for a long time was the main cash earner. However, during the 1970s the combination of falling coffee prices and outbreaks of coffee-berry disease led to a decline in the relative importance of coffee and an upsurge in dairying, which has now become a more important source of cash for the majority of households.

The growth of dairying in the region was initially supported by dairy development projects sponsored by the government and international development agencies. These agencies provided and encouraged the use of improved breeding stock, artificial insemination, forage planting, molasses, and urea feed supplements. The costs of these inputs were subsidized. Through this process, farmers began to incorporate dairy animals into their farms. By the time the study was conducted 20 years after the initial interventions, all the 120 households surveyed owned cattle, typically in small herds of 3 to 6 improved dairy stock. Only 7 percent of the sample cattle were local, purebred zebu. Milk output for the zebu cattle was about 2.3 liters per cow per day, while the average for the crossbred cow was 5.4 liters per day.

In addition to the dairy animals, the farmers grow coffee and banana as an intercrop. Coffee is sold for cash, while banana is consumed as a staple food. Since fallowing was no longer practiced, the fertility of these plots was maintained through the use of animal manure. Farmers collected about 5.4 tons of manure per cow per year. On fields where food crops of grain, maize, beans, or intercrops of maize and beans are grown, about 125 kilograms per hectare of ammonium sulfate was applied. Small areas, about 0.24 hectares on the average, were planted with forage—elephant and Guatemala grasses.

Only a third of the households surveyed had access to grazing land. As a result, most cattle were stall fed. The cows' basic diet consisted of banana leaves and stems, crop residues, and grasses either harvested from the cultivated forage plots or collected from the forest or river banks. Maize bran and purchased molasses and minerals were used to supplement these feeds. Economic analysis of the system showed rates of return of about 20 percent for dairying, which was almost three times the discount rate used in the analysis. Net returns were, however, sensitive to key parameters, such as milk yields, milk prices, and input costs.

Discussion: Drawing Lessons from the Different Intensification Patterns

The main features of the crop–livestock systems reviewed in the previous section are summarized in Table 5.2. The three systems cannot be directly compared because the main factors that have influenced their development are different. Population growth, at about 3 percent per year over the last 30 years, and declining rainfall over the same period have largely contributed to the pattern of crop–livestock systems in southwest Niger. In southwest Burkina Faso and southern Mali, cash-crop production and the high income earned from it provided the stimulus for increased farmer investment in livestock and the subsequent integration of crop and livestock activities. Growth in urbanization and deliberate government policy promoted the development of smallholder dairying in Tanzania. Differences in the main driving forces create difficulty in assessing the role of a given factor across the three systems.

Because the determinants are varied, the functions performed by livestock in these systems differ. In the first two case studies, the primary role of livestock is in providing inputs (manure and draft power) into crop production, while in the third the primary emphasis is in the outputs (milk and other dairy products) supplied by the animals. The higher variability of rainfall and the associated fluctuations in crop yield create an important role for livestock in both *ex ante* and *ex post* risk-management strategies of farmers in Niger (Williams, Fernández-Rivera, and Powell 1994). Higher and less variable rainfall in the subhumid and highland zones as well as the higher income from cash-crop production reduce the emphasis on using livestock as an insurance substitute.

The extent of intensification observed in the three case studies going from Niger to Tanzania also correspond to a gradual improvement in the agroecological conditions—higher rainfall and better soils. However, it would be wrong to assume a cause-and-effect relationship here. The same semi-arid climate in Niger that supports only a partial intensification of crop–livestock systems in the southwest supports an intensive and quite successful onion and garlic production in the inland valleys of central Niger. Similarly, soils in the groundnut basin of Senegal and in the cashew plantations of Tanzania (not in the Kilimanjaro region described above) are poor, yet intensive agricultural systems were able to develop in these places. Thus, it is the interacting effects of agroecological, eco-

conomic, technological, and institutional factors that determine the pattern of intensification at a given location.

The catalytic role that formal institutions (extension and credit), the private sector, and government policy can play in promoting sustainable intensification of crop–livestock systems is clearly seen in the case of southwest Burkina Faso, southern Mali, and Tanzania. Conversely, the partial intensification seen in Niger can be considered the end result of an institutional and policy failure. Farmers are still unable to use improved inputs, such as mineral fertilizers and feed supplements, because they lack access to them and because of the high and variable cost of these inputs in relation to product prices. For example, the price ratio of nitrogen to millet grain in Niger has risen from less than 2 in 1992 to more than 5 in 1997 as the fertilizer subsidy was removed. This makes the profitability of using such inputs highly variable over time and may create substantial financial risk for farmers.

TABLE 5.2 Main features of the three crop–livestock systems reviewed

Determinants, characteristics, and constraints	Case study		
	I	II	III
Principal driving forces	Population growth, declining rainfall	Improved technologies associated with cash-crop production	Growth in urbanization, incomes, and government policy
Main sources or types of risk faced	Weather	Price, financial	Price, financial
Animal management within the system	Grazing, range, and crop residue, with minimum supplementation	Grazing, range, and crop residue, with adequate supplementation (cake)	Stall feeding with cut forage and crop residue, with high supplementation (molasses)
Functions of animals within the system	Manure supply, risk management	Animal traction, manure supply	Milk, manure supply
Land rights	Communal, and private	Communal, and private	Communal, and private
Role of customary institutions	Positive, could be strengthened	Positive, could be strengthened	Positive, could be strengthened
Influence of formal institutions	Weak	Strong	Strong
Level of intensification	Low	High	High

Implications for the Policy and Research Agenda

The diversity in the origins and patterns of development of the crop–livestock systems considered suggests that different prescriptions will be needed to improve their productivity. Considering first the situation in Niger, while the achievable level of intensification may never approach what has been seen in Burkina Faso and Mali, a number of steps can be taken to deepen the ongoing process of intensification.

Improving soil fertility is crucial to increasing agricultural output in Niger. In addition to manure, which is already commonly used, other inputs, such as mineral fertilizer and feed supplements, are needed to increase the productivity of the farming systems. Improving farmers' access to these inputs through upgrading rural infrastructure and input-distribution systems seems to be an urgent task. Implementation of these measures will improve supply, but at the same time effective demand for these inputs will need to be created. One option will be to initiate the kind of vertically coordinated schemes that provide credit, access to new technologies, and a stable output market that has worked so well for cotton in Burkina Faso and Mali. A similar scheme for cowpea produced as cash crop in the Sahelo-Sudanian zone of Burkina Faso was reported by Bezuneh, Savadogo, and Sanders (1996). Policy interventions to aid the formation of farmer organizations that could work in partnership with the state in input distribution and credit provisioning will encourage greater access to purchased inputs and ease the burden on the public sector.

Given the variability in rainfall and its likely effect on animal feed supply, it is important that institutional changes take place that will encourage collective action in the management of grazing resources. Agronomic and ecological research on the long-term effects of grazing on the vegetation and soil is needed to inform decisions on appropriate grazing regimes. Economic analysis will also be needed to determine the net returns to different grazing schemes and stocking rates, and the incentives required to promote cooperative action. In addition, institutional arrangements for facilitating seasonal movement of herds will be required to improve livestock productivity and to prevent rangeland degradation in the cultivated zone.

Turning to the relatively more commercialized crop–livestock systems in Burkina Faso, Mali, and Tanzania, policy interventions to minimize the financial risks faced by farmers must be high on the agenda. Measures to reduce the unit cost of production and marketing will increase the profitability of these systems and ease the risk pressure on farmers. Evidence emerging after the structural adjustment and macroeconomic policy reforms in Burkina Faso, Mali, and many other countries shows that demand for purchased inputs may weaken as subsidies are removed and parastatals withdraw from input-distribution schemes (Reardon et al. 1997). This implies that cost-effective measures of input delivery need to be devised.

At the same time, research to boost the yields of crops and livestock should be encouraged. This research should be geared toward producing a diversified

range of technical options to suit the needs of farmers with different resource endowments, management skills, and ability to bear risk.

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PART II

**Modeling of the Effects of Risk on
Rangeland Management**

6 An Economic Analysis of the Effects of Production Risk on the Use and Management of Common-Pool Rangelands

NANCY MCCARTHY

Across much of Sub-Saharan Africa, extensive and semiextensive livestock systems are based on the use of common-pool rangelands for the essential input of forage into livestock production. These environments are often characterized by a high degree of environmental risk. While much research has been devoted to the study of common-pool resources and their attendant management institutions, less has been done to explore the effects of production risk on the decisions of producers who share a common-pool resource. Our objectives in this chapter are twofold. First, we examine the effects of risk on production decisions under the two extreme assumptions of either perfect cooperation or no cooperation over the use of the common-pool rangelands. Second, we explicitly examine the effects risk has on the incentives for individuals to cooperate as well as to deviate from cooperative agreements. We then use the theoretical models to investigate issues such as the following:

- Is there a differential effect of risk on producer behavior depending on the level of cooperation reached to manage the commons?
- How does risk affect producers' supply responsiveness with respect to changes in exogenous variables (that is, output price, forage productivity, costs)?
- How does risk affect incentives for a group to make and enforce use rules over the common property rangeland?
- How will heterogeneity in terms of risk preference across producers affect both supply response and the ability of the group to cooperate over the management of the commons?

The second and third sections of this chapter will each follow the same format: a short review of the relevant literature, development of a theoretical model, and discussion of the testable hypotheses deriving from the theoretical model. In the second section, we are concerned with identifying the impacts of risk on producer behavior under the two extreme cases: where members jointly maximize net benefits to the resource; and where members do not cooperate, and instead maximize individual benefits, taking as given others' stock levels (using the standard model arising from noncooperative game theory). Here we derive the conditions for which stock levels under noncooperation are greater than the joint-maximization levels and compute the comparative-statics proper-

ties of the noncooperative game. Furthermore, we allow for heterogeneity among agents in terms of marginal costs or risk preferences. In the third section, we examine the effects of risk and heterogeneity among producers on the scope for possible collective action over the management of the common-pool resources. Here we are concerned with two aspects of the collective management problem: determining the factors affecting the set of possible outcomes that simultaneously leave both players better off than at the Cournot-Nash noncooperative outcome, thereby determining the scope for collective action; and determining the effect of exogenous variables on the incentives of players to participate in, or deviate from, cooperative agreements.

All of the analyses in this chapter are concerned with the exploitation of a pasture of fixed size, which is exogenously given and well defined, and where the number of members accessing the resource is also fixed and well defined. As noted by many researchers of extensive and semiextensive livestock systems in Sub-Saharan Africa, one strategy pastoralists can use to manage rainfall risk is to maintain various degrees of access to a wide range of grazing resources (see Swallow 1991; Scoones 1994; van den Brink, Bromley, and Chavas 1995). Under these circumstances, herders will have at least some decisionmaking power over the size of the grazing area, which will be a function of both the productivity of the resource as well as its potential to mitigate rainfall, and therefore forage, variability. These analyses, however, do not explicitly model the impact of risk on resource use when herders' are not cooperating, nor the effect of risk on the incentives to actually make and enforce cooperative agreements over resource use. In our analysis below, we take as given the size of the resource to highlight these impacts; in the conclusion, we discuss the integration of the two models.

The Effects of Risk in Production under Joint-Maximization versus Individual Optimization

Relevant Literature

As noted above, most of the research on risk has focused on explaining the existence and resilience of even poorly managed common-pool pastures because of the resource's value as a means of insurance or risk mitigation through spatial mobility. In this chapter, however, we focus on the impact of risk on exploitation rates when the size of the common-pool pasture is fixed. The most active area of research for risk and common property in the context of a fixed resource has been in the area of fisheries management. Sandler and Sterbenz (1990), using general functional forms for both expected utility and production, show that harvest uncertainty in a fisheries model will result in lower exploitation rates than under the corresponding certainty case. This leads them to conclude that "the tragedy of the commons is therefore mitigated...in the face of harvest uncertainty" (Sandler and Sterbenz 1990, 156).

More generally, it is posited that the greater the variability of an activity, the less resources will be devoted to that activity when producers are risk averse. Sadoulet and de Janvry (1996) note that risk-averse producers will reduce output as risk increases—in a single-commodity model—as long as agents are not “too” risk averse. That is to say, for very-risk-averse agents, it is possible that they will dedicate more resources to the risky activity, to increase the chances that realized output reaches a sufficient level. Although this is theoretically plausible, empirical verification of such a high degree of risk aversion is nonetheless lacking. However, another interesting aspect of the problem occurs when risky production is incorporated into a household model, which allows for the fact that a household can be both a producer and primary consumer of its own output. Here Sadoulet and de Janvry note that it is more likely that the household will produce more as risk increases if the household is a net buyer of the commodity. The model developed below is a pure producer model, and as such does not permit interactions between production and consumption activities of households. Nonetheless, this point is important to consider in discussions of the more general applicability of the model.

Development of the Theoretical Model

A group can manage its resources in many ways, even in the simple model developed below. However, in this study we follow the typical analysis and begin by examining the two extreme cases—joint maximization and noncooperation (see Dasgupta and Heal 1979). Joint maximization implies that a group can “perfectly” manage its common resources (in the sense that all negative externalities are internalized, and costs to this management are zero—an assumption that is relaxed in the third section). Conversely, noncooperation implies that each individual is concerned only with his or her own profit-maximization problem, and we use a noncooperative game framework here to arrive at the equilibrium outcome. Furthermore, the model developed below consists of a single period; we consider neither intertemporal externalities nor possible outcomes that are supportable under a repeated game structure. Overstocking occurs if the stocking level chosen under the noncooperative game is higher than the level associated with joint maximization. Finally, we use the mean-variance approximation for expected utility obtained by employing a second-order Taylor series expansion (Hirschleifer and Reilly 1992).

Initially, we assume players to be homogeneous in terms of marginal costs and risk preferences. We do this as a base case and show that, as in Sandler and Sterbenz (1990), the total number of cattle stocked under risk is less than the corresponding case under certainty. Furthermore, we establish profits as being actually higher—but expected utility, lower—when production poses risk and a noncooperative game is played. Under joint maximization, stock levels, expected utility, and profits are all lower when risk is present, compared with the riskless scenario. For joint maximization, a further assumption must be imposed on the model with respect to individual stocking rates, which are otherwise not

identified. It is assumed that each herder is allocated rights to stock that is $1/n^{\text{th}}$ of the optimum. While this is an intuitively plausible assumption when producers are homogeneous, its justification under producer heterogeneity is more complicated. Thus, in this section, we examine comparative-statics results for the noncooperative game when agents are heterogeneous but defer a discussion of the effects of heterogeneity on joint maximization until the third section.

Joint-Maximization versus Noncooperation; Risk versus No Risk in Production

The profit-maximization equations are given below for the following scenarios:

- Joint maximization without risk in production
- A noncooperative game without risk in production
- Joint maximization with risk in production
- A noncooperative game with risk in production.

Immediately following are the respective first-order conditions.

Scenario 1: Joint maximization, no risk in production

$$\max_{L_1, L_2} EU(\mathbf{p}^{SO}) \equiv \mathbf{p}^{SO} = P_L [L_1 f(L_1 + L_2; \mathbf{a}, \mathbf{b}) + L_2 f(L_1 + L_2)] - cL_1 - cL_2. \quad [1]$$

Scenario 2: Noncooperative game, 2 players, no risk in production

$$\max_{L_1} EU(\mathbf{p}_1^{CN}) \equiv \mathbf{p}_1^{CN} = P_L L_1 * f(L_1 + L_2; \mathbf{a}, \mathbf{b}) - cL_1. \quad [2a]$$

$$\max_{L_2} EU(\mathbf{p}_2^{CN}) \equiv \mathbf{p}_2^{CN} = P_L L_2 * f(L_1 + L_2; \mathbf{a}, \mathbf{b}) - cL_2. \quad [2b]$$

Scenario 3: Joint maximization, risk in production

$$\begin{aligned} \max_{L_1, L_2} EU(\mathbf{p}^{SO}) = & \left[P_L L_1 * f(L_1 + L_2; \mathbf{a}, \mathbf{b}) \right. \\ & \left. - cL_1 - \gamma_1^2 \mathbf{s}_1^2 \mathbf{f}_A (P_L L_1 * f(L_1 + L_2; \mathbf{a}, \mathbf{b}))^2 \right] \\ & + \left[P_L L_2 * f(L_1 + L_2; \mathbf{a}, \mathbf{b}) - cL_2 \right. \\ & \left. - \gamma_2^2 \mathbf{s}_2^2 \mathbf{f}_A (P_L L_2 * f(L_1 + L_2; \mathbf{a}, \mathbf{b}))^2 \right], \end{aligned} \quad [3]$$

$$\text{s.t.} = L_1 = L_2.$$

Scenario 4: Noncooperative game, 2 players, risk in production

$$\max_{L_1} EU(\mathbf{p}^{CN}) = \left[P_L L_1 * f(L_1 + L_2; \mathbf{a}, \mathbf{b}) - cL_1 - \frac{1}{2} \mathbf{s}_q^2 \mathbf{f}_A (P_L L_1 * f(L_1 + L_2; \mathbf{a}, \mathbf{b}))^2 \right]. \quad [4a]$$

$$\max_{L_2} EU(\mathbf{p}^{CN}) = \left[P_L L_2 * f(L_1 + L_2; \mathbf{a}, \mathbf{b}) - cL_2 - \frac{1}{2} \mathbf{s}_q^2 \mathbf{f}_A (P_L L_2 * f(L_1 + L_2; \mathbf{a}, \mathbf{b}))^2 \right]. \quad [4b]$$

The parameters for the equations above are as follows:

- $EU(\mathbf{p}^{JM,CN})$ = expected utility of profits accruing under joint maximization, and under Cournot-Nash solution, respectively.
- P_L = price of livestock output.
- $f()$ = average product function.
- L_i = number of cattle stocked by players, $i = 1, 2$.
- \mathbf{ab} = forage productivity parameters, where $\mathbf{f}'_A \mathbf{a} > 0$, and $\mathbf{f}''_A \mathbf{a} < 0$.
- c = constant marginal cost of livestock.
- \mathbf{s}_q^2 = variance in rainfall.
- \mathbf{f}_A = coefficient of absolute risk aversion.

FIRST-ORDER CONDITIONS AND MODEL PROPOSITIONS. To simplify notation in the first-order conditions, the following definitions are used:

- f = average product function, $f = f(L_i + L_j; \mathbf{ab})$;
- f' = marginal of the average product function, $\frac{\partial f}{\partial L}$; and
- R = variance * coefficient of absolute risk aversion, $(\mathbf{s}_q^2 * \mathbf{f}_A)$.

Scenario 1: Joint maximization, no risk in production

$$2P_L * [f + 2 * L * f'] - 2c = 0,$$

or equivalently,

$$2P_L * [f + 2 * L * f^*] - c = 0, \quad [5]$$

where s.t. = $L_i = L_j = L$.

Scenario 2: noncooperative game, 2 players, no risk in production

$$P_L * [f + L_i * f^*] - c = 0 \quad [6]$$

for $i = 1, 2$.

Scenario 3: joint maximization, risk in production

$$2P_L * [f + 2L f^* - R_i L f * [2P_L(f + 2L_i f^*)]] - 2c = 0;$$

or equivalently,

$$2P_L * [f + 2L f^* - R_i L f * [2P_L(f + 2L_i f^*)]] - 2c = 0. \quad [7]$$

Scenario 4: noncooperative game, 2 players, risk in production

$$P_L * [f + L_i f^* - R_i L_i f^* * [P_L(f + L_i f^*)]] - c = 0, \quad [8]$$

for $i = 1, 2$.

Proposition 1: Comparing the first-order conditions between the risk and no-risk scenarios, we see that, under noncooperation, exploitation levels are lower when production entails risks—which is easily verified by comparing equations (6) and (8)—and that, under joint maximization, exploitation levels are lower when production entails risk. (Compare equations [5] and [7].)

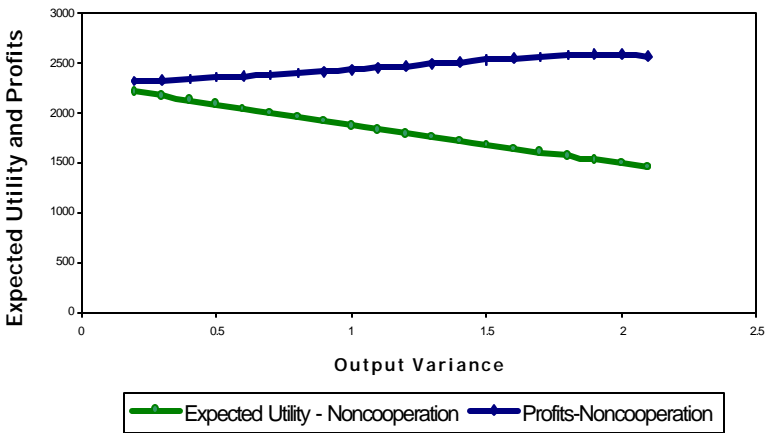
Proposition 2: Given riskiness in production, total stock levels are higher under noncooperation than under joint maximization, the proof of which is provided in Appendix 1.

Proposition 3: Stock levels under noncooperation and production risk may be lower than the levels under riskless, joint maximization. (Proof is provided in Appendix 1.)

We can now compare these results with those obtained in the Sandler and Sterbenz model. As noted above, they show that “overstocking” is reduced as risk increases, and that risk therefore “mitigates the tragedy of the commons.” However, we must make this comparison across two different types of management regimes as well as across two different levels of risk. That is to say, this result depends on using the joint-maximization solution in the absence of risk as the basis for calculating the degree of overstocking. If instead we compare the noncooperative outcome under risk with the joint-maximization solution under risk, the result would show that overstocking—defined here as the difference between the joint-maximization and noncooperative solutions—does not neces-

sarily decrease when risk increases. Nonetheless, a comparison to the riskless situation is appropriate if we consider this reflects the socially efficient outcome. We can make this point more forcefully through examination of the profits accruing under both scenarios as the level of risk is increased. As stated in proposition 1, stocking rates are lower under both regimes when there is production risk. However, profits accruing to the individual are actually higher under the noncooperative game for a wide range of values for risk, a result depicted graphically in Figure 6.1.

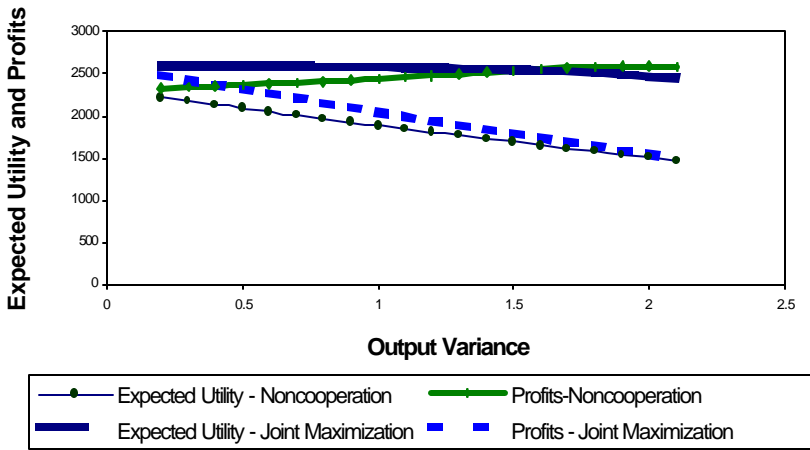
FIGURE 6.1 Change in expected utility and profits, for an increase in the variance of production



Thus, starting from a point of no risk, as risk increases, the stock level declines, and profits under noncooperation will increase until the point where stock levels coincide with the optimal stock levels for the riskless joint-maximization solution. At this point, further increases in risk will reduce both profits and expected utility. Note that, for the joint-maximization case, increases in risk will always reduce both profits and expected utility. Figure 6.2 illustrates the case in which profits are actually lower under joint maximization than under noncooperation; however, it should be stressed that expected utility will always be lower under noncooperation. Thus, where producers are risk averse, stocking rates may produce profits at—or even above—profits that coincide with joint maximization. The danger here is in interpreting these profits as indicative of producer welfare, or even worse still, as using this proxy of profits as indicating that the group is actually managing its resources in a socially optimal way. Consider a policy option that will reduce output variance faced by the producer. If the initial assumption is that the group is cooperating (on the basis of profitability), then a reduction in risk should lead to increased producer profits as well as to expected utility, without increasing stocking rates beyond the socially efficient

level (the riskless, joint-maximization level). However, if the group is not cooperating, a reduction in output risk may very well lead to decreased profits and increased overstocking—although expected utility will still be higher. Nonetheless, valuing such an intervention will crucially depend on the situation *ex ante*; a point that is discussed further in the third section of this chapter, where we examine the ability of the group to sustain cooperation in the face of exogenous parameter changes.

FIGURE 6.2 Change in expected utility and profits for an increase in output variance; noncooperation and joint maximization



In the next section we give the comparative-statics results for the noncooperative game, first assuming that producers are homogeneous, and second, assuming that there is heterogeneity among producers either in marginal costs or in risk preferences. As is made clear in the next section, heterogeneity among agents significantly complicates the joint-maximization problem; we defer this analysis until that section.

Comparative-Statics Results

Optimal stock levels are derived from the simultaneous solution of each player’s respective first-order condition as given in equation [8]. Thus, to derive comparative statics, we totally differentiate the first order conditions and compute the comparative-statics matrix. However, although the problem looks similar to the single-agent problem with two choice variables, in fact, second-order sufficient conditions cannot be used to sign the Jacobian to the problem, as discussed in Caputo (1996). Dixit (1986) uses an ad hoc dynamic adjustment process to arrive at the result that this matrix must be negative semidefinite, by

appealing to necessary and sufficient conditions for local asymptotic stability. Instead of appealing to the ad hoc adjustment process, we instead make an assumption that fits well with our particular empirical focus, which is that

$$\frac{\mathcal{J}f}{\mathcal{J}L_1} = \frac{\mathcal{J}f}{\mathcal{J}L_2}, \quad \frac{\mathcal{J}^2 f}{\mathcal{J}L_1^2} = \frac{\mathcal{J}^2 f}{\mathcal{J}L_2^2}, \quad \text{and} \quad \frac{\mathcal{J}^2 f}{\mathcal{J}L_1 \mathcal{J}L_2} = \frac{\mathcal{J}^2 f}{\mathcal{J}L_2 \mathcal{J}L_1}.$$

at the equilibrium. This assumption has been widely made in the theoretical literature (see Dasgupta and Heal 1979; Sandler and Sterbenz 1990), and posits that the “inputs”—in our case, cattle—are equally productive across herders *in terms of their ability to convert forage to meat, milk, or draft power* so that each producer’s share of total output is equal to his or her share of variable inputs applied. While we allow for heterogeneity among herders in terms of costs or risk, we still assume the animals to be of the same productivity, an assumption that fits well with the empirical observation that herders in extensive and semiextensive production systems generally stock the same type of cattle, usually indigenous breeds. This assumption would be somewhat dubious if, for instance, we were considering a herder who held indigenous cattle and who shared common pastures with another herder who held high-growth stock (with the assumption that both types of animals are, for example, equally adapted to their environment and are equally capable of handling environmental stress and disease risks). In the latter case, the high-growth stock would be more efficient at converting a given amount of forage into meat or milk than the indigenous breed, other things being equal. Given our empirical focus on animals held by herders in semi-arid Africa, this particular complication is not likely to arise. As shown in Appendix 2, this assumption ensures that the Jacobian is negative semidefinite, enabling us to compute the following comparative-statics results (proofs of which are provided in Appendix 3).

Under Agent Homogeneity

Proposition 4: Stock levels are decreasing in marginal costs. Stock levels may or may not be increasing in the productivity of the resource or with output prices. If agents are not “too” risk averse or the output variance is fairly low, then stocking rates will increase with increases in forage productivity and output prices, although the response will be dampened compared with the certainty case.

The direction of these results is not surprising. Although it is theoretically possible to get “perverse” responses, that is, that stocking rates actually decline with an increase in output price, it is highly unlikely. However, as in other studies, responses will be dampened compared with the certainty case, since higher profits lead to a greater variance in income and raise the cost of risk, thereby leading to smaller increases in inputs. We now examine the case where producers are heterogeneous, where the results are more complicated but more interesting.

Heterogeneity in Risk Preferences

Let herder 1’s coefficient of absolute risk aversion be greater than herder 2’s. While all of the comparative statics are derived in Appendix 3, it is instructive to examine one of the results when heterogeneity is introduced into the problem. Below is the equation for the change in the i^{th} person’s stock level given an overall positive change in forage productivity.

$$\frac{\partial L_i}{\partial \alpha} = \frac{-1}{|J|} * \left(A * \frac{\partial^2 P_j}{\partial L_j^2} - B * \frac{\partial^2 P_i}{\partial L_i \partial L_j} \right)$$

where

$$A = [P_L(f_\alpha + L_i f_{i\alpha})][1 - P_L R_i L_i f] - P_L R_i L_i f_\alpha [P_L(f + L_i f_i)], \text{ and}$$

$$B = [P_L(f_\alpha + L_j f_{j\alpha})][1 - P_L R_j L_j f] - P_L R_j L_j f_\alpha [P_L(f + L_j f_j)].$$

As with many of the following comparative-static results, the signing of this term depends not only on whether or not both herders are not “too” risk averse, but also on the absolute difference between herders with respect to stocking levels, $[L_i - L_j]$, and the term representing the coefficient of absolute risk aversion times the variance, R_i . From Appendix 2, we know that

$$\left| \frac{\partial^2 P_j}{\partial L_j^2} \right| - \left| \frac{\partial^2 P_i}{\partial L_i \partial L_j} \right| < 0.$$

If $|A| \geq |B|$ in the equation above, then stock levels will increase with increases in forage productivity. A is always greater than B whenever $R_i L_i \leq R_j L_j$. For $R_i L_i \gg R_j L_j$, however, it is possible for the following to be negative:

$$\frac{\partial L_i}{\partial \alpha}$$

That is to say, if the i^{th} herder is sufficiently more risk averse than the j^{th} herder, it is possible that the i^{th} herder will stock fewer animals on more productive land. The intuition is that the herder who is less risk averse will respond to changes in parameters relatively more than will the herder who is more risk averse. As captured in the comparative-statics expression above, an increase in forage productivity produces two effects: the positive direct effect, and the effect stemming from the other herder’s response to the same parameter change. Caputo (1996) calls this second effect the “strategic effect,” which we use as well. It is possible for the strategic effect, which is negative, to dominate the direct effect for one herder—especially if that herder faces much higher marginal costs or is much more risk averse than the other herder. It must be the case that the direct effect dominates for the lower-cost or less-risk-averse herder, how-

ever. Note that the possibility of a dominant strategic effect also holds in the absence of risk—if at the initial equilibrium, $L_j \gg L_i$, it is also possible that the overall effect of an increase in forage productivity will be to reduce stock levels for the i^{th} herder.

Finally, however, note that optimal number of livestock, L_i is an inverse function of the cost of risk, R_i . That is to say, all things being equal, a relatively high L_i will be associated with a relatively low R_i . Thus, we expect that, except for large differences in costs or in risk preferences, higher forage productivity will induce a positive response by both players. Nonetheless, starting from an initial difference in risk preferences and hence stock levels, the more-risk-averse individual will stock fewer animals in response to positive changes in exogenous variables than will the less-risk-averse individual—and hence, distribution of livestock assets will widen even when both players respond positively.

Proposition 5: Given that agents are not “too” risk averse, nor “too” differentiated in terms of risk preferences, individual stock levels will increase with increases in output price and forage productivity. Any changes in exogenous parameters that positively affect profits will lead to a widening of the distribution of livestock holdings; conversely, any negative changes will lead to a narrowing of that distribution.

Proposition 6: A decrease in the i^{th} herder’s marginal costs will lead to an unambiguous increase in that herder’s stock, and to an unambiguous decrease in the other herder’s stock. The overall effect on total stock levels is ambiguous and will depend on whether it is the low-cost or high-cost herder’s costs that are increasing.

Proposition 7: An increase in the coefficient of absolute risk aversion for the i^{th} player will result in lower stock levels for that herder, and to an increase in the other herder’s stock. The effect on overall stock levels is ambiguous.

Table 6.1 summarizes the results of the comparative statistics.

Summary

In this section we have shown that, under joint maximization, herders are better off in terms of welfare and profits as production risk decreases, and that their stock levels increase as production risk declines. However, under noncooperation, though stock levels will also increase with decreases in production risk, profits may in fact decline—although herders are better off in terms of welfare when this risk is lower. Furthermore, we have derived the comparative statics for the case of two herders. When herders are sufficiently homogenous in terms of risk preferences or marginal costs, then changes in exogenous parameters that

TABLE 6.1 Summary of comparative-statics results

Exogenous parameters	Case 1: Homogeneity (herder 1 and 2)	Case 2: Herder 1 with lower coefficient of absolute risk aversion		
		Herder 1	Herder 2	Total herd size
Herders not “too” risk averse, nor “too” differentiated in terms of risk preferences				
Increase in:				
Pasture productivity	+	+	+	+
Output prices	+	+	+	+
Decrease in:				
Pasture fragility	+	+	+	+
Marginal costs				
For both players, case 1	+			
For herder 1, case 2		+	-	+/-
Coefficient of absolute risk- aversion				
For both players, case 1	+			
For herder 1, case 2		+	-	+/-
Herders not “too” risk averse, but are sufficiently differentiated in terms of risk preferences				
Increase in:				
Pasture productivity		+	-	+/-
Output prices		+	-	+/-
Decrease in:				
Pasture fragility		+	-	
Marginal costs for herder 1		+	-	+/-
Coefficient of absolute risk- aversion for herder 1		+	-	+/-

positively affect profits for both herders will increase stock levels. However, even in this case, as long as herders exhibit some degree of heterogeneity beforehand, the distribution of livestock holdings will widen in response to these changes. In addition, where herders are sufficiently heterogeneous, it is possible for the more-risk-averse or higher-cost player to reduce his or her livestock holdings. Many other analyses have pointed to a widening distribution of assets when there is heterogeneity initially; however, in the case of noncooperatively exploited common property, these differences will be exacerbated, because of the added "strategic" effect. Policy changes that affect direct producer incentives for all resource users must adequately account for both these effects, lest the resulting distribution be far larger than anticipated.

Incentives for Cooperating, Incentives for Deviating, and the Scope for Collective Action

In the previous section, we focused on the two extreme cases of either no cooperation or perfect cooperation. Nonetheless, the set of possible outcomes that would be Pareto superior to the noncooperative outcome is usually large, and thus we have no reason to arbitrarily fix our attention on only these extremes. Thus, in this section, we develop a model of a centralized, local management-institution that can choose any stocking level that leads to a Pareto improvement for all players, subject to costs of cooperation. As noted in the introduction, we do not consider decentralized solutions, that is, outcomes that can be supported under a repeated game structure. Instead, we posit that the ability of the group to make and enforce use rules for the management of common pastures will be a function of the one-period incentives to cooperate, as well as incentives to deviate from any specified level of cooperation. What is unique to this model, then, is that although the group does attempt to jointly maximize the sum of members' utility, costs of doing so are a function of incentives to deviate from any agreements that are calculated from the noncooperative game. The main questions to be addressed is: If the group does attempt to cooperate, how does risk affect the different incentives to engage in cooperation, and how do differences in risk preferences affect the range of possible levels at which the group may decide to cooperate?

Relevant Literature

The literature on the use of common-property resources by a well-defined group of users is vast, and considerable empirical research addresses the ability of groups to manage common property resources (Ostrom 1990; Seabright 1993; McKean 1992; Stevenson 1991; Bromley 1992; Bardhan 1993). Although the case-study and socioanthropological literature has attempted to identify factors associated with successful management of common-property resources, a rigorous theoretical framework has yet to be developed, so that the effect of changes in exogenous variables on exploitation rates and the functioning of a manage-

ment institution are still not well understood. Nonetheless, many researchers with extensive field experiences have noted two distinct phenomena: The first is that, generally, some type of centralized management institution or regulatory body over resource use exists; or alternatively, lack of centralized management is usually associated with overexploitation as predicted by the noncooperative model (Ostrom 1990; Baland and Platteau 1996; McCarthy, Sadoulet, and de Janvry 1998). The second phenomenon is that groups undertake cooperation to the extent that the benefits from cooperation outweigh the costs of making and enforcing agreements (Ostrom 1990; Thompson and Wilson 1994), or stated somewhat differently, that partial cooperation is often observed in reality (Ostrom 1990; Baland and Platteau 1996).

Why is the first phenomenon interesting? The answer lies in the way economists generally approach the problem of the commons versus other disciplines, particularly sociologists, anthropologists, and even range ecologists (Behnke et al. 1993; McKean 1992; Berkes 1989). Economic models based on game theory hold that cooperation cannot be sustained in a one-period game, and conversely, that an infinite number of outcomes may be sustained by a group of users if the game is repeated and the future or uncertainty over when the game will end is discounted. These outcomes are sustained by credible threats to dissolve cooperation if any cheating is observed, either forever or for some specific number of periods (Kreps 1990). However, because these self-enforcing strategies are undertaken solely on the basis of individual actions, the group has no economic reason to form an institution to manage the commons, that is, there is no need for group cooperation, at least with respect to managing externalities (Baland and Platteau 1996).

If groups actually do form to manage the commons, this type of game-theoretic analysis cannot aid in explaining either the existence or the functioning of institutions to manage the commons. Baland and Platteau (1996) discuss a number of reasons why "collective regulation through a central authority may be desirable," including the following: where multiple equilibria exist, group-level regulation may aid in reaching the Pareto-optimal outcome; and where information is not perfect, decentralized punishment strategies may be very unstable. These are plausible explanations, but they cannot address the second observation, which is that cooperation is often partial. That is to say, we should not observe levels of cooperation that are below Pareto-optimal levels if the purpose of a centralized management institution is really only to act as a clearing house for information and for coordinating activities.

Several authors mention that both costs and benefits are associated with cooperation, so that the members of a group will weigh these costs and benefits when choosing a level of cooperation (Bromley 1992; Ostrom 1990, 1992; Wilson and Thompson 1993). At the same time, a number of authors note that groups are not likely to be able to enforce use rates that are socially optimal, and that cooperation is likely to be partial (Ostrom 1992; Baland and Platteau 1996). In fact, Oakerson (1992) states that "some degree of suboptimal use may actu-

ally be efficient when costs of obtaining collective action are taken into account.” On the other hand, Seabright (1993) cogently argues that as long as a members of a group can cooperate, they have no reason not to pick the best possible outcome to cooperate over. In addition, as noted above, Baland and Platteau (1996) argue that arriving at the Pareto-optimal level of cooperation when multiple equilibriums exist is likely to be a reason for the existence of a centralized regulatory body.

The main problem with the discussion of costs of cooperation is that little attention has been paid to the actual form of these costs, although much of the discussion seems to imply that they are fixed costs. Transaction costs of cooperating may be increasing in the number of members but, in many cases, the number of members is not the choice variable. The use rate—in the case of grazing land, the number of livestock to graze, or the number of livestock per some time period—is generally the choice variable under the greatest direct control of the users, either as individuals or as members of the group. A group may face some given level of transactions costs, and it might have some given stock of “social capital” that reduces the costs of cooperation, but it is unclear from the literature why these costs of cooperation are themselves a function of use rates, for example, stocking rates, amount of fish to harvest, or timber to fell. To summarize, benefits are greatest at the joint-maximization solution, and if costs are fixed, then there is no reason to observe partial cooperation. Below, we argue that costs are in fact a function of the agreed-upon stocking level, thereby allowing for partial cooperation.¹

Finally, we are again concerned with the effects of heterogeneity on the ability of the members of the group to cooperate. Perhaps the strand of literature that is most relevant to the model developed below has emerged from oligopoly theory, specifically the work on sustainability of collusion when firms are heterogeneous, though it is generally assumed that agents are risk neutral. The non-cooperative game framework for explaining the exploitation of common property correlates directly to the optimal quantities for producing in an oligopoly. Perfect collusion in oligopoly is equivalent to perfect cooperation over a common-property resource. Though much of the literature focuses on trigger strategies and mainly ignores explicit group collusion, work has been done that establishes the individual participation constraints that will bound the set of feasible solutions, especially when heterogeneity exists among producers. For example, where marginal costs differ among firms, the optimal “collusive” outcome may not be individually rational for certain firms to participate in—that is, it may entail output levels that cause some firms to shut down, and in the ab-

¹ Because the model is one-period with perfect information (perfect monitoring), the literature on repeated games and the possibility of partial cooperation or collusion where observability of actions is not perfect is not reviewed here. For the oligopoly case see Green and Porter, 1984; for public goods provision, see Bendor and Mookherjee 1988.

sence of side payments, these firms would not enter into such agreements (Harrington 1991; Schmalensee 1987). Johnson and Libecap (1982) note that this problem is likely to be further exacerbated if the allocation of grazing rights (or fishing quotas in their example) must be allocated equally, that is, for sociopolitical reasons (equity), or administrative feasibility. Equity considerations may in fact be very important in the case of common-property resources; the degree to which existing differences in wealth or efficiency can be institutionalized may very well be limited (although see McKean [1992] for the case of Japanese grazing lands).

Modeling Incentives for Cooperating and Incentives for Deviating

In what follows, we develop a model to determine whether the group members' engaging in cooperation is worthwhile, in terms of marginal costs and marginal benefits; and if so, at what level it will cooperate, and how levels of cooperation will change in response to changes in exogenous parameters. While a whole host of sociocultural factors may affect the members' ability to cooperate, in the analysis that follows we focus only on the pure economic incentives to cooperate and to deviate from agreements. Furthermore, we rely heavily on graphical analyses. For more rigorous mathematical treatment of the incentives for cooperating and to deviate, see McCarthy, Sadoulet, and de Janvry (1996); for a more rigorous treatment of individual participation constraints under agent heterogeneity, see Schmalensee (1989), and Harrington (1991).

To graphically illustrate the model, we must give a functional form to the average product function, as well as to parameterize the model. In the analysis that follows, we use a linear-quadratic value function for livestock production. The coefficient of absolute risk aversion is chosen so as to yield a coefficient of relative risk aversion of 0.65 in the base scenario; a figure that implies mid-level risk aversion.² Given these parameter values—and even within wide ranges of all these values—the nonexceptional comparative-statics results hold. That is to say, we have not reproduced the results where agents are too risk averse, or too differentiated in terms of marginal costs or risk preferences, as the former case is not likely to be of importance in empirical applications, and we deal with the latter case in more detail below.

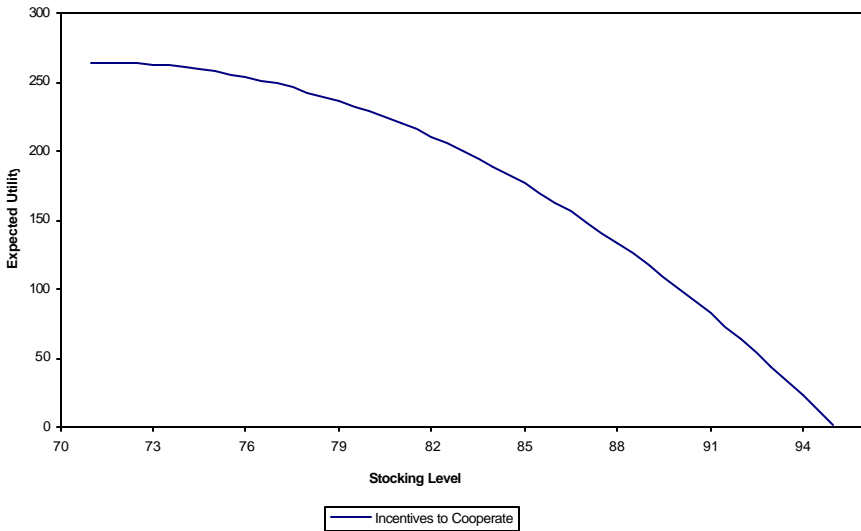
In terms of the incentives for entering into agreements as well as for defecting from them, first we must consider the net gains to the individual from entering into an agreement. These are defined as the profits associated with cooperation, \mathbf{p}_i^{Cc} , minus profits from the initial position of noncooperation (that is, the Nash noncooperative solution), \mathbf{p}_i^{NCnc} . In the analysis that follows, superscript notation has the following meaning: capital letters denote the actions taken by player 1, which can either be to cooperate at an agreed-upon level (C),

² A coefficient greater than 1 is considered highly risk averse.

or to optimally deviate from this agreement (*NC*); similarly, lower-case letters will refer to the actions of player 2 (*c*, *nc*).

The gains from cooperation are plotted in Figure 6.3. Where gains from cooperation for the individual in terms of expected utility are plotted against stock levels, note that gains are achieved by moving from *right to left*, that is, as the group destocks. Thus, the benefits from destocking can be calculated over the entire interval from the noncooperation outcome to the joint-maximization levels.

FIGURE 6.3 Gains of cooperation at varying stock levels



Next, we consider the logic of the prisoner’s dilemma game. Two elements of the game lock the players into the noncooperative outcome—incentives to cheat and incentives not to be duped. The following is a typical example of a Prisoner’s Dilemma game:

		<i>Player 2</i>	
		Cooperate	Not cooperate
<i>Player 1</i>	Cooperate	10, 10	0, <u>15</u>
	Not cooperate	<u>15</u> , 0	<u>5</u> , <u>5</u>

Consider player 1. In the first instance, he must choose the optimal decision to make, given that player 2 cooperates. Clearly his best response is to cheat, and to gain 15 instead of 10. We define incentives for cheating here as the difference between the profits acquired by optimally deviating when the other

player abides by a cooperatively agreed-upon stocking-level minus the profits associated with cooperation:

$$P_i^{NCc} - P_i^{Cc}.$$

Next, player 1 decides what is the best response when player 2 does not cooperate. Clearly this is to not cooperate as well. In this case, the player is choosing not to be cheated on, or not to be duped. Thus, the incentives not to be duped are defined as being the difference between both playing noncooperatively, and player 1's being duped while player 2 plays his or her optimal deviation strategy:

$$P_i^{NCnc} - P_i^{Cnc}.$$

This is the “relentless” logic of the prisoner’s dilemma; and, even though no strategy dominates in the noncooperative game,³ at each possible point of operation, there are incentives to cheat and incentives to deviate, as well as the incentives to cooperate.

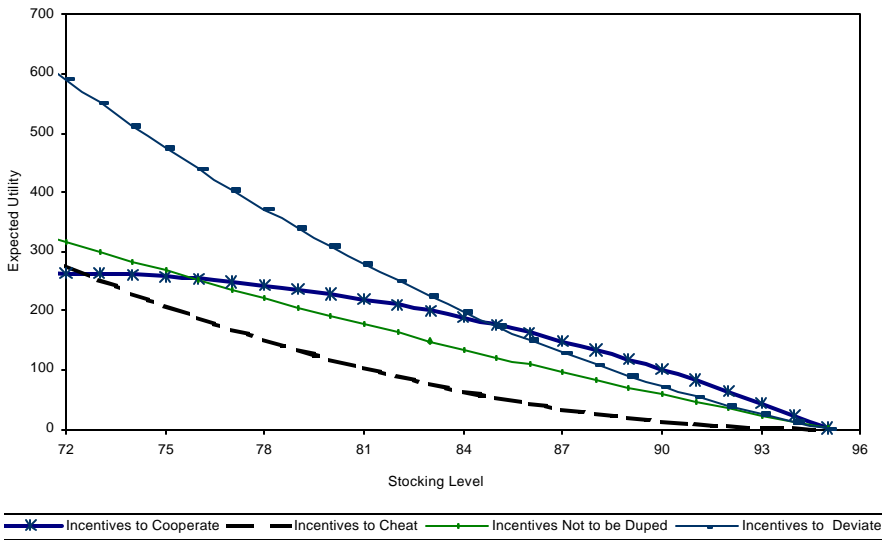
Hereafter, we refer to the combination of incentives to cheat and to not be duped as incentives to deviate. Figure 6.4 plots all four incentives as a function of stock levels. As can be seen, if the figure is viewed from right to left, the gains from cooperation are increasing at a decreasing rate, but incentives to cheat and to not be duped are increasing at an increasing rate. In the figure, the Nash noncooperative outcome is to stock 96 animals apiece; whereas the joint-maximization solution is to stock 72 animals apiece. At the stock level of 96, all incentives are zero: if the group agrees to allow each to stock 96, then this agreement offers no gains compared with the situation where none cooperated; and clearly incentives for deviating and for not being duped are zero, which is why this level is the solution to the noncooperative game.

Next, we consider the incentives for group members to stock 93 animals each. At this point, gains from cooperating are quite large at the margin, whereas incentives for deviating are quite low. Now, we consider a stock level of 73, just one above the joint-maximization solution. Here the gains from cooperating are very small, in fact quite close to zero. However, marginal incentives for deviating are at their highest. We hypothesize here that cost of monitoring and enforcing agreements is a function of the incentives for deviating. The following equation gives the maximization problem for the group:

$$\max W = \sum_i [P_i^{Cc} - P_i^{NCnc}] - g \left(\mathbf{g}^{Cheat} \sum_i I_i^{Cheat} - \mathbf{g}^{NotDuped} \sum_i I_i^{NotDuped}; Z^c \right).$$

³ The noncooperative game represented above is not a Prisoner’s Dilemma, since no strategy dominates. (Hence the reaction curves are curves and not a point; see Dasgupta and Heal 1979.)

FIGURE 6.4 Incentives for cooperating and deviating at different stock levels



Cooperation costs are a function of both incentives for deviating as well as variables that may shift the cost function, Z^C . These variables may be thought of as representing extraeconomic characteristics of the community that enable group members to achieve any level of cooperation at lower cost. In addition, although we use a general functional form for cooperation costs, this form must preserve the shape of the incentives, so that costs are increasing at an increasing rate as the joint-maximization solution is approached. Given this specification, marginal benefits from cooperation will be decreasing as the number of animals is reduced, whereas marginal costs are increasing; therefore, some level will equate marginal costs and marginal benefits. In the absence of variables that may shift the cost function (that is, the stock of sociocultural capital), the solution to this equation will always lead to a group-determined and group-enforced stock level that lies between the joint-maximization and noncooperative solutions—that is to say, a situation that appears to be partial cooperation will be observed.

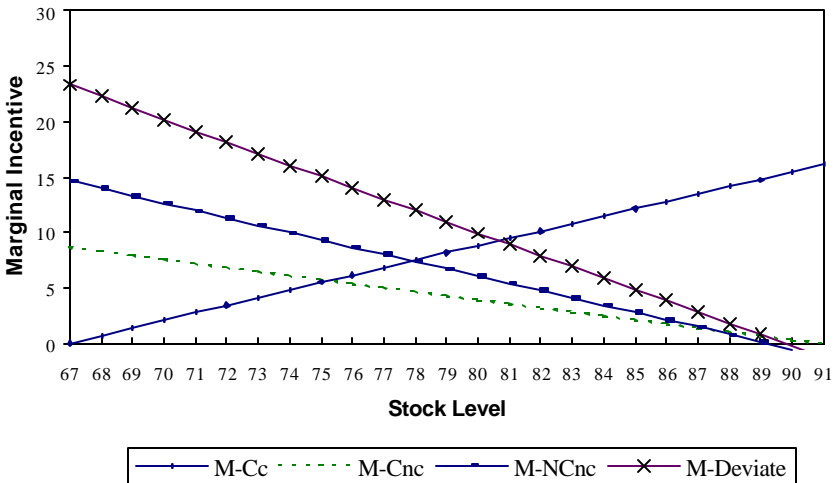
Next we consider that the group has reached some level of cooperation, given the associated incentives to deviate. What will happen for a given change

in parameters? For all parameter perturbations, both the incentives to cooperate and the incentives to deviate will move in the same direction.⁴

Because of shift variables, we have no theoretical reason to know where any particular group will be *ex ante*. For a concrete example, however, suppose that no shift variables exist, so that unit costs of enforcing agreements are equal to the sum of the incentives for deviating. This case illustrated in Figures 6.5 and 6.6, where decrease in the coefficient of risk-aversion shifts all marginal incentives up; where *M-I Cc* are the marginal incentives to cooperate, *M-I Cnc* are the marginal incentives to not be duped, *M-I NCc* are the marginal incentives to cheat, and *M-Deviate* is the sum of the marginal incentives to cheat and not be duped. The optimal number of animals to stock under the group cooperation solution increases from approximately 81 to approximately 85. However, because the optimal number of animals to graze also increases under costless joint-maximization, the rate of overexploitation increases only slightly—from 32.97 percent to 33.33 percent. Thus, the less risk averse group members are, the greater will be overgrazing.

To summarize, both gains from cooperation as well as gains from optimally deviating clearly increase with changes in all parameters that positively affect expected utility. In addition, an examination of the relative changes in incentives indicates changes in overgrazing will be relatively small.

FIGURE 6.5 Marginal incentives, coefficient of absolute risk aversion = 0.0005

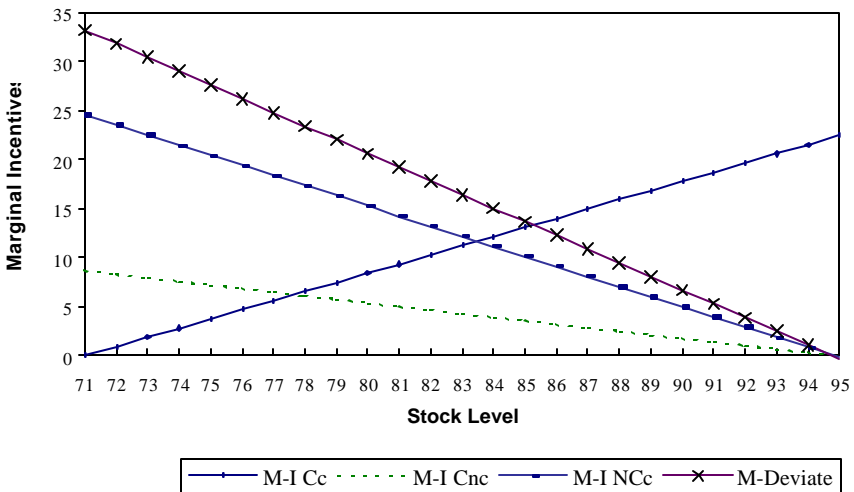


⁴ Note that this assertion relies on the assumption that all of the comparative-statics results of the previous section hold as stated above.

Effects of Heterogeneity on Incentives

Next we consider the effect of heterogeneity among players—in terms of either marginal costs or in terms of risk aversion. In the case where players are homogeneous, gains from cooperation are positive for both players over the entire range from the noncooperation to the joint-maximization outcomes, where rights are allocated equally among players. Let us reiterate that, to get a unique solution for both players under the joint maximization problem, we also needed to assume how total stock levels will be split among group members. In the case of homogeneity, equal allocation of rights seems a very plausible assumption. In the case of heterogeneity, however, such an assumption becomes more difficult to justify. For example, in the case of different (linear) marginal costs, total expected utility would be maximized by allocating all rights to the low-cost producer. Obviously, in the absence of side payments, such an allocation would not be supported by the high-cost producer. However, we retain the equal-allocation assumption on the basis that both equity and administrative considerations are likely to favor such a solution, and because much of the empirical literature supports the notion that, under most circumstances where use rules exist, these rules apply equally to all members (Johnson and Libecap 1982; Ostrom 1990; McCarthy 1996).

FIGURE 6.6 Marginal incentives, coefficient of absolute risk aversion = 0.0001



Typical reaction functions for two players with the same levels of risk aversion are illustrated in Figure 6.7. The isoprofit⁵ curves are drawn for each player corresponding to the profit attained at the noncooperative outcome. The area bounded by the two isoprofit curves represents Pareto-improving allocations of stocking rights across individual producers; we refer to this area hereafter as the “scope for cooperation.”

FIGURE 6.7 Reaction functions and isoutility, homogeneous herders

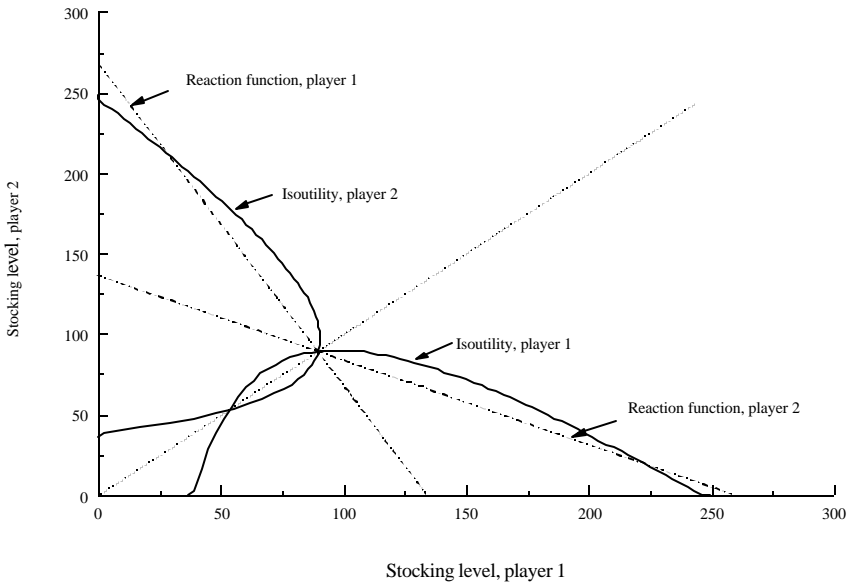
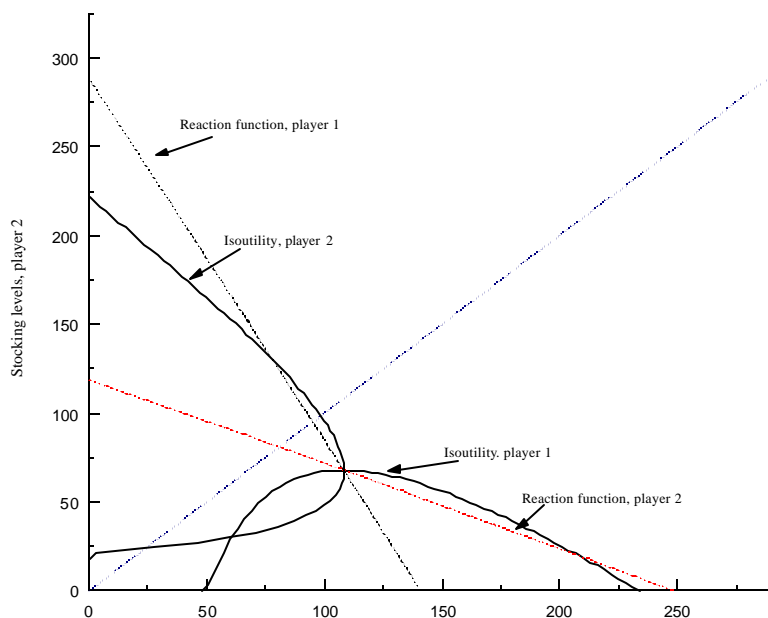


Figure 6.8 shows the same graph, except here player 1 has a lower coefficient of absolute risk aversion. Note that, in this case, no Pareto-improving allocation of stock levels falls on the 45 degree line; that is to say, an equal allocation of rights will not be supported by the low-cost producer, because profits for this herder are greater with the noncooperative solution than for any allocation that falls on the 45 degree line.

In the example given above, the coefficient of absolute risk aversion for player 2 has to be 5.5 times greater than that for player 1 for no scope for cooperation to exist, if stocking rights are allocated equally. If the players’ wealth levels were different because of other income or assets (in addition to the differential income arising from livestock activity), the coefficient of relative risk aversion (wealth times the coefficient of absolute risk aversion) would only need

⁵ An isoprofit line represents, in two-dimensional real space, all combinations of x , y that yield the same profit line. In Figure 6.7, x = stock levels of player 1, and y = stock levels of player 2.

FIGURE 6.8 Reaction functions and isoutility, heterogeneous herders

to be approximately 3.6 times greater. In the case of marginal costs, the difference between the two players needs be much smaller for no scope for cooperation to exist; player 2 need only have costs approximately 41 percent greater. It is worth noting that all of these figures are based on a single set of parameter values, and although the direction of the responses are thus far invariant to parameter changes, the weight of such responses differs more significantly. Thus, obtaining actual parameter values would be of critical importance in analyzing policies in any particular area.

Summary

In this section, we developed a model that incorporates incentives to deviate from agreements into the cost function for a group-maximization problem related to the use of a common rangeland. Where herders are homogeneous, we have shown that, if they have incentives to deviate from agreements, optimal stock levels for the group are likely to lie between the noncooperative and the costless, joint-maximization outcomes; and that, where community-level shift variables are zero, significant reductions in risk increase overstocking, but only slightly. One of the more important testable hypotheses of the model is that overstocking itself should respond only very slightly to large changes in exogenous parameters as long as the group can cooperate, because of the offsetting effects of incentives for cooperating and incentives for deviating. However, we have also shown that large and discrete jumps to noncooperation may occur

when a group solution is no longer feasible because of increased heterogeneity among herders. Thus, where only a fraction of herders gains access to outside income sources, or for any reason becomes less risk averse or more efficient producers, discrete breakdowns in cooperation may occur.

Discussion and Policy Implications

Essentially, the above analyses attempt to answer two distinct questions:

- What happens to the noncooperative game when risk is introduced, and how do results differ both compared with the riskless situation, as well as compared with the joint maximization, or perfect cooperation, solution?
- If the group does attempt to cooperate, how does risk affect the different incentives to engage in cooperation, and how do differences in risk preferences affect the range of possible levels at which the group may decide to cooperate?

The results suggest caution regarding the possible effects of risk reduction. Decreased risk may in fact result in lower incomes in the case of noncooperation, and if producer's are differentiated either in terms of marginal costs or risk preferences themselves, then decreased risk will widen the distribution of live-stock assets. In fact, any change in exogenous parameters that positively affects profitability will lead to a increase in this distribution, given some initial degree of heterogeneity.

Furthermore, if some type of cooperative arrangement were in place before a decrease in income variability (risk), cooperation will likely become more difficult to sustain at high levels of cooperation, and easier to sustain at lower levels of cooperation. There is no theoretical basis to assume, a priori, the functional form of these costs, and thus the comparative statics are indeterminate. However, if the cost function is a linear transformation of the sum of incentives for deviating, a decrease in risk will lead to slightly lower levels of cooperation in terms of overstocking, as illustrated in Figures 6.5 and 6.6.⁶ Unlike a decrease in risk, however, an increase in producer prices, an increase in pasture productivity, and a decrease in production costs will all lead to slightly higher levels of cooperation. These latter results run counter to the commonly held—although not universal—belief that increases in parameters that positively increase profitability will lead to a lower levels of cooperation. Nonetheless, given the parameter values chosen (and over a wide range of parameter values), we observed that only very small changes in the level of overgrazing occurred from most parameter changes, and this is because both incentives for cooperating as well as incentives for deviating move in the same direction. Thus, we hypothesize that

⁶ Although note that the increase in overstocking is very slight compared with the large decrease in the coefficient of absolute risk aversion.

communities that can cooperate will not be adversely affected by policies that decrease risk or increase the profitability of livestock production.

However, the models developed above can explain discrete jumps to non-cooperation for increases in profitability. As just noted, as long as an interior solution for the group maximization problem exists, increases in profitability will lead to greater gains from cooperation. However, if differences between the herders exist initially, these will be exacerbated by increases in profitability. At some point, the differences may become sufficiently large as to cause a discrete jump to noncooperation. Alternatively, consider that the productivity of the range is decreasing each year. As the resource degrades, differences between herders will diminish, and at some point, a discrete jump to cooperation may occur. Finally, if noneconomic variables that shift costs of cooperation change, a discrete jump from noncooperation to group cooperation, or vice versa, may also occur. Overall, the effect of increased profitability is ambiguous and depends on the degree of heterogeneity among herders, so that it is necessary to know how heterogeneous the community in question is, as well as the strength of the sociocultural shift variables, before a prediction can be made about changes in cooperation for changes in exogenous variables.

These results indicate that caution should be used when development projects and policies are undertaken that either alter the riskiness of livestock production itself, or of any exogenous parameters that improve profitability directly. The reason for this is that resulting outcomes may not be those desired—either decreased incomes and increased overstocking in the case of non-cooperation, or, a discrete jump to noncooperation from a cooperative starting point. The analyses also point to the problem of using income as an indicator of well being when livestock production is risky; overall utility increases with decreases in output variability, but income may in fact decline.

Finally, we can combine the results of these analyses with those analyses that examine the benefits of spatial mobility in terms of risk reduction (van den Brink, Bromley, and Chavas 1995; Wilson and Thompson 1993). Clearly, for most of the world's livestock-owning population, access to common, or even open access, pastures is of utmost importance in reducing the riskiness associated with climatic variability. Access to land, then, serves two very important functions—it is the source of an essential input, forage; and it reduces risk. In fact, spatial variability seems to be the single most important determinant of the resilience of common-property grazing lands. Nonetheless, when the commons are not well managed, a trade-off will exist between leaving lands in common versus privatization; namely, herder welfare will increase because of a larger amount of land over which to spread the riskiness in production, but profits will be lower as stock levels per unit area are higher because of reduced riskiness. We hypothesize, then, that the more land is appropriated privately (or by ever smaller subgroups), the lower is the ability to cooperate. Adding the results of the above models to the van den Brink, Bromley, and Chavas (1995) work—which considers that use rates are socially optimal and thus do not allow for

problems of noncooperation and overgrazing—enables researchers to better identify factors associated with cooperation and hence identify policies that will increase the welfare of herders and their ability to harness benefits from cooperation, as well as to more accurately identify areas of potential conflict and policy measures needed to resolve conflict.

Future Research

Dynamic considerations are absent from the model; and although many of the hypotheses from the model should remain intact, a rigorous dynamic framework should be developed, perhaps with the express intent of capturing cyclical behavior. The exogenous “shift” variables in the model of incentives need to be elaborated, and the added complexity of multiple users (with multiple interactions in other spheres) also needs to be addressed in a more systematic fashion. Finally, a simulation model should be developed to formally incorporate not only the spatial variability argument proposed by van den Brink, Bromley, and Chavas (1995), but also to capture the multiple covariate risks and crop–livestock interactions faced by agropastoralists.

Appendix 1. Proof that the Stocking Level under Noncooperation Is Greater than the Stocking Level under Joint Maximization

In the following, we let $R = S_i^2 f_A$.

The first-order conditions for the joint-maximization and the n -player game are as follows:

Joint maximization

$$\begin{aligned}
 NP_L[f + LNf' - R_i Lf [NP_L(f + Lf')]] - Nc &= 0. \\
 [f + NLf' - R_i Lf [NP_L(f + Lf')]] &= \frac{c}{P_L}.
 \end{aligned}
 \tag{1}$$

Noncooperative game

$$\begin{aligned}
 P_L[f + L_i f' - R_i L_i f [P_L(f + L_i f')]] - c &= 0. \\
 [f + L_i f' - R_i L_i f [P_L(f + L_i f')]] &= \frac{c}{P_L}.
 \end{aligned}
 \tag{2}$$

In equilibrium, both first-order conditions must be equal to $\frac{c}{P_L}$. Thus by establishing the sign of equation (3), we can determine the conditions under which the stocking rate under noncooperation is greater than under joint maximization:

$$[f + Lf']^*[1 - RLf] \lesseqgtr [f + Lf' + (N - 1)Lf']^*[1 - RLf - (N - 1)LRf]. \quad [3]$$

We immediately note that $[f + Lf'] > [f + Lf' + (N - 1)Lf']$ and $[1 - RLf] > [1 - RLf - (N - 1)LRf]$.

The left-hand side of the equation (noncooperation) is greater than the right-hand side (joint maximization) at the same stocking rate; therefore, in equilibrium, the stock level must be greater under noncooperation than under joint maximization.

Similarly, we can examine the first-order conditions for the risky, noncooperative case versus the riskless joint-maximization case. The left-hand side of the equation below is the first-order condition for the risky, noncooperative case; the right-hand side is the first-order condition for the riskless, joint-maximization case.

$$[f + Lf']^*[1 - RLf] \lesseqgtr [f + NLf'].$$

Rearranging the terms gives the following:

$$[f + Lf' - RLf(f + Lf')] < [f + NLf'].$$

$$[f - RLf(f + Lf')] < [f + (N - 1)Lf'].$$

Since $(N - 1)Lf' < 0$, the above expression holds true whenever $RLf(f + Lf') > (N - 1)Lf'$, or whenever the cost of risk (either in terms of high output variance or high coefficient of absolute risk aversion) is sufficiently high.

Appendix 2. Comparative-Statics Matrix for the Two-Player Noncooperative Game with Multiplicative Risk in Production

First, as described in the second section of the chapter, we assume that, in equilibrium, the following is true:

$$\frac{\mathcal{I}f}{\mathcal{I}L_1} = \frac{\mathcal{I}f}{\mathcal{I}L_2}.$$

$$\frac{\mathcal{I}^2 f}{\mathcal{I}L_1^2} = \frac{\mathcal{I}^2 f}{\mathcal{I}L_2^2}.$$

$$\frac{\mathcal{I}^2 f}{\mathcal{I}L_1\mathcal{I}L_2} = \frac{\mathcal{I}^2 f}{\mathcal{I}L_2\mathcal{I}L_1}.$$

As noted above, essentially we are assuming that the “inputs” that is, cattle—are equally productive across individuals (that is, the conversion of forage

to meat, milk, or draft power is the same across the *types* of animals held across individuals).

In the derivation of the comparative statics below, we allow individuals to differ in terms of marginal costs and in terms of risk preferences. Although we assume output variance to be the same for both individuals, the coefficient of absolute risk aversion may differ. Following Appendix 1, we let $R_i = \mathbf{s}_q^2 \mathbf{f}_{A_i}$.

The original maximization problem for $i = 1, 2$ is as follows:

$$\max_{L_i} E(U(\mathbf{p}_i^{CN})) = \left[P_L * L_i * f(L_i + L_j; \mathbf{a}, \mathbf{b}) - cL_i - \gamma_2 R_i (P_L * L_i * f(L_i + L_j; \mathbf{a}, \mathbf{b}))^2 \right],$$

with the first order

$$P_L [f + L_i f' - R_i L_i f [P_L (f + L_i f')]] - c = 0,$$

where $f = f(L_i + L_j; \mathbf{a}, \mathbf{b})$.

Totally differentiating the first-order condition with respect to L_i yields the following:

$$\frac{\mathcal{J}_i^2 EU_i^{CN}}{\mathcal{J}_i^2} = [P_L (2f' + L_i f'')] * [1 - P_L R_i L_i f] - R_i [P_L (f + L_i f')]^2.$$

With $f' < 0$ and $f'' < 0$, the first term is clearly negative, since the first component is negative, and the second component is positive from the first-order conditions. The second term is positive, so that the entire term is negative, as required.

Totally differentiating the first-order condition with respect to L_j yields the following:

$$\frac{\mathcal{J}_i^2 EU_i^{CN}}{\mathcal{J}_i \mathcal{J}_j} = [P_L * (f' + L_i f'')] * [1 - P_L R_i L_i f] - P_L R_i L_i f' [P_L (f + L_i f')].$$

This sign of this term is indeterminate. The first term is clearly negative, but the second term is also negative. Note that, in the absence of risk, the term would be negative.

The Jacobian is thus as follows:

$$\begin{vmatrix} \frac{\mathcal{J}_i^2 EU_i^{CN}}{\mathcal{J}_i^2} & \frac{\mathcal{J}_i^2 EU_i^{CN}}{\mathcal{J}_i \mathcal{J}_j} \\ \frac{\mathcal{J}_j^2 EU_j^{CN}}{\mathcal{J}_j \mathcal{J}_i} & \frac{\mathcal{J}_j^2 EU_j^{CN}}{\mathcal{J}_j^2} \end{vmatrix} \begin{matrix} < \\ > \end{matrix} 0.$$

To establish the sign of $|J|$, we initially assume that players are homogeneous, so that $L_1 = L_2$ in equilibrium. Given these assumptions, both of the following are true:

$$\frac{\mathcal{J}^2 EU_i^{CN}}{\mathcal{J}_i^2} = \frac{\mathcal{J}^2 EU_j^{CN}}{\mathcal{J}_j^2} .$$

$$\frac{\mathcal{J}^2 EU_i^{CN}}{\mathcal{J}_i \mathcal{J}_j} = \frac{\mathcal{J}^2 EU_j^{CN}}{\mathcal{J}_j \mathcal{J}_i} .$$

Solving the determinant, then, is equivalent to solving

$$A^2 - C^2,$$

where

$$A^2 = \left(\frac{\mathcal{J}^2 EU_i^{CN}}{\mathcal{J}^2} \right)^2, \text{ and}$$

$$C^2 = \left(\frac{\mathcal{J}^2 EU_i^{CN}}{\mathcal{J}_i \mathcal{J}_j} \right)^2.$$

Next, $A^2 - C^2 = (A - C)(A + C)$, so to establish the sign of the Jacobian, we must establish the signs of $(A - C)$ and $(A + C)$:

$$(A - C) = [P_L(2f' + Lf'')] * [1 - P_L R_i Lf] - R_i [P_L(f + Lf')] * [P_L(f + Lf')] \\ - [P_L * (f' + Lf'')] * [1 - P_L R_i Lf] + P_L R_i Lf * [P_L(f + Lf')] .$$

Rearranging the expression gives the following:

$$\left\{ [1 - P_L R_i Lf] * P_L f' - P_L R_i f * [P_L(f + Lf')] \right\} < 0.$$

The first term is clearly negative, whereas the second is positive (the bracketed term is positive because of the first-order conditions); thus the entire term is negative.

$$(A + C) = [P_L(2f' + Lf'')] * [1 - P_L R_i Lf] - R_i [P_L(f + Lf')] * [P_L(f + Lf')] \\ + \left\{ [P_L * (f' + Lf'')] * [1 - P_L R_i Lf] - P_L R_i Lf * [P_L(f + Lf')] \right\},$$

which equals the following:

$$\left\{ [1 - P_L R_i Lf] * P_L(3f' + 2Lf'') - P_L R_i [P_L * (f + Lf')(f + 2Lf')] \right\}. \quad [1]$$

In this form, the sign of the term is indeterminate. Although the first term is negative, the second term may also be negative. In fact, in the absence of costs of production, the second term would be negative, as $(f + 2Lf')$ would equal zero at the joint maximization stock level, and would be negative at the noncooperative equilibrium.

In what follows, we show that, whenever the first-order condition $(1 - P_L R_i Lf) > 0$ is met, equation (1) must be negative.

Expanding equation (1) gives the following:

$$\begin{aligned}
 & P_L \left\{ [1 - P_L R_i Lf] 2Lf'' + 3f' - 3P_L R_i Lff' - R_i P_L [f^2 + 3Lff' + 2L^2 f'^2] \right\} \\
 \Rightarrow & P_L \left\{ [1 - P_L R_i Lf] 2Lf'' + 3f' - P_L R_i [f^2 + 6Lff' + 2L^2 f'^2] \right\}. \tag{2}
 \end{aligned}$$

A condition sufficient for equation (2) to be negative is that

$$3f' - P_L R_i [f^2 + 6Lff' + 2L^2 f'^2] < 0.$$

Since both terms are negative, this condition will hold whenever

$$|3f'| > |P_L R_i [f^2 + 6Lff' + 2L^2 f'^2]|,$$

or alternatively, when

$$R < \frac{3f'}{P_L [f^2 + 6Lff' + 2L^2 f'^2]}. \tag{3}$$

From the first-order indicates that $R < \frac{1}{P_L Lf}$. Therefore, if $\frac{1}{P_L Lf}$ is less than the expression on the right-hand side of equation (4), then clearly R will be less as well. Substituting $\frac{1}{P_L Lf}$ for R yields

$$\frac{1}{P_L Lf} < \frac{3f'}{P_L [f^2 + 6Lff' + 2L^2 f'^2]}$$

when

$$\Rightarrow \frac{[f^2 + 6Lff' + 2L^2 f'^2]}{3Lff'} < 1,$$

$$\Rightarrow \frac{[f^2 + 2L^2 f'^2]}{3Lff'} + 2 < 1, \text{ and}$$

$$\Rightarrow [f^2 + 2L^2 f'^2] + 3Lff' < 0. \tag{4}$$

Rearranging the terms of equation (4) yields $(f + Lf')(f + 2Lf') < 0$ whenever $(f + 2Lf') < 0$, the case of interest here.

Thus, we have just shown that

$$|A| = \left(\frac{\mathcal{J}^2 EU_i^{CN}}{\mathcal{J}^2} \right)^2 > |C| = \left(\frac{\mathcal{J}^2 EU_i^{CN}}{\mathcal{J}_i \mathcal{J}_j} \right)^2,$$

and consequently, that the Jacobian is negative semidefinite.

Next, we establish the sign of $|J|$ when $L_1 \neq L_2$, when $c_1 \neq c_2$, or when $R_1 \neq R_2$. In this case, we let the following represent $|J|$:

$$\begin{vmatrix} A & C \\ D & B \end{vmatrix} \leq 0, \text{ or equivalently } AB - CD \leq 0.$$

We first note that, if $|A| > |C|$, and $|B| > |D|$, then clearly $AB > CD$. However, we have just shown that $|A| > |C|$, and symmetrically, $|B| > |D|$. Therefore, the determinant is always positive, *QED*.

Appendix 3. Comparative Statics

Totally differentiating the first-order conditions with respect to each of the parameters gives the following:

$$\frac{\mathcal{J}EU_i^{*NC}}{\mathcal{J}_i \mathcal{J}_a} = [P_L(f_a + L_i f_{ia})][1 - P_L R_i L_i f] - P_L R_i L_i f_a [P_L(f + L_i f_i)].$$

The above expression is positive when R_i is not “too” high:

$$\frac{\mathcal{J}EU_i^{*NC}}{\mathcal{J}_i \mathcal{J}_b} = [P_L(f_b + L_i f_{ib})][1 - P_L R_i L_i f] - P_L R_i L_i f_b [P_L(f + L_i f_i)] > 0.$$

This expression is also positive when R_i is not too high.

$$\frac{\mathcal{J}EU_i^{*NC}}{\mathcal{J}_i \mathcal{J}_p} = (f + L_i f_i)[1 - 2P_L R_i L_i f] > 0,$$

when R_i is not too high:

$$\frac{\mathcal{J}EU_i^{*NC}}{\mathcal{J}_i \mathcal{J}_k} = -1,$$

$$\frac{\mathcal{J}EU_i^{*NC}}{\mathcal{J}_i \mathcal{J}_j} = 0,$$

$$\frac{\mathcal{J}EU_i^{*NC}}{\mathcal{J}L_i \mathcal{J}R_i} = -P_L L_i f [P_L (f + L_i f_i)] < 0, \text{ and}$$

$$\frac{\mathcal{J}EU_i^{*NC}}{\mathcal{J}L_i \mathcal{J}R_j} = 0.$$

The above derivations hold symmetrically for player j .

Using the expressions derived above and applying Cramer’s Rule, we derive the following comparative-statics results:

$$\begin{aligned} \frac{\mathcal{J}L_i}{\mathcal{J}a} = \frac{-1}{|J|} * & \{ [P_L (f_a + L_i f_{ia})] [1 - P_L R_i L_i f] - P_L R_i L_i f_a [P_L (f + L_i f_i)] \} * \frac{\mathcal{J}^2 P_j}{\mathcal{J}L_i \mathcal{J}L_j} \\ & - [P_L (f_a + L_j f_{ja})] [1 - P_L R_j L_j f] - P_L R_j L_j f_a [P_L (f + L_j f_j)] * \frac{\mathcal{J}^2 P_i}{-\mathcal{J}L_i \mathcal{J}L_j}. \end{aligned}$$

As noted, many of the following comparative-statics results will be ambiguous. The signing of these expressions depends not only on whether or not both players are not “too” risk averse, but also on the absolute difference between players with respect to stocking levels, L_i , and coefficient of absolute risk aversion, R_i . Appendix 2 shows that $\frac{\mathcal{J}^2 P_j}{\mathcal{J}L_j^2} - \frac{\mathcal{J}^2 P_i}{\mathcal{J}L_i \mathcal{J}L_j} < 0$.

Let $A = [[P_L (f_a + L_i f_{ia})] [1 - P_L R_i L_i f] - P_L R_i L_i f_a [P_L (f + L_i f_i)]]$, and

$$C = [P_L (f_a + L_j f_{ja}) [1 - P_L R_j L_j f] - P_L R_j L_j f_a [P_L (f + L_j f_j)]] .$$

If $A \geq B$ in the equation above, then the result will certainly be positive. $A \geq B$ when $R_i L_i \leq R_j L_j$. For $R_i L_i \gg R_j L_j$, however, it is possible for this expression to be negative. That is to say, if the i^{th} player is sufficiently differentiated in terms of costs or risk preferences, the sign of this term may be negative:

$$\begin{aligned} \frac{\mathcal{J}L_i}{\mathcal{J}b} = \frac{-1}{|J|} * & \{ [[P_L (f_b + L_i f_{ib})] [1 - P_L R_i L_i f] - P_L R_i L_i f_b [P_L (f + L_i f_i)] \} * \frac{\mathcal{J}^2 P_j}{\mathcal{J}L_i \mathcal{J}L_j} \\ & - [P_L (f_b + L_j f_{jb}) [1 - P_L R_j L_j f] - P_L R_j L_j f_b [P_L (f + L_j f_j)] * \frac{\mathcal{J}^2 P_i}{-\mathcal{J}L_i \mathcal{J}L_j}. \end{aligned}$$

This term is also indeterminate; the sign will be negative as long as players are not too risk averse nor too differentiated in terms of livestock holdings or risk preferences. If players are differentiated, then the individuals who are less risk averse or who have lower costs will increase stocking rates by more than the other player:

$$\frac{\mathcal{J}L_i}{\mathcal{J}P_L} = \frac{-1}{|J|} * \left[[f + L_i f_i][1 - 2 P_L R_i L_i f] \frac{\mathcal{J}^2 P_j}{\mathcal{J}L_j^2} - [f + L_j f_j][1 - 2 P_L R_j L_j f] \frac{\mathcal{J}^2 P_i}{\mathcal{J}L_i \mathcal{J}L_j} \right] \geq 0.$$

As with the productivity parameters, changes in output price will have an ambiguous effect on stock levels, although the lower-cost or less-risk-averse player will unambiguously increase his or her stock levels. Starting from an initial point of inequality in risk preferences or stockholdings, the distribution among players will widen in response to changes in output price:

$$\frac{\mathcal{J}L_i}{\mathcal{J}c_i} = \frac{-1}{|J|} * -1 * \frac{\mathcal{J}^2 P_j}{\mathcal{J}L_j^2} < 0.$$

$$\frac{\mathcal{J}L_i}{\mathcal{J}c_j} = \frac{-1}{|J|} * 1 * \frac{\mathcal{J}^2 P_i}{\mathcal{J}L_i \mathcal{J}L_j} > 0.$$

$$\frac{\mathcal{J}L_i}{\mathcal{J}c} = \frac{-1}{|J|} * \left[-1 * \frac{\mathcal{J}^2 P_j}{\mathcal{J}L_j^2} - \frac{\mathcal{J}^2 P_i}{\mathcal{J}L_i \mathcal{J}L_j} \right] < 0.$$

$$\frac{\mathcal{J}L_i}{\mathcal{J}R_i} = \frac{-1}{|J|} * -[P_L L_i f [P_L (f + L_i f_i)]] * \frac{\mathcal{J}^2 P_j}{\mathcal{J}L_j^2} < 0.$$

$$\frac{\mathcal{J}L_i}{\mathcal{J}R_j} = \frac{-1}{|J|} * [P_L L_j f [P_L (f + L_j f_j)]] * \frac{\mathcal{J}^2 P_i}{\mathcal{J}L_i \mathcal{J}L_j} > 0.$$

$$\frac{\mathcal{J}L_i}{\mathcal{J}R} = \frac{-1}{|J|} * \left[-P_L L_i f [P_L (f + L_i f_i)] * \left[\frac{\mathcal{J}^2 P_j}{\mathcal{J}L_j^2} - \frac{\mathcal{J}^2 P_i}{\mathcal{J}L_i \mathcal{J}L_j} \right] \right] < 0.$$

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7 Fuzzy Access: Modeling Grazing Rights in Sub-Saharan Africa

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In Sub-Saharan Africa, mobility through transhumance is a much-valued strategy of pastoralists for dealing with rainfall variability (see Swallow 1994; van den Brink, Bromley, and Chavas 1995; Ellis and Swift 1988). Transhumance is generally practiced in the arid to semi-arid regions of Sub-Saharan Africa, an environment characterized by low mean rainfall and high rainfall variability. Higher rainfall variability increases the value of access to larger grazing areas and the concomitant ability to adjust to weather shocks after the fact, provided that rainfall is not perfectly correlated for all areas (Thompson and Wilson 1994).

However, spatial mobility and grazing access are costly. Migration imposes human labor costs as well as the cost of the energy used by the animal for migrating. Transaction costs are also associated with mobility; some form of transacting must take place among the varying pastoralist groups to govern access to pasture resources (van den Brink, Bromley, and Chavas 1995; Swallow 1994). As clearly shown in van den Brink, Bromley, and Chavas (1995), if land quality and mean rainfall are sufficiently low and rainfall variability is sufficiently high, some type of nonexclusive property right will dominate privatization even when transaction costs of mobility are introduced, although their model assumes socially optimal use of the nonexclusive rangelands.

Thus, the introduction of spatial rainfall variability into the analysis of rangeland management systems provides economic support for leaving large tracts of land open to common grazing. On the other hand, land resources held in common are still subject to the possibility of overuse when management of these resources is not perfect. Van den Brink, Bromley, and Chavas (1995) argue that traditional authorities had been (and in some cases, may still be) capable of coordinating access to pasture and water resources, and that a well-defined membership obeyed rules and regulations over use of these resources. The existence of the traditional land-access institutions would theoretically mitigate the negative externalities generally associated with unregulated common-property resources. Accordingly, their analysis does not consider possible negative externalities that arise under imperfectly managed common property.

There are a number of reasons for examining more closely the case in which these common grazing lands are not managed perfectly. Within the livestock sector, Jarvis (1980) discusses evidence that suggests that the communal nature of the grazing system used in Swaziland is a crucial determinant of pas-

toralist behavior and of the success or failure of livestock development programs. Many governments in Sub-Saharan Africa have had, and continue to have, policies that favor sedentary cultivators and agropastoralists over nomadic herders (Ensminger and Rutten 1991; Swallow 1994). These policies, it is argued, have diminished the power of traditional authorities to enforce rules and regulations over land use. Furthermore, the evidence on the ability of even powerful traditional authorities to regulate resource use in a “socially” optimal way is rather limited (Baland and Platteau 1996). Population growth in and of itself is likely to place stress on any institution whose primary goal is to avoid negative externalities generated by resource overexploitation. For all these reasons, it is important to consider the effects of common access on the relative desirability of traditional land systems and privatized lands for Sub-Saharan herders.

Another aspect of pastoral systems in Sub-Saharan Africa is the definition of the land area under study and the membership base of those who have access to the resource. Access to grazing land in Sub-Saharan Africa does not closely correspond to the traditional economic concept of common property, where some fixed number of members of the common-property user-group have equal and complete access to the available forage. An empirical regularity identified and discussed by a number of authors is that grazing-area boundaries and membership in the access group are not well defined. Scoones (1994, 27) writes the following:

Overlapping claims to resources, shifting assertions of rights and continuous contestation and negotiation of access rules dominate tenurial arrangements in uncertain environments. The solution is not to impose particular tenure types on a variable setting; whether these are uniquely communal or private they are unlikely to work. Instead, the need for flexible tenure arrangement must be recognized....Customary tenure systems operate shared, overlapping forms of tenure rights in such settings as maintaining strict boundaries is usually untenable.

Toulmin (1995, 101) also notes that,

Such movement is possible where secondary rights of access exist for herders to bring their animals into areas they do not usually use....In addition, drought conditions are likely to increase competition for scarce fodder between local animals and herds from elsewhere, further constraining access in such periods for those with weak claims to exploit local pastures.

In these analyses, the ill-defined or “fuzzy” nature of resource boundaries and resource access-rights is considered a positive factor in the functioning of the pastoral system. A belief in the importance of this characteristic is shared by local observers. Recently in the *Daily Nation* (Kenya), an editorialist wrote of the pastoralist situation in northeastern Province of Kenya that,

Mobility, which is part and parcel of nomadic pastoralism, has been reduced, the resource use cycle has been shortened and individual and *at times community territorial claims are becoming more specific* [italics added].

The author believes that the specificity of the claims is counterproductive to the functioning of the pastoral system. This consensus starkly contrasts with the standard common-property finding that a well-defined membership and a resource with well-defined boundaries are required ingredients for the successful management of the commons (see, for example, Ostrom 1990; Thompson and Wilson 1994; and Oakerson 1992).

Each property-rights system has relative advantages. When access rights and the resource are well defined, each individual can be assured that any collective benefits provided by the group will accrue to the group alone, and management should be easier with a relatively small, well-defined group. Flexibly defined, or fuzzy, access may be preferable to well-defined grazing areas for two additional reasons: the ability for pastoralists to improve their income realizations by mutually adjusting access to common areas in response to relative outcomes on other areas of their grazing ranges, and the risk-reducing role of mobility.

The fuzzy-access-right regime is for incomplete, contingent markets, while private and common property are complete, nonconditional market regimes. In this chapter, the initial focus is on the incomplete nature of the fuzzy-access regime and then on evaluating the net effects of incompleteness and conditionality.¹

The objectives of this chapter are to develop, using fuzzy-set theory, a model that incorporates these important features, and to consider under what conditions a flexible, partial-access regime dominates a conventional common-property regime. We then address the implications of our findings for Sub-Saharan Africa policymakers.

Defining Fuzzy Access-Rights

In Goodhue and McCarthy (1998), we demonstrated that common-property considerations reduce the expected benefit of flexibility to individual groups identified in van den Brink, Bromley, and Chavas (1995). A standard common-property analysis does not account fully for the properties of the traditional grazing system. As stated in the introduction, access to various pastures—even those referred to as being held in common—is generally more complicated than that

¹ We are indebted to Jean-Paul Chavas and Lowell Jarvis for stressing the importance of the distinction between incompleteness and conditionality.

captured in a conventional common-property model, or an open-access model.² Grazing-area boundaries and, more importantly, clans' membership in the grazing-access group for given pastures, appear to be rather imprecise. Some clans may use a pasture consistently from year to year but for different lengths of time, whereas other clans may use it only occasionally. Further, clans' use of the pasture may depend on conditions in other parts of their grazing range. We use fuzzy sets to model these attributes of grazing access-rights.

Fuzzy sets focus on imprecision because of the absence or modeling costliness of clearly defined definitions of sets. This approach stands in contrast to the standard economic modeling approaches, which treat uncertainty as due to an underlying random variable. Fuzzy mathematics examines imprecise phenomena that lack clearly defined class criteria.³ The lack of clearly defined class criteria may be an inherent part of the nature of the system, or may be due to the system's complexity; Zadeh (1965) introduced fuzzy mathematics as a way of modeling extremely complex systems. Rather than requiring immense numbers of specific rules to precisely define the nature of a system, the use of fuzzy sets allows for imprecision in how each exact situation is described.

Fuzzy-set theory models the important features of the pastoralist grazing-access system in Sub-Saharan Africa in a consistent way.^{4,5} A pastoralist's (or a pastoralist group's), i 's, access to a pasture is the degree of membership of that pasture in the fuzzy-set "areas accessed by pastoralist". In the following analysis, where we have a single commonly accessed pasture, we denote A 's access to the pasture as P_A and B 's access as P_B . When we examine the flexibility of the traditional fuzzy-access regime in the next section, we further use fuzzy-set the-

² We follow the distinction elucidated in Dasgupta and Heal (1979) between a common-property resource freely accessed by a finite number of individuals and the open-access case where the number of accessing individuals expands until profits are driven to zero.

³ Goodhue (1998) evaluates firms' ability to sustain collusion using a trigger-pricing punishment-strategy when firms' uncertainty regarding demand conditions is due to imprecise or vague information, rather than to the unknown realization of a random variable of known mean and variance. The fuzzy game reverses the cyclical prediction of the standard trigger-price game (Green and Porter 1984) in the presence of demand uncertainty: in the fuzzy game, collusion-sustaining price wars are most likely to occur during times of high demand.

⁴ An alternative method of modeling the observed system of partial access would be to allow herders to have beliefs over the percentage access that they have to forage in a given area. This alternative, however, will be internally consistent only in cases where the pasture is perfectly managed. If the idea of percentage access is defined more broadly, it becomes functionally similar to fuzzy access but lacks an equivalent theoretical basis.

⁵ In addition to many other sources, Kaufmann and Gupta (1991), Driankov, Helendoorn, and Reinfrank (1994) and Jamshidi, Vadiee, and Ross (1993) develop basic fuzzy-set theory. Dompere (1995), Mansur (1995) and Greenhut, Greenhut, and Mansur (1995) use fuzzy logic to model features of economic systems.

ory to model the responsiveness of the regime to differences in relative rainfall levels. We have three levels of possible rainfall shocks: -1 , 0 , and 1 . We define their membership in two fuzzy sets—high rainfall and low rainfall. For example, $\text{low} = \{1/-1 + 0.5/0 + 0/1\}$. This notation means that a shock of -1 possesses a membership of degree 1 in the low-rainfall set, a shock of 0 possesses membership of degree 0.5 in the low-rainfall set, and a shock of 1 is not a member of the low-rainfall set.

Specifying grazing access through a fuzzy property-right reflects the flexibility of traditional pastoralist systems. This flexibility, as well as the notion that access to certain areas is considered either partial or incomplete, aids herders in adjusting to adverse shocks. Access rights are not clearly defined. In particular, access rights (as opposed to actual resource use) are not considered necessarily mutually exclusive or complete. Conflict between groups may arise because of the failure of a group seeking access to an area primarily grazed by another group to ask permission before moving, and may also arise because of the failure of the primary user to grant this permission when requested (Casimir 1987). The fact that both these situations may lead to conflict suggests that access is defined imprecisely, or fuzzily. If the primary-user group had clearly defined rights that allowed it to exclude other groups arbitrarily, as in a private-property regime, the refusal of permission to graze would not lead to conflict, within the context of the institutional system. The behavioral norm of other groups requesting access from the primary group indicates that, even though they expect to be allowed to graze, they do not feel that their right to do so is complete, as would be the case in a more traditional common-property regime.

The Basic Model: Exogenously Defined, Costless Grazing Access

In our study, we modeled two pastoralist groups, A and B . Each group maximizes its animals' total weight gain, which we assumed to be a linear-quadratic function of the stocking days on the pasture (following McCarthy [1996]). For convenience, we assume the output price is exogenously determined, and normalized to 1 , so that total weight gain equals total profits. In this section, each group chooses its number of stock days to maximize its expected profits on a commonly used pasture in a noncooperative fashion. Both groups have fuzzy access-rights to the pasture. In this section, we investigate how the imprecise nature of access rights affects stocking-rate decisions. Analysis of the flexible response of the regime to relative shocks is deferred until the last section. Accordingly, each group's fuzzy access-right is exogenous and fixed. The pasture is characterized by its number of hectares, h , its forage productivity parameter, \mathbf{a} and its externality parameter, \mathbf{b} . It is subject to a weather shock, \mathbf{q} with an expected value of 0 .

Under the fuzzy-access formulation, herders do not regard their access to the pasture as necessarily complete. The nature of their access rights and its effects on their stocking decisions is depicted in the following maximization prob-

lem, where P represents the degree of fuzzy access and ranges from 0 (no access) to 1 (full access):

$$\begin{aligned} \max_a a(1+q) \left(\mathbf{a} - \mathbf{b} \frac{(a+b)}{(P_A H)} \right), \text{ and} \\ \max_b a(1+q) \left(\mathbf{a} - \mathbf{b} \frac{(a+b)}{(P_B H)} \right). \end{aligned} \tag{1}$$

Under this formulation, the stocking rates are

$$a = (2P_A - P_B) \mathbf{a}H/3\mathbf{b}, \text{ and } b = (2P_B - P_A) \mathbf{a}H/3\mathbf{b} \tag{2}$$

Returns for A from the use of the common pasture are

$$W = (1+q) \frac{\mathbf{a}^2 h_z (2P_A - P_B)^2}{9\mathbf{b}P_A}.$$

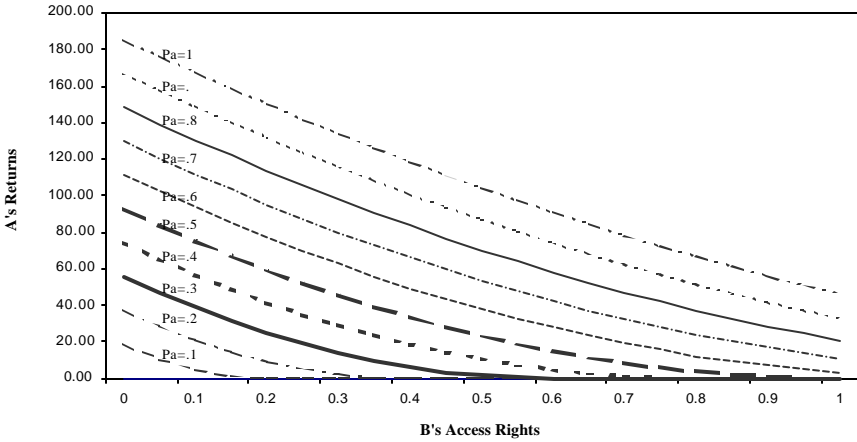
Note that, for stocking rates and profits to be positive, A 's access rights must be no less than one-half B 's, and vice versa. With sufficiently different access rights, stock levels of those holding higher rights will drive total stocking rates to such an extent that low-access clans will choose not to use the pasture. When both pastoralists have the same degree of fuzzy access, the total stocking rate will correspond to the stocking rate of the conventional, crisp, common-property regime. Asymmetry in fuzzy access-rights results in lower total stocking rates than the rate obtained under the conventional common-property regime. The total stocking rate may be computed as follows:

$$a + b = \begin{cases} \frac{\mathbf{a}h}{3\mathbf{b}}(2P_A - P_B) & P_B < \frac{P_A}{2} \\ \frac{\mathbf{a}h}{3\mathbf{b}}(P_A + P_B) & \text{when } P_A > \frac{P_B}{2}, P_B > \frac{P_A}{2} \\ \frac{\mathbf{a}h}{3\mathbf{b}}(2P_B - P_A) & P_A < \frac{P_B}{2} \end{cases}$$

As seen in Figure 7.1, profits to clan A are increasing as its access increases and decreasing as clan B 's access increases. Each line denotes a level of fuzzy access for A . As this level increases, A 's profits are higher for any level of B 's fuzzy access, measured on the horizontal axis. As B 's fuzzy access increases, A 's profits clearly decrease. Figure 7.2 plots total returns to A and B . Note that total profits are highest when rights are asymmetric. At the extremes, where one clan has full access and the other clan has no access, returns from the common pasture achieve the socially optimal level. For symmetric access-rights, profits to each clan are everywhere below profits accruing when both have full access. Looking at the equation for social returns, it is apparent that, when access rights are initially equal and are then reduced symmetrically for both clans,

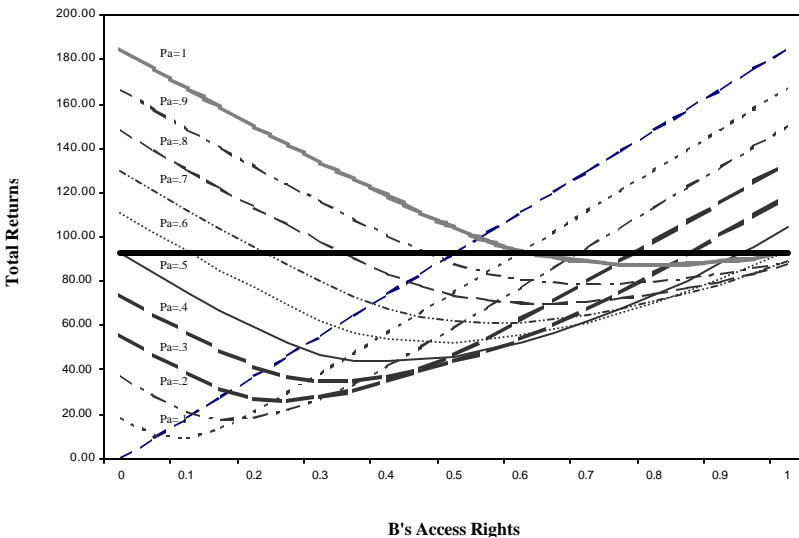
the marginal gain to clan A due to the reduction for clan B is lower than the marginal loss to clan A for a corresponding decrease in their own access rights:

FIGURE 7.1 A's expected returns



NOTE: Starting with the bottom line and going up, the level of fuzzy access for herder A is, respectively, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, and 1.0.

FIGURE 7.2 Total returns plotted as a function of B's access rights, for different levels of access for herder A



NOTE: Starting with the bottom line and going up, the level of fuzzy access for herder *A* is, respectively, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, and 1.0.

$$p_A + p_B = \frac{a^2 h}{9b} \left(\frac{(2P_A - P_B)^2}{P_A} + \frac{(2P_B - P_A)^2}{P_B} \right). \quad [3]$$

More generally, social returns will be higher under the fuzzy common-property regime than under the crisp common-property whenever the following condition holds:

$$P_A^3 + P_B^3 > 2P_A P_B.$$

PROPOSITION. Relative to the crisp common-property regime, fuzzy access-rights may result in higher or lower total expected returns when access rights are costless and exogenously determined.

PROOF. Under the crisp common-property regime with no cooperation, individual and total expected returns are

$$p_A = \frac{a^2 h}{9b}, \quad p_B = \frac{a^2 h}{9b}, \quad \text{and} \quad p_{total} = \frac{2a^2 h}{9b},$$

which can be seen by setting $P_A = P_B$ in equation (3).

Under the fuzzy access regime, individual and total expected returns are

$$p_A = \frac{a^2 h (2P_A - P_B)^2}{9bP_A},$$

$$p_B = \frac{a^2 h (2P_B - P_A)^2}{9bP_B}, \quad \text{and}$$

$$p_{total} = \frac{a^2 h}{9b} \left(\frac{(2P_A - P_B)^2}{P_A} + \frac{(2P_B - P_A)^2}{P_B} \right).$$

When the expressions for total returns under the two regimes are compared, the fuzzy access regime results in larger expected returns if $P_a^3 + P_b^3 > 2P_a P_b$.

Clearly, this expression will never hold when only one pastoralist chooses to graze the common pasture but both have nonzero access-rights. It does, however, hold for some combinations of access rights where both pastoralists use the common pasture. The proposition is illustrated in Figure 7.2. For purposes of comparison, the thick, horizontal line plots total returns from the crisp common-property case.

This condition provides a guideline for cases in which governmentally guaranteed access for specified clans to well-defined pastures would increase social welfare. If the condition fails, converting the traditional fuzzy-access-right system to a standard common-property regime would improve welfare. In the graph, this would be true for the combinations of access rights that result in

total returns below the dark, horizontal line. Of course, this analysis abstracts from the costs of maintaining access and how access rights are determined. However, even this simple condition based on a model of exogenous rights provides some indication of when the traditional fuzzy access-system is likely to be socially preferable. The traditional system is likely to dominate the crisp common-property system when access rights are significantly asymmetric, but not so asymmetric that only one clan chooses to use the pasture.

Empirically, this finding correlates to cases where range areas are predominantly used by one group, but where another group has partial access or a weaker claim. The group with the high level of rights is the primary “manager” of the area, and the group with the low access is another clan that may access the area either through lineage ties or other links between the two clans. In such an initial situation, enforcing full access for both clans significantly increases the use of the pasture, creating relatively large negative externalities that outweigh the direct gains of increased access.

Another factor affects the relative profitability of the traditional fuzzy access-system and enforced full access: pastures that are not heavily accessed by either clan, so that P_A and P_B are both relatively low, will always yield higher social returns if full access is enforced for both clans. Empirically, this corresponds to cases in which the rangeland is so underused that the gains from increased stocking rates outweigh the increased negative externalities.

Comparative Statics

For the case of exogenously determined, costless fuzzy access-rights, the effects of changes in the exogenous parameters, including P , depend on both the direct effects of the parameters on herders’ returns, and the strategic effects. The effects of \mathbf{a} , \mathbf{b} and h have the same sign as in the crisp common-property analysis; that is, an increase in total available forage net of transaction costs ($\mathbf{a}h$) increases profits, and an increase in \mathbf{b} the externality parameter, decreases profits.

PROPOSITION 1: An increase in total available forage ($\mathbf{a}h$) increases profits, and an increase in the externality parameter (\mathbf{b}) decreases profits.

The effect of a change in the exogenous property rights on profits depends on the relative strength of individuals’ fuzzy rights. For herder A , if $P_A > P_B/2$, then an increase in his access right increases his profits, and an increase in B ’s access right decreases his profits. If one herder has sufficiently weak access-rights relative to the other, then the sign of these results is reversed.

PROPOSITION 2. When a clan has a nonzero stocking rate, an increase in the exogenous fuzzy access-right of that clan will increase its profits and an increase in the exogenous fuzzy access of the other clan will reduce its profits.

PROOFS. Proofs of the propositions are in the appendix of this chapter.

The Benefits of Flexible Fuzzy Access

In this section, we examine in more detail the role that ex post mobility plays as an insurance mechanism. Sub-Saharan Africa land-management systems provide herders with flexibility to respond to adverse rainfall shocks. Clans maintain access to different pastures, both through their own actions and through their alliances with other clans. These alliances may be viewed as a mutual insurance mechanism, where clans adjust their use of the available forage on the basis of relative rainfall shocks to their other grazing areas and the grazing areas of affiliated clans. Using a fuzzy property-regime, we model this by allowing herders' effective access to be a function of their ex ante access and realized shocks.

We again model two pastoralist groups, *A* and *B*. Now, each group chooses its number of stock days to maximize its profits on two separate pastures during two time periods. *A* has exclusive access to pasture 1, and *B* has exclusive access to pasture 3. Both groups have fuzzy access-rights to pasture 2, the common pasture of the previous section. Each pasture is characterized by its number of hectares, *h*, its forage productivity parameter, **a** and its externality parameter, **b**. Each pasture is subject to weather shocks, **q**, **q**₁ and **q**₃ respectively, where the expected value of each shock is 0 and shocks are uncorrelated across pastures. Subscripts are used to designate the two core areas, 1 and 3. Subscripts are suppressed for the common pasture, 2. In accordance with the seasonal transhumance patterns of many pastoralists, each group grazes its core area during the first period, and observes rainfall shocks on all three pastures. In period two, pastoralists allocate stocking days between the core pastures and the common pasture.

In period one, each pastoralist simply maximizes total profits on his core area. Abstracting from real-world considerations, we assume that available forage on the core pastures in period two is independent of period-one stocking decisions and that realized period-one profits are independent of the shocks observed before period-two stocking decisions are made. Accordingly, we can focus on the effects of the fuzzy access-regime in period two and ignore expected profits from period one. In period two, *A*'s maximization problem is the following:

$$\max_{a, a_1} a(1 + \mathbf{q}) \left(\mathbf{a} - d - \mathbf{b} \frac{(a + b)}{(P_A h)} \right) + \mathbf{a}_1(1 + \mathbf{q}) \left(\mathbf{a} - \mathbf{b} \frac{a_1}{h_1} \right).$$

B's maximization problem is similar. Total returns for each herder are the sum of total gains from his core grazing area and total gains from his use of the common grazing area. This specification is more realistic than the previous specification, where pastoralists may choose to use only one pasture after observing rainfall realizations. The comparison of the insurance value of the fuzzy property-regime with a common-property regime, we consider a very simple, probabilistic distribution of rainfall and weather shocks, where the probability function **q** ∈ {−1, 0, 1} represents equal probability of the three shocks. Shocks are

independently and identically distributed across pastures. In the crisp common-property case, the weather shocks simply enter directly into the realization of total weight gain on each herder’s core area and the common access area.

In the fuzzy-access case, the shocks on each herder’s core parcel have a second effect: they alter the herder’s fuzzy access to the common grazing parcel. We model a simple fuzzy rule that relates the access of *A* and *B* to their common grazing land to their shocks on the core grazing areas. Herders adjust common access in response to *relatively* bad outcomes. Herders observe shocks for all pastures, and group the realizations according to their membership in two fuzzy sets describing the *absolute* rainfall level:

$$low = \{1/-1 + 0.5/0 + 0/1\} \text{ and } high = \{0/-1 + 0.5/0 + 1/1\}.$$

Let \bar{P}_A and \bar{P}_B denote each herder’s ex ante degree of fuzzy access. Then, for herder *i*,

$$\tilde{P}_i = \bar{P}_i + \frac{1 - \bar{P}_i}{4} \left((m_{bw}(\mathbf{q}) - m_{bw}(\mathbf{q}_i)) - (m_{igh}(\mathbf{q}) - m_{igh}(\mathbf{q}_i)) \right), \text{ and}$$

$$P_i = \begin{cases} 0 \\ \tilde{P}_i \\ 1 \end{cases} \text{ if } \begin{cases} \tilde{P}_i < 0 \\ 0 \leq \tilde{P}_i \leq 1 \\ 1 < \tilde{P}_i \end{cases}.$$

That is, your fuzzy access increases when you sustain a relatively *bad* shock on your core grazing land and decreases when you realize a relatively *good* shock on your core grazing land. Regardless of the relative magnitude of your shock, however, you can not obtain more than complete access to the pasture or negative access to the pasture. The possible outcomes under this fuzzy rule are described in Table 7.1. The first column reports the shocks to *A*’s and *B*’s core grazing areas, and the other columns reports each clan’s correspondingly adjusted fuzzy access.

In this section, we focus on the effects of the fuzzy rule on the variance of herders’ returns compared to the crisp common-property case. This comparison highlights any effects of herders adjusting their access to common pastures on the basis of relative weather shocks to core grazing areas. Ex ante fuzzy access-rights are assumed to be determined costlessly and exogenously. Recall from the last section that the expected returns from the traditional fuzzy-access system may be either higher or lower than returns from a crisp common-property regime of enforced full access for both clans. By analyzing the effects of flexible fuzzy access on the variance of herders’ returns, we can identify cases where both the mean and variance effects support the implementation of a give regime, or where the mean and variance may have offsetting effects. If the variance of herder income is a policy concern, governments may wish to favor an access regime that does not necessarily have the highest expected value.

TABLE 7.1 Possible outcomes under a fuzzy rule

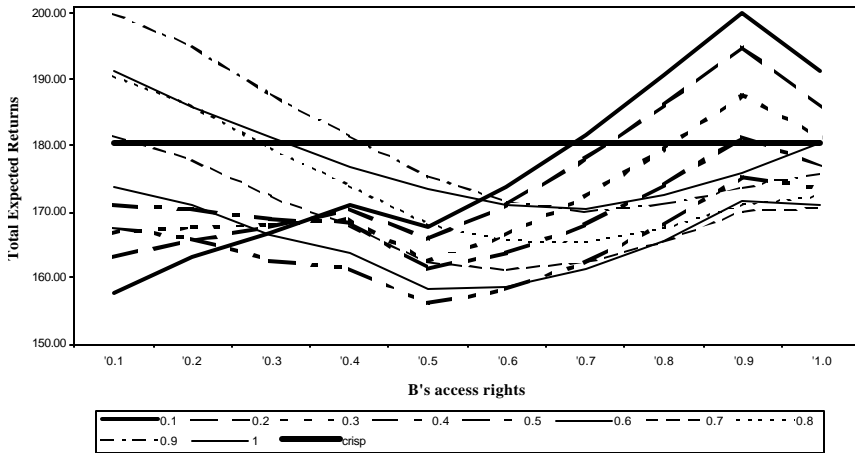
Shocks	P_A	P_B
(-1,-1)	\overline{P}_A	\overline{P}_B
(-1,0)	$\min\left\{1, \frac{1+3\overline{P}_A}{4}\right\}$	$\max\left\{0, \frac{5\overline{P}_B-1}{4}\right\}$
(-1,1)	$\min\left\{1, \frac{1+\overline{P}_A}{2}\right\}$	$\max\left\{0, \frac{3\overline{P}_B-1}{2}\right\}$
(0,-1)	$\max\left\{0, \frac{5\overline{P}_A-1}{4}\right\}$	$\min\left\{1, \frac{3\overline{P}_B+1}{4}\right\}$
(0,0)	\overline{P}_A	\overline{P}_B
(0,1)	$\min\left\{1, \frac{3\overline{P}_A+1}{4}\right\}$	$\max\left\{0, \frac{5\overline{P}_B-1}{4}\right\}$
(1,-1)	$\max\left\{0, \frac{3\overline{P}_A-1}{2}\right\}$	$\min\left\{1, \frac{\overline{P}_B+1}{2}\right\}$
(1,0)	$\max\left\{0, \frac{5\overline{P}_A-1}{4}\right\}$	$\min\left\{1, \frac{3\overline{P}_B+1}{4}\right\}$
(1,1)	\overline{P}_A	\overline{P}_B

In Figure 7.3, we have plotted total expected returns under a flexible fuzzy-access regime as a function of B 's access rights. Here total returns under this scenario are relatively similar to the graph of total expected returns under fixed fuzzy access in the previous section. One interesting difference is that, under the parameters used for the graph, total expected returns decline when either user's rights increase from 0.9 to 1.0.

The flexibility of the fuzzy-access regime and its responsiveness to relative shocks on herders' core areas have two opposing effects on the variance of returns to each herder: first, since access to the common parcel is negatively related to returns realized on the private core, the variance of total returns from using the two pastures is reduced. Second, the responsiveness to relative shocks introduces a new source of variance for a clan. Access to the common area depends on relative shocks to the two core areas, and the other clan's core area shock is a new source of variance. When access rights are exogenous and costless, the flexibility associated with the traditional fuzzy-access regime reduces the variability of returns for herders. This is true provided that one herder's ini-

tial rights are significant enough that the benefits he obtains from the adjustments to relative shocks outweigh the costs of the introduction of the shock to the herder's core as a source of variance in the first herder's realized returns.

FIGURE 7.3 Total expected returns under a flexible fuzzy-access regime as a function of *B*'s access rights



Simulations indicate that the variance of returns for each of the two herders in this model is reduced under the traditional fuzzy-access regime compared with a crisp common-property system for some parameter sets, provided each herder views his degree of access to the available forage in the common parcel as being sufficiently high, and that both herders choose a nonzero stocking level. Further, as seen in Figures 7.4 and 7.5, which depict the coefficients of variation for *A* and *B*'s returns, the traditional fuzzy-access regime reduces the coefficient of variation relative to a standard common-property regime for regions where the two groups are more symmetric in access rights. (We prefer to use the coefficient of variation to facilitate comparing outcomes with different means.) In these figures, some combinations of fuzzy access-rights for *A* and *B*, the traditional regime dominates crisp common-property regime for both clans on the basis of the coefficient variation.

Further, comparison of these figures with the previous one depicting expected total returns shows that regions of access-right pairs exist where there is a mean-variability tradeoff—where, for example, the traditional regime results in lower expected returns but with a lower coefficient of variation. While in this model, we do not directly model our pastoralists as risk averse, which would affect their stocking decisions, policymakers may care about other reasons for the mean-variability tradeoff. For example, the legitimacy of institutions may be more likely to be challenged when seasonal or yearly outcomes are highly variable. That is, stability of outcomes for pastoralists may contribute to the stability

of the supporting institutional system, so that policies favoring reduced variance may be preferred over higher expected profits.

FIGURE 7.4 A 's coefficients of variation less A 's coefficients of variation in crisp common-property regimes

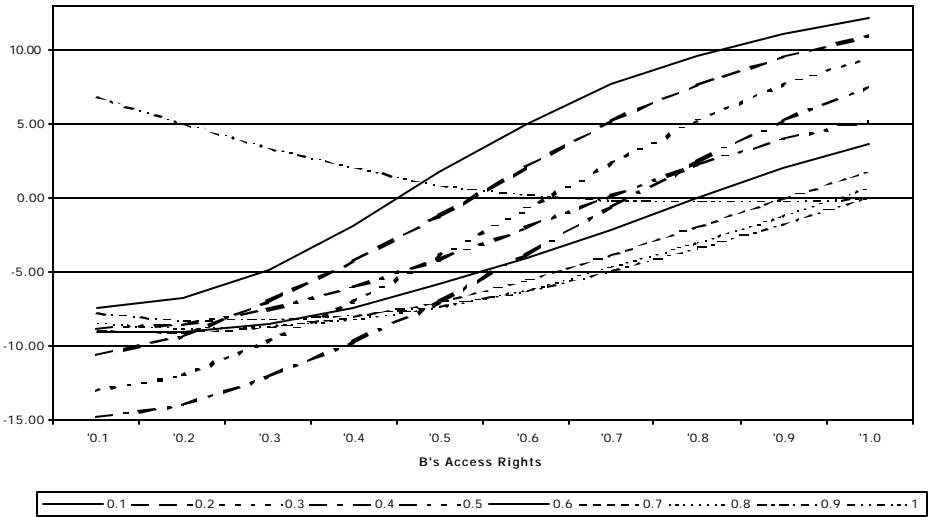
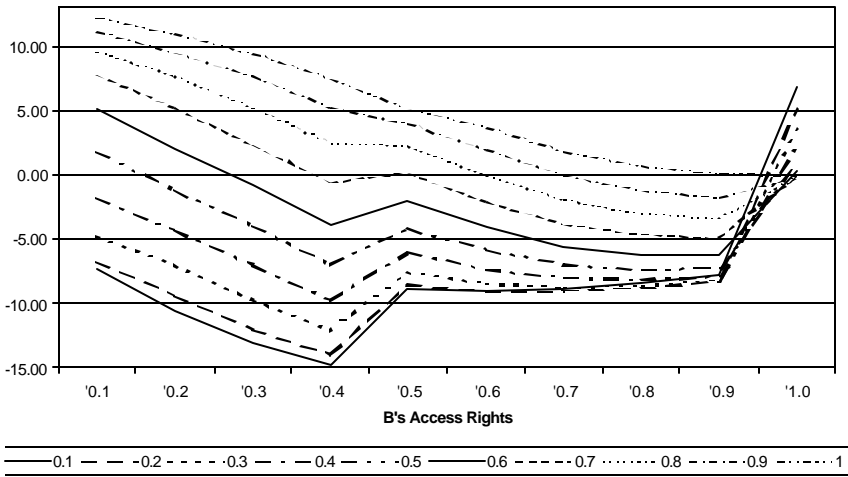


FIGURE 7.5 *B*'s coefficients of variation less *B*'s coefficients of variation in crisp common-property regimes



Discussion and Policy Relevance

Pastoralist mobility, common use of pastures, and the imprecise nature of grazing rights affect the desirability of policy options for Sub-Saharan Africa grazing systems. Modeling traditional grazing rights with fuzzy sets shows that, under some conditions, the traditional fuzzy access results in higher total returns than does conventional common access. Further, the traditional system may reduce the variability of herders' returns. Both private-property rights and conventional common-property rights limit herders' ability to respond to weather shocks *ex post*. Their response is limited to the choice of pastures; their stocking-rate decisions depend only on the property-rights regime. Fuzzy access-rights that adjust in response to relative rainfall shocks enhance the value of mobility in terms of lower variance of returns. While anecdotal evidence exists supporting this sort of risk shifting, its importance remains to be verified empirically. Even in the absence of such adjustments, however, there are conditions under which fuzzy access-rights result in higher mean returns than crisp, common-property rights do.

The partial-access model may aid policymakers in evaluating alternative interventions. If the fuzzy representation captures facets of empirical reality that causes the system to behave differently than do systems with well-defined boundaries and groups, the fuzzy representation will provide a better theoretical basis for evaluating possible policy initiatives and their predicted effects.

Land reform is an extremely important policy issue in Sub-Saharan Africa. As mentioned earlier, previous policy efforts have effectively discriminated against nomadic pastoralists. Land privatization, which restricted access to a single individual or group, was the favored means of assigning property rights until fairly recently. Now, however, policymakers are questioning the appropriateness of private-property rights. While privatization is no longer assumed to be the best policy response, policymakers are still concerned with groups' abilities to manage property resources held in common.

In conventional common-property research, well-defined boundaries and well-defined access are considered essential for successful management of the commons. If this is true in the Sub-Saharan pastoral context, then one option would be an access clarification policy that specifies groups' access to given pastures and assigns the management of these pastures to specified clans. If, on the other hand, benefits of the fuzziness of the traditional land-rights system would be lost under such an access-clarification policy, then perhaps it would be better to support the traditional land-access system.

Our findings indicate that flexible, fuzzy access-rights will be preferred to well-defined access-rights when each clan has sufficiently high access-rights, but where one clan has a higher degree of access than the other. Asymmetric access-rights enhance the role of one clan to "act" as primary managers of a resource, but asymmetric rights also diminish the risk-reducing role of mobility when access rights are also a function of relative rainfall shocks. Alternatively, in situations where access rights are extremely symmetric or extremely asymmetric, performance is likely to be better, in total, under a system of well-defined access-rights, enforced by the state.

There are policies that may enhance the traditional system. Linking funds for waterhole improvement to specific clans, and supporting their control of the improved water source, could reduce incentives to subvert the traditional system in situations where, currently, access rights are symmetric across users. It may also be possible to institutionalize some aspects of the traditional access-system so that clans that overgraze pastures may have some aspects of their rights, such as access, sanctioned. While this could prove quite difficult, having asymmetric access-rights in the case where the traditional system is preferable increases the likelihood of sanctions being enforced.

This analysis presumes noncooperative behavior by users of the commons when making their stocking-rate decisions. The inclusion of cooperative behavior in the stocking decision does not alter the general conclusion that traditional fuzzy access results in most cases in higher total returns than conventional common access, but does reduce the number of such cases. McCarthy (Chapter 6) examines the cases of partial cooperation in the absence of fuzzy access-rights and in the presence of risk. Whether the determination of access rights is cooperative or noncooperative is a question that remains to be answered empirically.

For the purpose of this work, we have abstracted from other factors that may influence the relative desirability of these two regimes. We did not allow for the possibility of rainfall correlation across pastures. That correlation is expected to affect the benefits of both access and flexibility for a given common pasture, but will not cause one land-tenure system to always dominate the other two alternatives. Determining whether this is indeed the case requires further research.

Another interesting phenomenon is that total stocking rates will be lower where fuzzy access-rights exist than under a noncooperative common-property regime. We have not addressed the question of intertemporal externalities here, but where these are important, lower stocking rates should generate additional value to this form of tenure arrangement compared with the crisp common-property rates.

For this analysis, we have assumed fuzzy access rights to be costlessly and exogenously specified, and the effects of these rights on pastoralists' stocking decisions have been examined. Understanding the factors underlying groups' access-right choices and maintenance costs will provide a deeper understanding of the costs and benefits of the traditional system. Factors such as distance, forage quantity, seasonal availability, rainfall amount and correlation with other pastures, and the presence of other groups are all likely to affect the value of maintaining fuzzy access-rights to a given pasture for a given group.

One simplifying assumption of this analysis that may understate the benefits of the traditional system of fuzzy access-rights is the restriction of the analysis to a single pasture grazed in common by the two clans. With the introduction of additional pastures grazed in common, the clans will have greater scope for mutually insuring against negative shocks on part of the grazing range. Another one of the findings of this analysis has potentially interesting implications for the multipasture analysis and its potential implications for clans' choice of mutual insurance alliances: the traditional system dominates privatization or a standard common-property regime when fuzzy access-rights are relatively asymmetric. If clans maintain greater fuzzy access to pastures closer to their core, because of lower costs of rights or for other reasons, then clans *may* be more likely to benefit by mutually insuring other clans that are not too close to their core, even in the absence of distance-related rainfall correlation. Definitively answering this question requires further theoretical and empirical analysis.

Appendix—Comparative Statics of Exogenously Specified, Fuzzy Access-Rights

Differentiating A 's profits with respect to the components of total available forage and the externality parameter results in the following three derivatives:

$$\frac{\mathbb{I}P_A}{\mathbb{I}a} = \frac{2ah(2P_A - P_B)^2}{9bP_A}$$

$$\frac{\mathbb{I}P_A}{\mathbb{I}h} = \frac{a^2(2P_A - P_B)^2}{9bP_A}$$

$$\frac{\mathbb{I}P_A}{\mathbb{I}b} = \frac{a^2h(2P_A - P_B)^2}{9b^2P_A}$$

Regardless of the relative values of P_A and P_B , the expression $(2P_A - P_B)^2$ is always positive. Accordingly, the first two derivatives are positive and the third derivative is negative, given that a , h and b are all specified to be positive.

Differentiating A 's profits with respect to his own and B 's exogenous fuzzy property rights results in the following pair of derivatives:

$$\frac{\mathbb{I}P_A}{\mathbb{I}P_A} = \frac{a^2h}{9b} \left(\frac{(2P_A - P_B)(2P_A + P_B)}{P_A^2} \right)$$

$$\frac{\mathbb{I}P_A}{\mathbb{I}P_B} = \frac{-a^2h}{9b} \left(\frac{2(2P_A - P_B)}{P_A} \right)$$

As long as $P_A > P_B/2$, then the first expression will be positive and the second negative. This condition is exactly the one required for A to choose a non-zero stocking rate.

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8 Ownership, Appropriation, and Risk

PASQUALE LUCIO SCANDIZZO

According to Schlager and Ostrom (1992), five basic rights are most relevant for the use of common resources. These are defined as follows:

- Access—the right to enter a defined physical area and enjoy nonsubtractive benefits (for example, hike, canoe, or sit in the sun)
- Withdrawal—the right to obtain resource units or products of a resource system (for example, catch fish or divert water)
- Management—the right to regulate internal use patterns and transform the resource by making improvements
- Exclusion—the right to determine who will have access rights and withdrawal rights, and how those rights may be transferred
- Alienation—the right to sell or lease management and exclusion rights.

While these claims may characterize the stakeholders' structure of resource use, they are unlikely to resolve the problem of ownership and control. In fact, a basic confusion of languages appears to affect most literature on the argument of property. For at least one influential school of thought, "a property right is an enforceable authority to undertake particular actions in a specific domain" (Commons 1968). On the other hand, for most economists who have recently looked into the question (Williamson 1994; Hart 1997), property is characterized by residual rights, that is, by the claims to what survives after all other claims have been satisfied.

The economic point of view appears to include the alternative that considers property as the process of appropriating "bundles of rights" in the sense that any rights not specifically given to one particular class of stakeholders will coalesce into the "bundle" secured by ownership. This also implies, however, that the specific assignment of rights to specific subjects cannot be considered ownership because it lacks the encompassing characteristic of residuality. The case of common-resource use is particularly relevant in this respect, since the multiplicity of rights that can be given out for alternative uses (for example, access and withdrawal) makes residual rights crucial for social efficiency. For example, if the members of the local community secure access and withdrawal rights, residual claimants are vested with management and alienation rights. These rights

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were indeed at the origin of enclosure and appropriation, as they arose to limit nonresidual claims to their ex ante, well-specified nature.

More generally, following Hart (1995), we can assert that the imperfect nature of contractual relations makes ex ante arrangements differ from ex post outcomes in unpredictable ways. This renders most contracts contingent on the state of the world precarious and risky, especially in the case of natural resources. Because of the inherent uncertainty associated with the vesting of customary rights and the instability in the power relations among competing groups, rent seeking and opportunism are likely to be especially strong in the case where access and withdrawal to a given resource are not bundled together in strong property rights. In this context, ex post arrangements are likely to involve continuous and substantial renegotiations of ex ante agreed rights. The role of residual rights is thus likely to encompass management and exclusion and, as an extreme measure to resolve conflict, alienation. In a very general sense, therefore, contracts can be conceived as a way of assigning contingent rights and corresponding responsibilities under uncertainty and incomplete information. In other words, contracts are inherently stipulations on risk sharing between two basic parties: a primary risk-holder and a residual owner.

Norway offers an interesting example of common property as a residual claim. In this country, different types of commons, mainly differentiated on the basis of ownership of the grounds, are a prominent feature of natural-resource management. Today Norwegian commons can be classified in three broad categories: state commons, *bygd* (community) commons, and private commons. The characterizing difference among state, *bygd*, and private commons is the ownership of ground. While in a state common, the state (central government) is the owner of the ground; in the *bygd* and the private commons, the commoners own the ground. What distinguishes *bygd* and private commons from co-ownership is that in the *bygd* commons more than 50 percent of the commoners are owners of the ground and in the private commons less than 50 percent of the commoners own the ground.

Ownership of the ground covers an important role as a container of what is called the remainder. This is defined as a bundle of residual rights encompassing all rights not explicitly assigned to the common. Hydroelectric power, for example, is one of these remainder rights, which emerged only recently (after being ignored for more than 100 years) as a consequence of a new technology. On one hand, thus, the remainder can be seen as a nucleus of rent seeking and appropriation that provides the holder of residual rights with risks and opportunities. In turn these constitute the incentive to oversee the resource and make sure that the owner reaps the benefits that pertain to his or her rights. On the other hand, the residual rights vested onto the remainder suggest specific responsibilities for maintenance and monitoring of the resource and offer a tax basis for the government to enforce conservation policies.

The contrast between common and remainder rights brings to the fore the point that rights have a dual nature—"the opportunity set enhancement of those

who have rights and the opportunity set restriction of those who are exposed to them” (Samuels 1974, 122). Every definition of claims imposes benefits and costs, the enhancement of some opportunity sets, and the simultaneous restriction of others. Externalities are thus ubiquitous and reciprocal—any definition or redefinition, assignment or reassignment, or change in the degree of enforcement of rights benefits some interests and harms others (Medema and Samuels 1996). The externality remains, in different form; it is merely shifted, as was made clear by Ronald Coase in *The Problem of Social Cost* (1960). The contingent nature of benefits and costs are the consequence both of the inherently incomplete nature of all contracts, and of the random nature of asset yield. This sets the stage for sharing the predictable rights and obligations, and prominently, the risk arising from the unpredictable.

More precisely, because the assignment of rights concerns possible actions under alternative contractual arrangements, limited information creates a context where uncertainty matters. Two types of uncertainty appear to be relevant in this respect: the unknown outcome of the random variables, for which assignment of rights enables appropriation or use; and the behavior of the contractual parties under alternative circumstances. In both cases the rights tend to circumscribe the faculty of undertaking an action that would not be feasible under alternative assignments. Thus, the option value of stakeholders’ rights—that is, the options open as a consequence of the assignment—constitutes a characterizing feature of any contractual distribution of rights.

This chapter shows that the assignment of rights over the random yield of a natural resource can be modeled as a problem of partitioning the sample space into mutually exclusive subsets, one of which, the remainder, has a residual nature. Moreover, the random nature of the underlying variable creates a risk, which becomes the main differentiating factor in all alternative assignments of rights. This risk, which may be measured as the value of the put option¹ corresponding to the parties’ default rights, is de facto the main object of contention among the stakeholders involved and can be demonstrated to be the ultimate determinant of the extent of residual rights under alternative regimes.

This chapter

- discusses some philosophical problems at the root of the appropriation and the granting of rights,
- describes the basic model for analyzing the contingent contracts in question, investigates the key element of appropriation,
- discusses the value of appropriation in a dynamic framework,
- elaborates on the role of risk and the relationship between the value of waiting and the right to default,

¹ The right to sell a fixed amount of the yield of the resource at a predetermined price within a given time.

- considers the relationship between efficiency and distribution in the granting of rights,
- and presents some conclusive considerations.

Common Property and the Social Standard

Delimiting the extent of what is privately and what is publicly owned can be interpreted as the result of creating social institutions to regulate the distribution of contingent rights and responsibilities. While these may consist of complex arrangements, whose meaning may be largely contextual, their ultimate functioning will depend on a relatively simple operation: the establishment of a social standard (Scandizzo and Knudsen 1980, 1996). This can be seen as a key feature of a contract that redistributes contingent rights by partitioning a given distribution into two parts: the part above the standard and the part below the standard. Depending on whether the standard is a minimum threshold (such as a poverty line) or a maximum limit (such as a pollution quota), the contract provides for an appropriate compensation being extracted from one part of the distribution to improve the other part. Thus the social standard can be seen as a way of specifying a socially desirable distribution (over individuals or states of nature) under the constraint that the only operation feasible is truncation of one of the tails, or possibly both.

Because the standard allows a separation of the outcomes of an underlying random variable into two nonoverlapping subsets, its application can also be seen as risk redistributive. The redistribution consists in attributing to one of the components of the distribution (and the corresponding contingent rights) the responsibility of covering any shortfall between actual outcomes and the standard itself. As such, it can be self-sustaining, as in a self-financing, negative income-tax program or in a self-liquidating buffer stock.

In the case of natural-resource management, at least three different applications of a social standard come to mind. First, a maximum limit to the amount of natural resource used by individuals (firms and, possibly, consumers) can be set as a share of an aggregate preservation target to be applied to each potential user or only to some users. Second, a safety-first criterion can be used, by requiring that the use of the natural resource in question be not above a maximum limit defined as the one desirable in the least favorable state of nature. Third, the possibility of irreversible loss can be captured by a social standard that reflects the option value of the resource under uncertainty, that is, the risk of using a resource whose future value may turn out to be higher than expected.

A social standard can also be interpreted as a yardstick for determining the distribution of a given type of risk between two subgroups of a population, one of which is defined as a residual claimant. In the case of a common resource, the standard can be interpreted as a line dividing the rights of the “commoners” from those of the public or the private owners. In turn, the latter are defined as residual claimants of the resource after the “commoners” are compensated and

brought up to the social standard by a sufficient transfer of usage rights. The degree of compensation to which the commoners are entitled is the social standard, while the right to default on such compensation is a complement of residual rights of the individual proprietors. The individual proprietors have the responsibility of ensuring that all nonresidual claimant rights are satisfied, and can appropriate the residual surplus of any asset only after these responsibilities have been met. If this is not possible, however, they have the right to default. In a riskier environment, the standard may be expected to be more generous, and the rights to default on the part of the individual owners correspondingly higher. Thus, the higher the risk, the more likely the arrangements relying on common property, and vice versa.

In the case of enclosures of eighteenth-century England, for example, private individuals reduced production risk by fencing and farming village land intensively. The ensuing fall in the willingness to share risks was instrumental in creating a class of landless poor, who had to migrate to the cities in search of employment and income. Appropriation was thus possible because society accepted a new, lower poverty line, whereby the people excluded from the traditional use of common land experienced a drastic fall in income. Compensation in general was not paid because a new social standard evolved that tolerated, to a much larger extent, individual poverty; and because the new owners eluded payment (Zaretsky 1976).

Another example comes from pastoralism, which in the semi-arid African regions is characterized by high variability of rainfall, low population density, and high transaction costs (McIntire 1993). These conditions prevent the existence of conventional-factor (land, labor, and capital) markets so that contracts are generally complex, provide for risk sharing and common-resource management, and rely on normative notions of the rights to exploit pastures (Thompson and Wilson 1994). Poorer households are explicitly taken into account in these institutional arrangements, and the generosity with which they are treated appears directly related to the high risks of the environment (Sakurai 1995).

In the case of natural resources, the possibility of depletion or irreversible damage gives rise to yet another partition between primary and residual claimants. The present generation, in fact, may be imagined as vested of residual rights in the sense that it can claim the whole lot of natural resources, once an appropriate reserve is made to avoid the future generation's finding itself with an amount short of the social standard. The value of the resources that the present generation can claim is thus equal to the total amount that is expected to be available to both generations minus the amount that it deems necessary to ensure that the future generation is able to enjoy the standard. A key residual right is the value of the option of not making provisions beyond what is presently considered a reasonable complement to individual efforts of the members of future generations.

For example, the inhabitants of the Sahel address land conservation by enhancing mobility and by organizing collective access-control over their own re-

sources. In the more densely populated areas, on the other hand, attempts to develop active conservation policies are more evident and they appear to go hand in hand with land-use intensification, exclusive resource control, and technological change (Vedeld 1997). The concern for conservation thus appears to be positively related to the reduction of production risk, while the social standard for food security is much higher in the riskier areas.

How a social standard is established is a question that can be viewed from the point of view of both positive and normative economics. The rise of a social standard is part of a complex process of developing structures for social action through common goal-setting, institution-building and norm-designing. As such, it may be related to the notion of social justice as fairness developed by Rawls (1974, 1996) and his school of thought. That the residual claimants of the social product may be defined as those who are willing to take the burden to provide for the needy may be seen as an implicit stipulation of a “fair” social contract. The thought experiment behind the veil of uncertainty, whereby one chooses the society that maximizes the well being of the least well off, can also be seen as a way of explaining the emergence of a social standard and the willingness of those above it to forego part of their income to improve the condition of the people below it.

From a normative point of view, on the other hand, a social standard can be established by answering a very general question: What partition of a statistical population (of persons or events) is consistent with a program that transfers resources from one group to another for a given unit cost of the transfer? For example, how do we define a mutually consistent poverty line and poverty eradication program if the cost of transferring resources from the rich to the poor is c dollars for each dollar transferred? If Rawls’ criterion of maximizing the income of the poor is adopted, the solution to this problem can be obtained easily by imposing the condition that the posttransfer income of the people charged with the transfer (that is, their income minus the total cost of the transfer) be not less than the ex post income of the people who benefit from the transfer. If the transfer cost, c , is zero, the answer is that the class of poverty lines with the desired characteristics is bounded from above by the average income of the population. For c greater than zero, on the other hand, it can be shown that such a Rawlsian poverty line is given by average income minus c times the option value of becoming poor.

As residual claimants of national income, in other words, the “rich” should be prepared to transfer to the “poor” a maximum income equal to what they would expect behind the veil of uncertainty (that is, expected income) minus an allowance to reflect the uncertainty of their future condition. This allowance in turn is calculated as the resource loss that would occur should poverty be eradicated totally at the expense of the rich. Thus, under such an interpretation of the Rawlsian rule, the minimum socially tolerable difference between the rich and the poor is the gap that could not be closed by a transfer program.

Because the setting of a social standard immediately recalls the notion of social justice, it is important to see the problem of ownership from a point of view entirely alternative to Rawls'. One such point of view is given by Nozick (1977, 1993), who rejects the idea that rights should be judged on the basis of a "consequentialist" principle, that is, on the effects of their distribution on the well-being of any members of the society. Building upon Locke's conception of property rights, Nozick proposes two procedural principles to determine social justice: legitimate acquisition, and efficiency of original appropriation compared with nonappropriation. The first principle states that "A person who acquires a holding...from someone else entitled to that holding, is entitled to that holding" (Nozick 1977, 151). Thus, given a distribution of holdings at time t , its "just evolution" at time $t + 1$ requires that all transfers of rights are voluntary and lawfully contractual in nature. The second principle defines the criterion to judge original appropriation or justice in acquisition. This principle states that "a person who acquires a holding in accordance with the principle of justice in acquisition is entitled to that holding" (Vedeld 1997, 151). In this respect, Nozick argues that the initial acquisition of holdings from the previously unowned natural world is acceptable so long as the appropriation "leaves no one worse off than she would have been had that part remained un-owned" (Roemer, 1996). Nozick's view is opposite to Rawls' in that he openly rejects the idea that societies may develop their own standards of justice on the basis of what is deemed desirable as a *consequence* of the application of the allocation of rights. His second principle, however, cannot escape some consideration of the consequences of appropriation. This consideration is somewhat weaker than Rawls' but is vulnerable to two objections. First, in many cases (most notably for natural resources), determining whether appropriation "leaves no one worse off" may be impossible. Future generations, for example, may be considerably worse off as a consequence of the appropriation of natural resources and their succeeding depletion by lawful owners. Second, no compelling reason exists to consider nonappropriation as the sole yardstick by which to judge efficiency. Joint ownership (including, as a subclass, all types of public ownership) may very well be a superior alternative.

In spite of these objections, Nozick's proposal is interesting in that it may provide an additional (rather, an alternative) useful criterion for evaluating the vesting of rights as the partition of risk, through the application of a social standard. Nozick's first principle, in fact, outlines a procedure by which the vesting of rights may gain social approval. Any transfer of rights is likely to be validated if it is at the end of a sufficiently long sequence of past contracts. What is required for such a validation is a certain stability of the same partition of claims and responsibilities invoked by the contract. In turn, this implies that the dividing line between the amount of risk that each of the two parties agrees to bear also must be correspondingly stable. In other words, the social standard is itself legitimate only to the extent that it is validated by an unchallenged (or not successfully challenged) series of contracts upholding it. Nozick's second principle

can be interpreted as a criterion to evaluate the establishment of a social standard from an original state, where property is unowned. The standard can be used in this case to justify a different distribution of contingent rights and responsibilities from the original one. This redistribution, in turn, is validated by its strong Pareto-efficient consequences.

The Fundamental Contingent Contract

While for some contracts unforeseeable contingencies may conceivably be of minor concern, in fact virtually no transfer of rights can occur outside the realm of basic uncertainty. Any contract can be described as a logical sequence of uncertain claims and counterclaims in response to an original act of appropriation. The sequence ends when it finds an acceptable balance among the rights and responsibilities of the contracting parties. The balance should be acceptable not only to the parties engaged in negotiating the contract, but also to the broader community, whose laws and regulations may validate the clauses of the contract, provide a forum for complaints, and allow any conflicts to be litigated, negotiated, and ultimately resolved by consensus or enforcement.

In their barest form, contracts can be studied in a world with one time period, where asset returns are uncertain in the sense that expectations entertained ex ante are not necessarily realized ex post. Under these conditions, the basic contract is stipulated ex ante and implemented ex post. It can be described as arising from a negotiating relation between two parties, which for the moment is simply indicated as party *A* and party *B*, and an asset producing a random yield *y*. The random yield is characterized by a probability distribution function $F(y)$ and a density $f(y)$, which are commonly known.

Formally, the logical sequence describing the contract can be expressed as its value V_i ($i = A, B$) for the contracting parties:

$$V_A = Ey - P + R. \quad [1]$$

$$V_B = P - R. \quad [2]$$

In its simplest form, the contract originates from the appropriation of a commonly held resource by party *A*. As a consequence, the contract provides a value to party *A* that is the algebraic sum of three terms:

- The expected value of the resource yield Ey
- The ensuing obligation to pay compensation P to *B* (or to pay dues to a third party that undertakes the task to keep *B* out of *A*'s property)
- The right to default, R .

In turn, the value of the contract for *B* is given by *A*'s payment minus *A*'s default rights. Party *A* thus holds the "residual rights" in the contingent sense that she can appropriate what is left once *B*'s rights are satisfied. If this is not the case, either because *A* fails to honor her promise to *B* or because she can no longer

enforce her ownership through third parties, “residual” rights are transferred to *B*. In the absence of stipulated restrictions by the two parties or by the law, V_A and V_B are also the liquidation values of the contract for the two parties, that is, the minimum amount of money that each of them would accept to alienate the rights conferred by the contracts.

Equations (1) and (2) express the simplest string of values characterizing a contract. Two main ways in which this basic structure can be complicated are the specification of additional payments to cover predictable contingencies, and the provision of clauses contingent upon acts of one or both agents. While both of these complications have been examined in the literature (see, for example, Grossman and Hart 1983; Hart and Moore 1990), they are not essential to understanding the fundamental nature of the contract, which rests only on the three basic elements indicated: expected asset value, compensation to the party excluded (or enforcement costs to exclude), and default rights.

To investigate further the shaping of rights arising from this formulation in equations (1) and (2), consider residual rights. The contingent nature of these rights arises as a consequence of the imperfection of the contracts and is independent of the will of the negotiating parties. In the basic structure designed in this chapter, they arise from an external principle of law: limited liability, that is, the fact that satisfaction of any obligation cannot exceed the repayment capacity of the subject involved. In this case, limited liability implies that party *A* may default on her payment to party *B* if such a payment exceeds the income-generating capacity of the asset. This information enables equations (1) and (2) to be rewritten as follows, respectively:

$$V_A = Ey - P + \int_0^P (P - y) dF(y). \quad [3]$$

$$V_B = P - \int_0^P (P - y) dF(y). \quad [4]$$

The default value R equals the difference between the payment and asset yield in the “unfavorable” states of nature, that is, in those states where the payment could not be made because it would exceed the yield. This value, $R(P)$, is thus an expected gain for party *A* (the contingent holder of residual rights) and an expected loss for party *B*. It can also be considered a risk—the risk of default, which is charged to the payee (party *B*) whether the contract provides for it or not.

By developing R by parts, the following is obtained:

$$R = \int_0^P F(y) dy. \quad [5]$$

This mathematical form describes more explicitly the residual value as a measure of risk.² An alternative way of formulating equations (1) and (2) in light of 3 and 4 is as follows:

$$V_A = \int_0^{\infty} y dF(y) - P(1 - F(P)). \quad [6]$$

$$V_B = \int_0^P y dF(y) + P(1 - F(P)). \quad [7]$$

This formulation shows that appropriation engenders a form of “vertical” sharing of the yield of the asset involved. This means that property rights—defined as a bundle of access, withdrawal, and alienation rights, even when they are not decomposed into their constituent rights—are always shared to some degree by the contractual parties involved, by virtue of the principle of contingent residuality.

Another point is that party *B*, who holds the residual under the unfavorable states of nature, need not be a private party but may instead represent the community at large or a local community having a specific, original claim to the resource appropriated by *A*. In many contracts, on the other hand, society—or any additional stakeholder holding a recognizable claim as a consequence of the contract—might be included as a third, implicit agent.

The Value of the Payment

The provision of a given payment *P* is a crucial determinant of the structure of the contract for three main reasons:

- It is the explicit quid pro quo of the transfer of rights between the two parties, or, alternatively, the specific costs that *A* has to incur to appropriate the asset against *B*'s will.
- It marks the extent of default rights, and the contingent nature of the residual.

² This can be seen by appealing to the concept of stochastic dominance of second degree. If two assets, 1 and 2, with different yield distributions $F_1(y)$ and $F_2(y)$, are compared, asset 1 dominates, stochastically, second-degree asset 2 if the following is true for all P :

$$\int_0^P [F_2(y) - F_1(y)] dy \geq 0.$$

Thus, equation (5), as a building block of stochastic dominance, can be considered a local measure of risk.

- As a consequence of the preceding, the provision determines the dividing line between the unfavorable states of the world, where the residual is assigned to the transferring party, and the favorable states, where the residual is assigned to the party appropriating the asset.

For example, P may be the amount of rent in a lease contract, the price of the asset in a sale contract, the bidding price at an auction, the principal and the interest on a loan, the enforcement cost of privatization, or any other ex ante promise for a payment whose actual disbursement is contingent upon ex post outcomes.

Because of its dual characteristic of a payment and a dividing line among “superior” and “inferior” states of the world, P may also be given a broader interpretation. In a social contract where the stochastic variable is income distribution, productive resources may be seen as appropriated by the “well off,” defined as the people whose income is above the “poverty line,” P . In this case, the social contract stipulates the promise of the “well off” to provide for the needy. This is accomplished by a transfer sufficient to ensure that all people below the minimum level of income (or basic commodities) are given enough to meet the basic need requirement P .

In this Rawlsian interpretation of the social contract, social justice would be served by the society where P was the highest possible. The height of P , however, would depend both on the level of society’s total wealth, Ey , and on the value of default rights, R . In this case, in fact, such a value depends on the wealth of the people below the poverty line, P , and measures their capacity to approximate the social standard without the help of the well off.

However, returning to the main frame of reference in this discussion, how is P established in general? Focusing on this question requires noting that, once the two parties have agreed on the terms of the contract, the interest of A is to minimize P , while the interest of B is of course the opposite.³

³ For A to credibly commit herself to the contract, she has to stipulate the payment and the default rights in a way that ensures her incentive to default only if $y < P$. this will occur if residual rights are determined as follows:

$$R = \int_0^D (P - y) dF(y), \tag{1.1}$$

where D is the default line .

In other words, R stipulates that if $y < D$, A will default on the payment but will turn the asset back to B . In this case, maximizing V_A with respect to D results in the following:

$$Max_D V_A = Ey - P + \int_0^D (P - y) dF(y). \tag{1.2}$$

(continued on the following page)

The conditions of the contract can be investigated by using the structure of a two-by-two, noncooperative game. A basic version of such a game is shown in Figure 8.1, where it is assumed that the two parties can adopt two alternative strategies: attempt to appropriate and accept not to appropriate. The pay-off matrix in the figure shows an ex ante sharing of the asset plagued by an external cost, C , which only one of the two parties (say party A) would be able to eliminate under appropriation. This may be the case, for example, if A is an individual, while B is a collective party, so that any free-rider problem (such as overstocking) would continue to occur under ownership by B .

FIGURE 8.1 Payoff matrix for the single-period game

		PARTY B	
		Appropriate	Not appropriate
PARTY A	Appropriate	$\mathbf{a}Ey,$ $(1-\mathbf{a})(Ey-C)$	$Ey-P_B^*,$ P_B^*
	Not appropriate	$P_A^*,$ $Ey-P_A^*-C$	$\mathbf{a}(Ey-C),$ $(1-\mathbf{a})(Ey-C)$

Under what conditions can party A be expected to assume ownership of the asset, with the agreement of the other party, provided a compensation P_B^* is paid or even without her agreement, if appropriate costs to enforce appropriation are incurred? Clearly these conditions are realized if the outcome in the northeast corner of Figure 8.1 is a Nash equilibrium, that is, if it is the locus of the best possible response for both parties.

A necessary and sufficient condition for appropriation to be a best possible response for A is as follows:

$$Ey - P_B^* \geq \mathbf{a}(Ey - C) \text{ and } \mathbf{a}Ey \geq P_A^*; \tag{8}$$

and for B ,

$$\frac{\partial V_A}{\partial D} = (P - D)f(D) = 0. \tag{1.3}$$

$$\frac{\partial^2 V_A}{\partial D^2} = -f(D) + (P - D)f'(D). \tag{1.4}$$

This is < 0 for $P = D$. Thus, under the definition of the residual rights as expressed in equation 1.1, A can commit herself credibly to the contract if she may default only when she cannot sustain the payment ($y < P$), because it is in her interest to push the default line up to P .

$$P_B^* \geq (1 - \mathbf{a})(Ey - C) \text{ and } (1 - \mathbf{a})(Ey - C) \geq Ey - P_A^* - C, \quad [9]$$

where the compensation, P_A^* and P_B^* , is defined as the net risk of default, that is,

$$P_A^* = P_A - R(P_A) \text{ and } P_B^* = P_B - R(P_B).$$

When the two inequalities are combined, the following is obtained:

$$(1 - \mathbf{a})(1 - \mathbf{r}) \leq \frac{P_B^*}{Ey} \leq (1 - \mathbf{a}) + \mathbf{a}\mathbf{r}, \quad [10]$$

where $\mathbf{r} = C/Ey$, and

$$\mathbf{a}(1 - \mathbf{r}) \leq \frac{P_A^*}{Ey} \leq \mathbf{a}. \quad [11]$$

Now the conditions to obtain a stable Nash solution must be considered. These can be derived by maximizing the Nash product (Harsanyi and Selten 1992) between the gains of each party with respect to the ex ante situation (the southeast corner of the payoff matrix):

$$\max U = [Ey - P_B^* - \mathbf{a}(Ey - C) - \bar{N}][P_B^* - (1 - \mathbf{a})(Ey - C) - \bar{N}], \quad [12]$$

where \bar{N} = the Nash value.

Performing the maximization with respect to P_B^* results in the following:

$$\frac{P_B^*}{Ey} = (1 - \mathbf{a}) + \mathbf{r}\left(\mathbf{a} - \frac{1}{2}\right). \quad [13]$$

If this scheme is enforced, the parties share an equal improvement from A's appropriation equal to one-half of the external costs C . Equation (13) can be written as follows:

$$P_B = \left[(1 - \mathbf{a}) + \mathbf{r}\left(\mathbf{a} - \frac{1}{2}\right) \right] Ey + \int_0^{P_B} F(y) dy. \quad [14]$$

This expression can be solved explicitly if the form of $F(y)$ is known. For example, if $F(y)$ is a uniform distribution in the interval $[0,1]$, the only feasible solution is as follows:

$$P_B = 1 - \sqrt{1 - \theta}, \quad [15]$$

where $\theta = (1 - \mathbf{a}) + \mathbf{r}\left(\mathbf{a} - \frac{1}{2}\right)$.

More generally, if the geometric average is maximized, the following results:

$$\max U_w = [Ey - P_B^* - a(Ey - C)]^q [P_B^* - (1 - a)(Ey - C)]^{(1-q)}, \quad [16]$$

where $0 \leq q \leq 1$.

The following value leads the two parties to share the gain C from privatizing the asset with the proportions aq for party A and $(1 - a)q$ for party B :

$$P_B = (1 - a)Ey + \int_0^{P_B} F(y)dy + (a - q)C. \quad [17]$$

Consider now the condition expressed in equation (11). This condition refers to the case where party B would appropriate the asset and party A would oblige accepting the compensation P_A^* . The Nash solution would require the following:

$$P_A^* - a(Ey - C) = Ey - P_A^* - C - (1 - a)(Ey - C), \quad [18]$$

that is,

$$\frac{P_A^*}{Ey} = a(1 - C). \quad [19]$$

However, this would imply a compensation compatible with equation (11), so that the alternative solution, in which A appropriates and B is compensated, would be accepted. In fact, it is easy to check that any mutually acceptable level of compensation P_A^* would lead to payoffs lower than the payoff that could be realized by both parties by the level of compensation P_B^* in the interval indicated in equation (10).

The Option Value of Appropriation

The framework developed can be generalized by considering the problem of appropriation in a multitemporal contract. At a time t , a given asset offers a yield y that changes stochastically over time according to a Brownian process of the form:

$$dy = m y dt + s y dz, \quad [20]$$

where

m and s = constants; and

$$dz = a \text{ random variable with expected values } Ez \text{ and } Ez^2 = dt.$$

The ex ante appropriation value of the asset can be considered a call option,⁴ whose value is as follows:

$$F(y) = \max E[(V(y_t) - P)e^{-rt}], \tag{21}$$

where

E = expectation;

T = the time at which appropriation is made;

r = the discount rate; and

$V(y_t)$ = the value of the asset at time T .

It is assumed that $m < r$; otherwise the expectation in equation (21) could be made indefinitely large by choosing a larger T .

By solving the maximization problem, equation (21) (Dixit and Pindyck 1994), the payoff matrix of Figure 8.1 can be reformulated as shown in Figure 8.2.

FIGURE 8.2 Payoff matrix for the multiperiod game

		PARTY B	
		Appropriate	Not appropriate
PARTY A	Appropriate	$(ay)/d,$ $(1-a)(y-C)/d$	$y/d - P_B,$ P_B
	Not appropriate	$P_A,$ $(y-C)/d - P_A$	$a(y-C)/d + L(P_B)y^{b_1},$ $(1-a)(y-C)/d + L(P_B)y^{b_1}$

In Figure 8.2, $d = r - m$ and y/d represents the expected present value of the yield stream y_t , when its initial level is y . In fact, because of the Brownian process assumption, $E(y_t) = ye^{rt}$, and discounting at the appropriate rate r results in the following:

⁴ The right to buy a fixed amount of the yield of the asset at a predetermined price within a given period of time.

$$\int_0^{\infty} ye^{(m-r)t} dt = \frac{y}{d}. \tag{22}$$

The expressions $L(P_B)y^{B_1}$ and $L(P_A)y^{B_1}$ represent the value of the option of appropriating the whole resource from each of the two parties. It is possible to show (Dixit and Pindyck 1994) that $L(P_B)y^{B_1}$ and $L(P_A)$ are constants that depend on the compensations P_B and P_A respectively paid by A and B . b_1 is a parameter that depends only on the parameters of the process underlying y and on the discount rate as follows:

$$b = \frac{1}{2} - (r-d)/s^2 \pm \sqrt{\left[(r-d)/s^2 - \frac{1}{2} \right]^2 + 2r/s^2}. \tag{23}$$

From equation (23), it follows (Dixit and Pindyck 1994) that b_1 is the positive root of equation (23) and that b_1 and $b_2/s < 0$.

For appropriation to be profitable for A , the following conditions can be derived, from Figure 8.2:

$$\frac{y}{d} - P_B \geq a \left(\frac{y-C}{d} \right) + L(P_B)y^{b_1}, \text{ and} \tag{24}$$

$$a \frac{y}{d} \geq P_A.$$

Similarly, for party B ,

$$P_B > (1-a) \left(\frac{y-C}{d} \right), \tag{25}$$

and

$$(1-a) \left(\frac{y-C}{d} \right) + L(P_A)y^{b_1} > \frac{(y-C)}{d} - P_A.$$

Consider first the inequality in equation (24). For a given P_B , appropriation becomes profitable for party A when the increase in payoff from the prior situation, that is, the difference of the two sides of equation (24), equals zero:

$$V_A = (1-a) \frac{y}{d} + a \frac{C}{d} - L(P_B)y^{b_1} - P_B = 0. \tag{26}$$

The point at which appropriation is jointly profitable is also the optimum value of y . (Waiting does not pay any longer.) Thus, the first derivative of V_A in

equation (26) with respect to y should also be zero. (This is called the “smooth pasting condition,” see Dixit and Pindyck 1994) that is,

$$\frac{\partial V_A}{\partial y} = \frac{1-a}{d} - b_1 L(P_B) y^{b_1-1} = 0 \Rightarrow L(P_B) y^{b_1} = \frac{1-a}{db_1} y. \quad [27]$$

Substituting this expression in equation (26) results in the following:

$$y^* = \frac{b_1}{(b_1-1)} \frac{d}{(1-a)} \left(P_B - \frac{aC}{d} \right), \quad [28]$$

where y^* is the value of y , at the optimum, for a given P_B . Thus, for any given y , it will be profitable to appropriate for party A if and only if the following is true:

$$P_B \leq \frac{(b_1-1)}{b_1} \frac{(1-a)}{d} y + \frac{aC}{d}. \quad [29]$$

In other words, for a given y , party A will be able to enjoy an appropriation rent, if she can negotiate a deal where P_B is lower than the level at which it just becomes profitable to appropriate. This is compatible with the improvement of B 's payoff unless P_B falls below the limit set by the first inequality in equation (25).

Consider now the prospect of appropriation from B 's point of view. Her gain under this hypothesis would be the difference between the right-hand and the left-hand sides of the second expression in equation (25).

A procedure similar to the one used for A yields the following:

$$y^{**} = \frac{b_1}{b_1-1} \frac{d}{a} \left(P_A + \frac{aC}{d} \right). \quad [30]$$

If $a = 1 - a$ and $P_A = P_B$, clearly $y^{**} > y^*$ because, under the same privatization cost, A 's appropriation is more beneficial, since it eliminates the externality C .

This is even more so if, as it can be expected, $a < 1 - a$. In fact, the smaller party should generally be expected to appropriate before the larger one, for two reasons: it will be easier for her to reduce the externality (because she has to respond to a smaller number of co-owners and possibly only to herself), and she will be able to offer a better deal to the other party.

From equation (30), it can be argued that, for a given y , for appropriation to be profitable to party B , it is necessary that the following be true:

$$P_A \leq \frac{(b_1-1)}{b_1} \frac{a}{d} y + \frac{aC}{d}. \quad [30]$$

Comparison of equations (29) and (31) readily shows that for $a < 1 - a$ then $\bar{P}_A \leq \bar{P}_B$; where \bar{P}_A and \bar{P}_B are the maximum acceptable levels of compensation that each appropriating party may be willing to pay.

The Role of Risk

The contingent value of the contract, under the dynamic model presented in the section *The Option Value of Appropriation*, above, appears to depend on a different feature than in the one-period model. This was in fact characterized by default risk, which functioned as a put option for the holder of residual rights (the appropriating party) on the asset. For the multiperiod contract, on the other hand, this model has assumed that the payment to the expropriated party is made at the beginning so that all risk is borne by the new owner. The appropriating party, however, does hold an option in the form of the right to wait before she makes the move to appropriate. Rather than holding a put option as in the one-period case, the appropriating party kills a call option, which she holds before moving to the new contract from the previous position.

The appropriation contract may be framed, however, in a context of limited liabilities and default rights, by assuming that compensation to the expropriated party is not paid immediately but, at least partly, after a certain number of periods. In this case, rather than waiting, the appropriating party may appropriate and then consider the probability of default.

To explore this possibility, assume that at time t party B agrees to forego her rights on the asset in exchange of a compensation P_B to be paid in equal installments P_B^a . In this case the appropriation condition for A will be as follows:

$$\frac{P_B^a}{r} \leq \left[\frac{(b_1 - 1)}{b_1} \frac{(1 - a)}{d} y + \frac{aC}{d} \right]. \tag{34}$$

where P_B^a = the price at which appropriation will occur.

Once appropriation has been accomplished, however, at time $t + \mathbf{t}$ party A faces a different prospect. If $Ey(t + \mathbf{t}) = ye^{u(t+\mathbf{t})}$ is sufficiently high; in fact, she will be able to pay the contract price and keep the asset.

If the expected value of y at any time is not sufficiently high, however, A may decide to default. Because of limited liability, default may not cause any loss in party A 's personal wealth, if any, but will presumably prevent her return among the beneficiaries of common property. Party A 's prospective gain from default at time $t + \mathbf{t}$ may thus be indicated as follows:

$$\hat{V}_A = \frac{P_B}{r} - \frac{y}{d} - R(P_B)y^{b_2}. \tag{35}$$

where

- $R(P_B)y^{b_2}$ = the value of the put option held by B as her right to default;
- $R(P_B)$ = a constant that depends on the value of the promise to pay P_B ; and
- b_2 = the negative root of the quadratic equation in equation (23).

Using the smooth pasting condition $\mathcal{N}_A/\mathcal{N}_y$ and substituting into equation (35) results in the following, to avoid default:

$$\frac{P_B^e}{r} \leq \frac{y (|b_2| + 1)}{d |b_2|} \tag{36}$$

where P_B^e denotes the price at which appropriation will cease.

From equations (34) and (36), it may be concluded that, for any level of expected yield, appropriation will not occur and, if it has occurred, will cease if the contract price exceeds a multiple of the present value of the asset. Such a multiple will be a function of the variance:

$$\frac{\partial P_B^a}{\partial s} = \frac{(1-a)y}{d} \frac{1}{b_1^2} \frac{db_1}{ds} < 0 \quad \frac{\partial P_B^e}{\partial s} = -\frac{y}{d} \frac{1}{|b_2|^2} \frac{d|b_2|}{ds} > 0 \tag{37}$$

An increase in risk will cause the entrance fee for appropriation to decrease but the default level to increase.

The difference between the entry and the exit price, in fact, is much more important than what it may appear from the algebraic expressions. If plausible values of the parameters are used to study the effect of risk increases, the values of the entry and exit price P_B^a and P_B^e diverge dramatically. This is shown in Table 8.1, which reports the values of b_1 , b_2 , P_B^a/y , and P_B^e/y both under the hypothesis that the discount rate is not adjusted and then when it is adjusted for risk. The adjustment is made using the capital-asset-pricing formula

$$r = r + \mathbf{j}r_{ym} \times s$$

where

- r = the riskless rate (the market price for risk),
- r_{ym} = the correlation coefficient between the asset (yield) and the market price, and
- s = the standard deviation of y .

Table 8.1 and Figures 8.3 and 8.4 show that, as variance increases, unadjusted entry compensation levels quickly stabilize at about 90 percent of expected yield. Exit levels instead increase rapidly so much that even moderately high values of the variance seem to imply no respect of abandoning the asset.

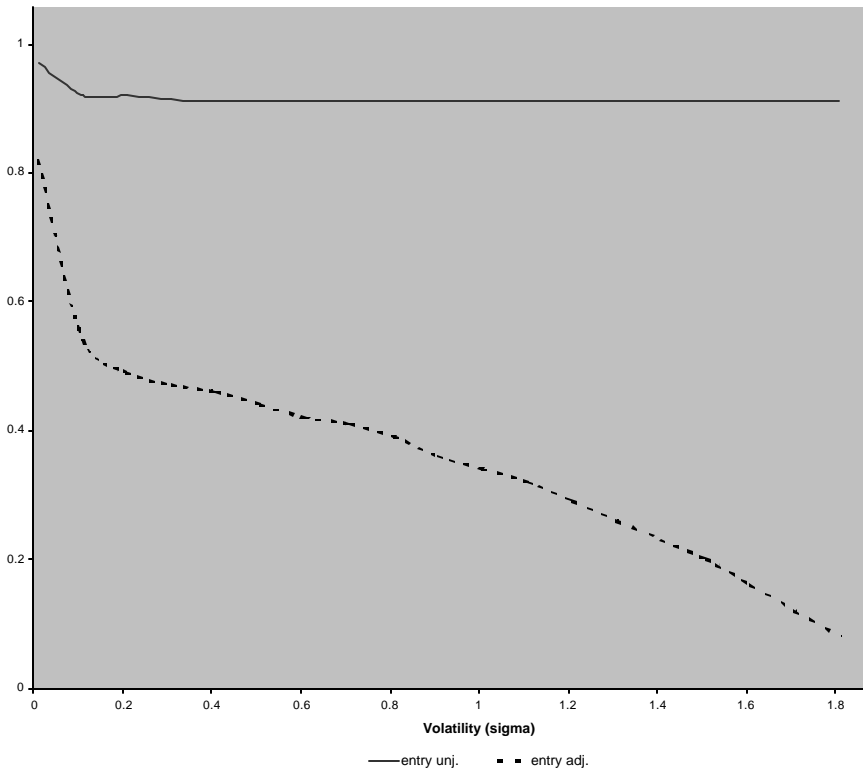
Adjustment for risk appears to act mostly on the entry level, which is substantially reduced. Exit levels, even though they are lower than in the unadjusted case, are so high that they still seem to rule out any possibility of default.

The dramatic divergence in the values of the two thresholds is mainly due to the large differences in absolute value between the values of the risk parameters b_1 and b_2 , since the latter approaches zero very quickly as the variance increases. Thus, for even moderately high values of the variance, a new owner will be willing to pay very little compensation to the excluded party. However, once she holds her new possession, it will take a very large price to make her default.

TABLE 8.1 Entry and exit threshold levels for increasing risk

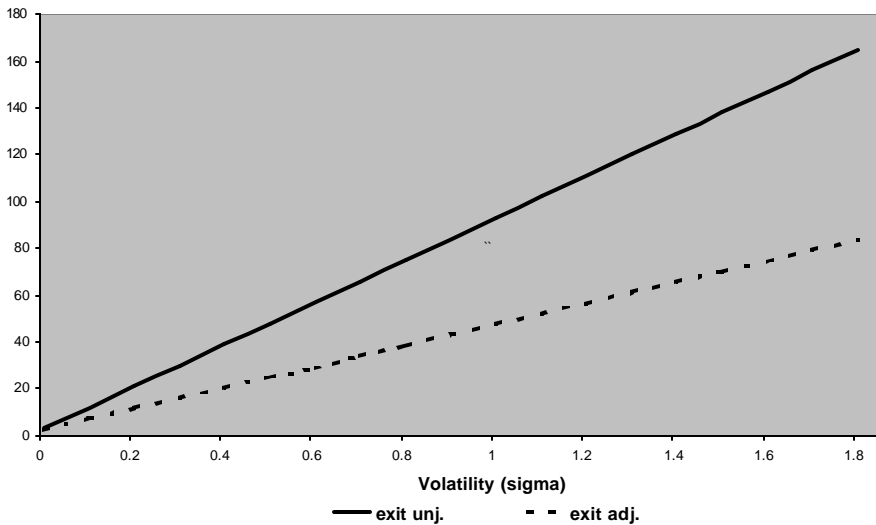
S.D., sigma	Risk parameters		Risk- adjusted discount rate, RHO	Compensation thresholds			
	Beta1	Beta2		Unadjusted for risk		Adjusted for risk	
				Entry	Exit	Entry	Exit
0.01	1.902498	-2.1025	0.024	0.970289	2.951249	0.821115	2.529642
0.11	1.818182	-0.2	0.064	0.92106	12	0.536602	7.111111
0.21	1.809998	-0.10524	0.104	0.916037	21.00497	0.493925	11.61977
0.31	1.806895	-0.07141	0.144	0.914121	30.00687	0.472252	16.12309
0.41	1.805262	-0.05404	0.184	0.91311	39.00787	0.455485	20.62485
0.51	1.804255	-0.04347	0.224	0.912486	48.00849	0.439621	25.12594
0.61	1.803571	-0.03636	0.264	0.912061	57.00891	0.423185	29.62668
0.71	1.803076	-0.03125	0.304	0.911754	66.00922	0.405511	34.12721
0.81	1.802702	-0.02739	0.344	0.911522	75.00945	0.386251	38.62762
0.91	1.802409	-0.02439	0.384	0.91134	84.00963	0.365205	43.12794
1.01	1.802174	-0.02198	0.424	0.911193	93.00977	0.342254	47.62819
1.11	1.80198	-0.02	0.464	0.911073	102.0099	0.317317	52.1284
1.21	1.801818	-0.01835	0.504	0.910972	111.01	0.290343	56.62858
1.31	1.801681	-0.01695	0.544	0.910887	120.0101	0.261293	61.12873
1.41	1.801562	-0.01575	0.584	0.910813	129.0101	0.230142	65.62886
1.51	1.80146	-0.0147	0.624	0.910749	138.0102	0.196868	70.12897
1.61	1.80137	-0.01379	0.664	0.910693	147.0103	0.161458	74.62906
1.71	1.80129	-0.01299	0.704	0.910644	156.0103	0.123899	79.12915
1.81	1.801219	-0.01227	0.744	0.9106	165.0104	0.084184	83.62923

NOTE: S.D. indicates standard deviation.

FIGURE 8.3 Entry unadjusted and adjusted for risk

Now, consider the probability of appropriation and default. It is reasonable to hypothesize that the larger the number of people seeking ownership rights is, the smaller the ratio between the compensation that they have to pay and the asset yield is. Thus, in a riskier society, by virtue of equation (34), the number of owners should be fewer, since only a few will find attractive a very low ratio between the price and yield of the asset. However, a comparatively larger share of owners will hold on to the asset, once it is appropriated, and will not default. A higher variability, in fact, implies, other things being equal—that “it pays to wait” before exercising the default option and forego the rights to the asset.

These results can also be interpreted in a context where A 's “payment” denotes the expenditure for privatizing, and where default rights may be renegotiated. Thus, for example, some access to A 's land may be granted to B in the event of a poor realization. Alternatively, A 's access to the remaining commons may be reduced, so that A receives less in bad years (because of this lack of access).

FIGURE 8.4 Exit unadjusted and adjusted for risk

Thus, the interesting feature of a risky situation is not that the appropriator may default, but that, *ex post*, either she must expend even more resources to keep others out (if she realizes a relatively good yield) or that she wants to access what remains of the commons but may not be able to (if she realizes a relatively bad yield). This also implies that, in a riskier society, owners will tend to be more generous toward the people who were excluded from the asset and to whom compensations are due. If the contract between the owner and the excluded party takes the form of a loose arrangement that can be periodically negotiated, for example, a higher risk may be expected to result in higher level of payment. Alternatively, as risk decreases, the established owners' willingness to pay will be reduced and, at the same time, a higher level of appropriation will occur.

Because technical progress typically involves both an increase in average yield and a decrease in its variability, its effect on appropriation is ambiguous. On one hand, it will tend to increase the price that would-be owners are willing to pay to appropriate a commonly held asset. On the other hand, it may increase or decrease the degree to which established owners will be willing to pay compensations to the commoners. If the effect of risk prevails over the increase in average yield, in fact, a higher rate of default, as well as lower propensity to increase the level of compensation to the commoners, should be expected to accompany technical progress.

In conclusion, in a higher-risk society, the following should be expected:

- Fewer people will try to appropriate the commonly held assets.

- When appropriations are accomplished, compensations actually paid to the excluded parties will be lower.
- Compensations promised will be higher.
- Defaults will occur comparatively less often.

The Efficiency Question

Consider now the efficiency of private property from the point of view of resource allocation. Assume that the asset appropriated may be combined with one or more inputs x , at a given market price w , according to a neoclassical production function:

$$q = q(x)u, \tag{38}$$

where u is a random variable in $[0,1]$.

For example, x may represent land, livestock or other inputs, while u is random shocks. The appropriation contract can be reformulated as follows:

$$V_A = q(x) \int_{u_p}^1 u dF(u) - (P + wx)(1 - F(u_p)), \tag{39}$$

where $u_p = [u; uq(x) - wx < P] = \frac{P + wx}{q(x)}$.

In the E,P,R formulation of the contract, the following can easily be checked:

$$R = \int_0^{u_p} [(P + wx) - qu] dF(u). \tag{40}$$

The following can be obtained through using the E,P,R formulation and developing R in equation (40) by parts:

$$V_A = q(x)Eu - wx - P + q \int_0^{u_p} F(u) du. \tag{41}$$

Differentiating with respect to x , equating to zero, and solving for $qxEu$ yields the following, after some simplification:

$$q_x Eu = \frac{w(1 - F(u_p))Eu}{\int_{u_p}^1 u dF(u)} = \frac{w(1 - F(u_p))Eu}{Eu - \int_0^{u_p} u dF(u)}. \tag{42}$$

From equation (42), it can be argued that the marginal productivity will be greater or less than factor remuneration according to whether the following is true:

$$Eu \begin{matrix} < \\ > \end{matrix} \left[\int_0^{u_p} u dF(u) / \int_0^{u_p} dF(u) \right]. \tag{43}$$

Solving for P , from equation (41), can further yield the following: $q_x E_y$ is greater or less than i according to whether P is greater or less than $qE_y - wx + R/F(u_p)$. However, it can be easily checked from equation (39) that $V_A \geq 0$ will require $P \leq qE_y - wx + R$. Thus, the range of the possible values of P for which underutilization of resource occurs is much larger than the alternative on the privately appropriated land. Contrary to the “tragedy of the commons,” which derives from a tendency to overexploit a common resource, appropriation may thus cause a “tragedy of the private.” In any case, for $u_p \neq 0$, allocation will necessarily be inefficient, according to whether party A has a higher or lower incentive to combine productive resources with the asset appropriated. It can also be shown that, for the Nash solution $V_A = V_B$, marginal productivity will be greater than the wage rate, so that underexploitation of resources will ensue.⁵

In the appropriation–nonappropriation game, it can thus be argued that the condition to benefit both parties becomes

$$(1-a)(1-r-I) \leq \frac{P_A^*}{\bar{q}(Eu)} \leq (1-a) + ar - I, \tag{44}$$

where r and I represent, respectively, the external costs under common access and the efficiency losses due to limited liability—all measured in units of the efficient solution $\bar{q}Eu$.

Thus far, it has been assumed that party B is somewhat passive, in the sense that P and w are established by the market or by a bilateral bargaining process independent of factor allocation. Alternatively, however, it can be assumed that P is determined on the basis of a participation constraint for B (Mitra 1983).

In this case, it might be argued that, since there are no transaction costs, Coase theorem would apply. Even in the absence of transaction costs, however, efficiency may not be reached if part of the burden of default risk has to be

⁵ For the Nash solution $V_A = V_B$, the value of u_p is $u_p = \frac{1}{2}Eu - \frac{1}{2} \frac{wx}{q} + \int_0^{u_p} F(u) du$

and equation 43 will imply that $qxE_y > w$, since $Eu < \int_0^{u_p} u dF(u) / \int_0^{u_p} dF(u)$ requires

only that $Eu > -\frac{wx}{q} - \frac{1 - F(u_p)}{F(u_p)} \int_0^{u_p} F(u) du$, which is always true for $u_p \geq 0$.

borne out by the owners of the resource. More specifically, consider the following contract formulation:

$$V_A = q(x) \int_{u_p}^1 u dF(u) - (wx + P)(1 - F(u_p)) , \tag{45}$$

where

$$u_p = \frac{wx + P}{q(x)} ; \text{ and}$$

$$V_B = q(x) \int_{u_x}^1 u dF(u) + P(1 - F(u_p)) - wx(F(u_p) - F(u_x)) , \tag{46}$$

where $u_x = \frac{wx}{q(x)}$.

Equations (45) and (46) indicate that party *A* treats the payment to the input owner (possibly herself) as having seniority rights with respect to party *B*. Thus, the compensation *P* is paid only after the market value of the input has been paid. Furthermore, it is assumed that limited liability holds both for *A* and for *B* and that the market rate *w* is given and nonnegotiable.

Given these assumptions, consider *A*'s problem as the maximization of V_A in equation (45) given the requirement that the expected income V_B be equal to a given amount \bar{V}_B .

The following is obtained through substitution of equation (46) into equation (45):

$$V_A = q(x) \int_{u_x}^1 u dF(u) - wx(1 - F(u_x)) - \bar{V}_B , \tag{47}$$

which can be written as

$$V_A = q(x)Eu - wx + q \int_0^{u_x} F(u) du - \bar{V}_B . \tag{48}$$

The first-order conditions for the maximization of equation (48) can be written as follows:

$$\frac{\partial V_A}{\partial x} = \frac{\partial q}{\partial x} Eu - w + \frac{\partial q}{\partial x} \int_0^{u_x} F(u) du + F(u_x) \frac{du_x}{dx} = 0 , \tag{49}$$

where $\frac{du_x}{dx} = w \left[\frac{1}{q} - \frac{q_x x}{q^2} \right] = \frac{w}{q} (1 - \theta)$, $\theta = \frac{d \log q}{d \log x}$.

Solving for w yields the following:

$$w = \frac{\partial q}{\partial x} Eu + \frac{\partial q}{\partial x} \int_0^{u_x} F(u) du + F(u_x) \frac{w}{q} (1 - \theta), \tag{50}$$

with decreasing returns $q < 1$ and $w > (\frac{q}{q'}) Eu$, denoting overuse of the resource, with respect to its private optimal use. This overuse is the result of the fact that limited liability allows both A and B to default when $u < wx/q$.

Conclusions

This chapter has explored the significance of appropriation and the transfer of rights in the context of imperfect contracts. It has identified the basic form of appropriation in an E, P, R contract, whereby a party acquires the right to enjoy a random yield y and in exchange, agrees to pay to (at least) another party a price P , whose payment is subject to a right of default R . This chapter has proposed to consider default rights as the fundamental consequence following appropriation of residual rights and the basic risk burden faced by nonappropriating stakeholders.

While risk aversion in one or both parties has bearing on the negotiation of the transfer price, default risk asserts itself independently of subjective preferences. It always corresponds to a put option that the vesting of the rights create and that neither party can avoid. Ultimately, however, both the price paid and the particular *distributional* solution must be found through negotiation. The question of a “fair price,” in particular, seems to be a legitimate problem in this kind of exchange and precedes logically and, perhaps, has preceded chronologically, all questions of efficiency. The transfer price’s being considered as a social standard emphasizes the fact that the transfer of rights generally involves problems of fairness and provision for the needy.

In an intertemporal context, the problem of acquiring a property asset can be distinguished from that of maintaining the asset. In both cases, risk increases the value of waiting, that is, the value of not modifying the status quo. Higher risk will result in a lower acceptable cost to appropriate the asset and thus, presumably, in a lower number of people taking the action to appropriate. For those who already own assets, on which compensations are due to other parties by virtue of explicit or implicit contracts, the situation is similar. Increases in risk will imply, in fact, that these owners will default under comparatively higher dues. Fewer appropriators, therefore, will choose to exercise the limited liability option, under higher risk. The quantitative impact of risk, however, is very different in the two cases: moderate on the threshold compensation acceptable to seek ownership, and extremely strong on the default threshold.

The default threshold can be interpreted as the compensation paid by the owners of wealth (the rich) to the people who do not own substantial resources (the poor). Interpreting the average value of the payment made by the rich to the poor as a social standard emphasizes the fact that the transfer of rights generally involves problems of fairness and prevision for the needy. As such, the price paid by the holders of residual rights to the other parties is likely to reflect the social consensus on the sharing of the risks among the parties involved.

The riskier the environment in which the deal itself is consummated, the more likely the social standard is to be more generous toward the commoners that are deprived of their rights. The reason for this is that, in a riskier environment, a higher compensation is likely to be more acceptable to the rich and more necessary to the poor. Higher risk and a correspondingly higher social standard for food security, for example, can be interpreted as a form of communal property arrangement where access to common resources is enhanced through mobility, reciprocity, and other arrangements (see, for example, Vedeld 1997).

Nevertheless, the distribution may be separated from the efficiency problem through the assumption that the original condition is resource sharing and joint management. Against this standard, it can be shown that any act of appropriation may generate both benefits and costs through the elimination of the externalities associated with collective action on one hand (the “tragedy of the commons”) and through the interjection of inefficiencies due to default risk on the other.

Fuller appropriation of rights to a simple asset thus appears to be a more desirable strategy than partial appropriation. In fact, privatization appears justified at least on the grounds that the ownership of a nexus of rights from the part of single owner reduces her incentive to default and provides, *ex ante*, a more credible basis for the transfer of rights.

On the other hand, neither joint ownership nor full appropriation provide clear-cut rules to choose a superior solution from the point of view of social justice and efficiency. Joint ownership, as a solution that maximizes total output, in fact, is an extreme case where distribution is totally undetermined, while efficiency is at a maximum. However, this can be so only if it is accepted that the assumption that the ensuing distribution will display a pattern of incentives validating the joint maximization assumption. Similarly, appropriation may solve the problem of distribution in a clear-cut way, but leaves efficiency to be determined by the arrangements between the appropriating and the expropriated parties. Even if transaction costs are disregarded, compensation arrangements are likely to result in inefficiencies due to limited liability and the opportunity to shift some of the default costs onto other parties.

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PART III

**Policies and Institutions for Risky
Environments**

9 The Dynamics of Land Use and Property Rights in Semi-Arid East Africa

BRENT SWALLOW AND ABDUL B. KAMARA

Land-use and property-rights systems in Africa are expected to evolve along two main pathways during the coming decades. In the subhumid and wetter semi-arid areas, crop and livestock enterprises are expected to become more integrated. Crop residues will generate more feed for livestock, and livestock will provide more traction power and nutrients for crops. It is expected that privatization of property rights to both agricultural and grazing lands will increase and that land will be more easily exchanged. In the arid areas, mobile livestock-production is expected to remain the dominant land use, with cultivation only increasing in the few areas that are favored with fertile soils and good supplies of groundwater. Property rights are expected to change gradually, with more exclusive property rights emerging in some dry-season grazing areas (McIntire, Bourzat, and Pingali 1992; Winrock International 1992).

Between the wetter semi-arid and arid areas lies a large transition zone where land use and property rights could evolve toward either integrated crop-livestock systems or remain under mobile livestock-production. Similarly, property rights could either tend toward increased privatization, or remain as common or state-owned property, or slide toward open access. In the unimodal rainfall areas of western Africa, this transition zone is defined by having an average annual rainfall of between 300 and 700 millimeters. In the bimodal rainfall areas of eastern Africa, this transition zone is defined by average annual rainfall of between 500 and 1,000 millimeters (Ellis and Galvin 1994).

The objective of this chapter is to enhance understanding of the dynamic processes that are shaping property rights and land use in the transition zone in East Africa. Particular attention is given to a rapidly changing situation in southern Ethiopia. The section following this introduction reviews past studies of changes in property rights and land use in East Africa. The next section contains a review of the theoretical literature on property-rights change. A conceptual framework is presented in the fourth section, which offers a better understanding of the processes of property-rights and land-use change in semi-arid East Africa. In the penultimate section, the conceptual framework is used to frame an in-depth study of property rights and land use change in the Borana Plateau of Southern Ethiopia. The closing section consists of a discussion and conclusions.

Review of Literature on Property-Rights and Land-Use Change in East Africa

In the last few years, several studies have been conducted on property-rights and land-use change in pastoral and agropastoral areas of East Africa. This section reviews studies from Kenya, Somalia, and Sudan that have identified factors causing changes in property rights and land use. The studies are categorized by the pathways they depict:

- Endogenous development of local commons
- State sponsorship of local commons
- State sponsorship of individualization
- Endogenous individualization
- Resilient customary systems
- Creation of open access.

These studies illustrate the many different pathways to development being pursued in the arid and semi-arid areas of East Africa.

Endogenous Local Commons

Ensminger (1992) conducted a study of long-term changes in economic institutions among the Orma pastoralists of northeastern Kenya. The Orma population stands at 40,000. They currently occupy an area to the west of Tana River with an average annual rainfall of 400 to 600 millimeters spread over two rainy seasons (Jaetzold and Schmidt 1983).

Until the middle of this century, the Orma had abundant grazing resources that were governed by a loosely defined set of norms. These resources became increasingly scarce as the Kenyan government expropriated large tracts of land to establish irrigation schemes, game reserves, and government ranches in the 1950s. Turkana pastoralists also encroached into Orma territory during drought. In response to the increased grazing pressure, the Orma devised a system of restrictions on the use of pastures near their villages. This effectively excluded transhumant herds and established a local commons. The Orma Council of Elders oversaw the management and use of the common pastures. This Council was a decentralized form of government that relied on consensus of community members. Individual community members enforced the decisions of the Council.

Demand for grazing resources increased between the 1950s and 1980s as improvements in transportation infrastructure resulted in increases in the local price of cattle. Encroachment by Somali pastoralists further reduced grazing land available to the Orma. In the mid-1980s, the Orma Council of Elders effectively admitted that it was no longer able to enforce the rules that maintained the local commons. During the drought of 1985, an interest group of commercially oriented sedentary livestock producers was able to convince the Kenyan central government (the state) to intervene to prevent further Somali encroachment into the region. The state expanded the local commons and more effectively enforced

the rules. State intervention was through the local chief, with the support of most of the elders.

The Orma case study shows the way that external factors can combine to induce reform in the demand for changes at three levels: property rights, composition of interest groups, and legislation in terms of rule formulation and enforcement. Improvements in transport and communication infrastructure had the dual benefit of increasing the returns from commercial cattle production and reducing the state's law-enforcement costs. Interest groups were formed to influence state policy in favor of protecting the Orma from the Somali. Law enforcement shifted from the Orma to the local chief and the state security system.

This case study also illustrates the possible impacts of climatic variability. During good rainfall years, the Somali pastoralists had little reason to encroach upon Orma territory. With drought, however, the Somalis moved further into Orma territory. This put pressure on the local institutions. In one instance the institutions that govern resource use among the Orma became stronger and resisted the encroachment. In another instance those institutions became weaker.

State-Sponsored Local Commons

The Kenyan government has been sponsoring privatization of agricultural land since the mid-1950s. The Swynnerton Plan was a colonial-government program for the registration of private title deeds to agricultural land. Implementation of the Swynnerton Plan began under the colonial government and continued with the postcolonial government. While the original plan did not allow for the registration of individual title deeds to pastoral land, some people took advantage of the provisions of the plan to register individual title deeds to some of the most productive land in Maasailand.

The two districts of Kajiado and Narok that encompass modern Maasailand cover approximately 36,000 square kilometers of land. Average annual rainfall varies from 300 to 800 millimeters in Kajiado and from 500 to 1,000 millimeters in Narok. In 1979, the average population density was 7 persons per square kilometer in Kajiado and 13 persons per square kilometer in Narok (Jaetzold and Schmidt 1983). Group ranches were promoted in the Kenyan Maasailand for several reasons:

- To prevent encroachment into pastoral territories
- To promote efficient use of rangelands
- To stimulate investment in rangeland development
- To encourage pastoralists to market a larger percentage of their animals.

It was hoped that, overall, the result would be greater offtake of animals and fewer livestock to counter the prevailing trend of overstocking. Group-ranch development began in the mid-1960s and was mostly completed by 1980. Groups of Maasai men were registered as the legal owners of individual tracts of land ranging from 50 to 1,000 square kilometers (Galaty 1992).

Some positive results undoubtedly came out of the development of the group ranches for the Maasai living in Maasailand. Individual appropriation of land was scaled down and the influx of non-Maasai into Maasailand was stemmed. Development projects funded the construction of some livestock-production infrastructure, such as boreholes, dams, troughs, tanks, pipelines, and cattle dips. Schools, shops, and health clinics were also established (Ruttan 1995).

Nonetheless, despite the heavy investment, stocking rates, herd mobility, and marketing behavior did not change significantly. Indeed, Homewood (1993) reported that, after 20 years of group ranches, there are no significant differences in livestock production, wealth, or human nutrition between the Maasai in Kenya and their counterparts in Tanzania. Negative results commonly noted include the following:

- Poor project implementation
- Reduction in the power of customary authorities without the development of an appropriate substitute
- Divergence between the boundaries of group ranches, customary land management units, and ecological units
- Elimination of customary property rights without the development of appropriate substitutes (Kituyi and Kipuri 1991).

This case study illustrates a dynamic relationship between property rights outside of the pastoral sector and the supply and demand for property-rights change in the pastoral sector. On the supply side, the group-ranch concept was based on the premise that private property would lead to greater efficiency and productivity. The group ranch was seen as a means to strengthen group property rights. On the demand side, some individuals took advantage of the titling scheme and were able to obtain title deeds to rangeland. This reduced security of tenure under the customary system and increased demand for group ranches (Ruttan 1995).

State-Supported Individualization

Before, during, and after the development of the group ranches in Kenya, many Maasai expressed a demand for individual title deeds. Individual titles were first granted for better-watered areas close to the urban center of Nairobi. As problems with the group ranches emerged, group ranches were subdivided and areas that had not previously been adjudicated into group ranches were individualized (Grandin 1991). By 1990, owners of 40 of the 51 group ranches had decided to subdivide their land.

Ruttan (1995) conducted research in two of the seven subdivided ranches in Kajiado District. In Okinos, the average ranch size was 47 hectares, while in Emboloi the average ranch size was 93 hectares. Former members of the group-ranch committees obtained ranches twice as large as those received by ordinary members. Between 1986 and 1990, more than one-third of all those holding ti-

titles had applied for further subdivision of their land for sale to other parties. Ten percent of all title holders had transferred a total of 2.4 percent of all of the land. Of the 37 plots sold, 84 percent were purchased by non-Maasai. Nominal land prices increased nearly 10-fold between 1986 and 1994.

A smaller number of pastoralists (2.2 percent of title holders) had mortgaged their land to receive loans. Very little had been invested in fences, boreholes, or other capital. Most of the proceeds from the sale of land apparently were invested in the construction of modern homes. Thus it seems that the demand for individual titles to rangeland is driven by three main factors. First, the parts of Maasailand with good overland connections to Nairobi, with good soils, and that receive good rainfall are of high value in nonpastoral land uses. Second, actual demand has resulted in a speculative demand for less-favored areas. Third, people observe that national policies favor private property over common property. The incentive to increase individual investments in grazing land does not appear to be a major factor.

Endogenous Individualization

Behnke (1986) summarizes studies undertaken on “spontaneous range enclosure” in the South Darfur Province of Sudan and the central rangelands of Somalia. In South Darfur, range enclosure—appropriation of rangeland by erecting thorn fencing around plots—occurred in two areas. One was an area in the environs of Nyala town, where agropastoralists enclosed land to protect gardens used to produce fodder for sale in Nyala. The second was in an area where land resources were subjected to increasing pressure from permanent residents and seasonal transhumants. Most private enclosures were claimed by the wealthier herd owners who could afford the cost of fencing.

In central Somalia, range enclosure occurred in both the agropastoral and pastoral zones. In the agropastoral zone, range enclosure was stimulated by the development of boreholes, which increased the competition for nearby cultivated land. Some of the enclosures may have been speculative, with people anticipating future increases in land pressure. Traditional usufruct rights to cropland supported claims to private enclosures. Enclosure in the pastoral area around El-Buur town was stimulated by the drought of the 1970s, which increased the relative value of good pasture near town; national agricultural policies that favored cultivation; and the interests of particular descent groups to enclose the best pastures for their own exclusive use, while still using what was left of the common pastures.

Behnke concludes that individuals will enclose common pastureland when they judge enclosure to be practical and profitable. Profitability changed as a result of changes in technology (for example, exogenous development of boreholes) and changes in market conditions (for example, increase in urban population). Climatic conditions may also induce individualization. During droughts, plots of land that produce better and more reliable fodder may be enclosed as they acquire a higher scarcity value than other plots in the area. Behnke also

concludes that national policies and local institutions determine the ease with which individuals defy customary rules against enclosure. Local institutions were more consistent with individualization in the agropastoral area than in the pastoral area.

Resilient Customary Common Property

Stiles (1992) and McCabe (1990) describe two situations in arid and semi-arid regions of northern Kenya in which customary systems of production and property rights appear to be very resilient. Customary systems continue to be viable despite variable environmental conditions, conflict with neighboring groups, and changes in the economic and political environment. Stiles (1992) describes the case of the Gabbra, a group of 35,000 pastoral people living in an area measuring 40,000 square kilometers of north-central Kenya. Rainfall in the Gabbra area increases as the elevation changes, with average annual rainfall ranging from 150 millimeters in the Chalbi Desert to nearly 1,000 millimeters in the Marsabit and Kulal highlands. McCabe (1990) describes the case of the Ngisonyoka Turkana—10,000 people living in an area of about 10,000 kilometers in northeastern Kenya. Mean annual rainfall across the area is about 220 millimeters per year. The areas occupied by either group is not cultivated, although some of boundary of the area occupied by the Gabbra is cultivated.

The Ngisonyoka Turkana and the Gabbra defend the boundaries of their territories with military force. Drought conditions result in greater conflict as the groups residing in the area try to spread over more land, while at the same time, neighboring groups increasingly do the same. In normal years, the Ngisonyoka Turkana only use about three-quarters of their territory to avoid the risk of violent conflict and banditry from the neighboring Pokot and Karamojong groups. However, in drought years, they run the risks and rely quite heavily on the contested areas.

The Gabbra maintain particularly strong and centralized sociopolitical-religious institutions that support the common-property regime. Wells belong to the clan or group that dug them and are managed by a “father of the well.” Elected leaders, called *hayu*, act as judges. Their appointees, *jallabu*, serve as mediators. The Ngisonyoka Turkana have a more decentralized form of governance. Wells are owned by individual families and councils of elders resolve disputes.

McCabe (1990) and Stiles (1992) argue that these systems continue functioning smoothly despite changes in national policies toward property rights, in environmental conditions, in technology, and in the activities of donor and international agencies. National policies on property rights that had so much impact in Maasailand have had little impact on the Turkana and Gabbra. However, technical and social changes initiated and promoted by nongovernmental organizations and development-assistance agencies have had a greater impact. The construction of modern wells has threatened the social bases of resource-management regimes. The availability of modern weaponry has escalated inter-

group conflicts. Education has reduced the availability of labor, and the Christian religion has reduced the social bases of the property-rights regime. Population growth has not been a major driving force. On the contrary, out-migration and children's going to school are reducing the labor available for herding. This is critical, since the systems of herd splitting and hand elevation of water from deep wells "... results in the highest level of work recorded for any society in the world" (Stiles 1992, 46).

Creation of Open Access

The Butana area of Sudan is located to the east of Khartoum, between the White Nile and Atbara rivers. Rainfall is extremely variable in space and time. Mean annual rainfall over the last 90 years has been 150 millimeters. The main natural resources are grazing land, *wadi* or riverine areas, and water. The indigenous residents of the area are the Shukriya. In contrast to the northern Kenyan study-areas described above, the Butana has undergone monumental changes, especially during the last three to four decades. Kirk (1994) describes how those changes have led to the destruction of a functional common-property regime and the creation of open access to the grazing resources.

According to Kirk (1994), a common-property regime was established throughout the plains of eastern Sudan between the seventh and thirteenth centuries. Land use in the area has changed gradually, with mechanized cultivation of *durra* beginning in the 1940s to supply British army troops. Mechanized, rainfed agriculture and irrigation schemes expanded after the 1940s, with *durra*, groundnuts, and wheat being the main crops. Now most of the south of the Butana is cultivated.

Despite these changes in the external environment and land use, the regime for common property remained intact and functional until 1971. Between 1969 and 1971, the Native Administration was abolished and two new laws were imposed: the Land Administration Act and the Unregistered Land Act. These changes in national policy resulted in strengthening the state's claim of ownership to communal land, disenfranchising the customary authorities, and creating open access to grazing land. The results have been reduced mobility for the Shukriya; increased competition between Shukriya and other ethnic groups for the available pasture lands (Kirk 1994); and reduction in the quality of the pasture, with perennial grasses and the best browsing shrubs virtually disappearing from the landscape (Kirk, Rahmann, and Weiser 1994).

Overview of Development Pathways in East Africa

From this review, it is possible to identify some similarities and numerous differences across the semi-arid areas of East Africa. Internal population growth has been a ubiquitous catalyst of change across East Africa, although local demographic changes have varied from one place to the other. Permanent and temporary out-migration have reduced total labor supply in northern Kenya, while net in-migration has added to local growth and thus further increased the

total labor supply in the Kenyan Maasailand. Commercialization has resulted in increased incentives for livestock production in northeastern Kenya and the Butana of Sudan but appears to have had very little impact in northern Kenya. The land-titling program that was instituted in Kenya had major impacts in Maasailand but has not had major impacts in the drier pastoral areas.

Changes in environmental conditions appear to have had similar effects in all of the study sites. During good rainfall years, people are able to obtain most of the feed that their livestock need from nearby pastures, where property rights are most secure. Grazing lands that are contested by more than one group, or normally controlled by another group, are left alone. Grazing or fallow lands that have favorable soil and water conditions may be cultivated. Most customary systems support the rights of individual families to appropriate land for crop cultivation. In some instances, people take advantage of those provisions to appropriate much larger areas than they need to cultivate.

During drought years, neighboring pasture cannot adequately feed livestock. Pastoralists with large herds and highly mobile production systems are willing to travel long distances in search of feed. This may take them onto contested rangelands and into the normal home pastures of other groups. Conflict over control of pasture land is common. Three outcomes of conflict have been observed in these case studies: some areas become permanently insecure and contested, some areas that were previously claimed by one group are appropriated by another group, or some areas that were previously governed very loosely are governed more tightly.

The following section of the chapter reviews existing models of changes in land use and property rights. The models go from the simple demand-driven model to the more complete conceptual framework provided by Douglass North. Elements of those models are then used in the analytical framework.

Review of the Models of Property-Rights and Land-Use Change

The Demand-Driven Model of Property-Rights Change

Demsetz (1967) and Posner (1977) first developed what is called here the “demand-driven” model of property-rights change. The essence of that model is that society will define and enforce more exclusive and secure rights when the benefits exceed the costs. The benefits of more exclusive and secure rights include the transfer of resources to more efficient uses and users, increased investment in the resources, using land as collateral, and reducing litigation over obscure property rights. The costs of more exclusive and secure rights are the transaction costs associated with the definition and enforcement of rights over smaller and more individualized units of land. The net benefits of exclusive and secure rights increase as populations grow and markets become more commercialized.

Several authors have criticized the demand-driven model and its applicability in Africa. The main criticisms are as follows:

- It incorrectly assumes that private property is the only institutional arrangement that facilitates the internalization of negative externalities.
- It ignores the transaction costs associated with the creation and enforcement of private property (Bromley 1989; Platteau 1995).
- It ignores circumstances in which common property may be more efficient than private property (Bromley 1989; Roumasset and La Croix 1988).
- It assumes that changes in property rights are made on the basis of aggregate social welfare.

However, even the critics admit that the demand-driven model captures at least two important dimensions of property-rights change. First, changes in the scarcities of production inputs and market opportunities change people's perceptions of the merits of different property rights. Second, the general trend in contemporary Africa is toward more individualized property rights (Platteau 1995; Netting 1993).

The Bromley Model of the Property-Rights Gradient

Bromley (1991) distinguishes four property regimes: private property, common property, state property, and open access. Private property provides the greatest opportunities for extraction of economic surplus but involves the highest transaction costs. Common property is next in terms of both economic rent and transaction costs, followed by state property and open access. As a result, therefore, the gradient of property rights and economic rent will be socially efficient, with land that would generate the highest rent as private property, land that can generate the next highest level of rent as common property, followed by state property and open access for land that would generate lower levels of economic rents. With everything else equal, therefore, this model predicts a pathway of property-rights change with resources gradually moving from open access, to state property, to common property, and ultimately to private property as population growth and increased commercialization lead to increases in the scarcity of the land.

The Supply of Property-Rights Change

Anderson and Hill (1975) recognized that costs are associated with institutional change. Property-rights institutions gradually change in response to changes in the marginal benefits and marginal costs associated with the definition and enforcement of property rights. Howitt (1995) added to the Anderson and Hill model. He proposed that changes in property rights will occur in discrete jumps because of the lumpy and irreversible nature of reforms in property rights and uncertainty over the streams of benefits emanating from many natural resources. Two important results follow. One, the switch from one property regime to another will occur when the present value of the costs of unmet future demands minus the value of the option to switch in the future equals the lump-sum cost of making the switch. Two, increases in uncertainty about benefit streams increase the value of the option to switch in the future. Efficient switches in property

rights will thus require greater excess demand when physical deliveries are more uncertain.

Hayami and Ruttan (1984) and Feeny (1988) develop a model of “induced institutional innovation” that pays more attention to factors affecting the supply of institutional innovation. These authors accept that efficient institutions may not be forthcoming for two reasons: the overall national interest diverges from economic efficiency, or the interests of elite government officials diverge from the economic interests of society. Feeny (1988) provides an example from Thailand in which these two divergences slowed the development of irrigated rice. The supply of institutional change therefore depends upon the costs of such change and the capacity and keenness of the political establishment to set up new institutions.

Concern with the keenness of the political establishment to found new institutions is illustrated in the interest-group and rent-seeking models of property rights. According to Eggertsson (1990, 275–276),

The interest group theory of property rights takes the fundamental social and political institutions of the community as given, and seeks to explain the property rights in various industries in terms of interaction between interest groups in the political market.

Another way to articulate the interest-group theory is in terms of rent-seeking. Eggertsson (1990, 279) defines rent-seeking as

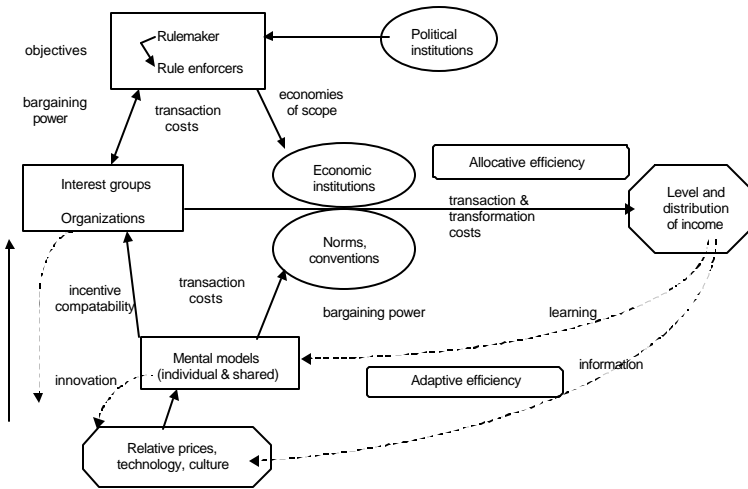
...attempts by individuals to increase their personal wealth while at the same time making a negative contribution to the net wealth of their community.

A limitation of the models of rent seeking is that they are based on the assumption that states will supply workable systems to govern property rights in the absence of pressure from interest groups.

North’s Model of Institutional Change

Figure 9.1 shows a model of institutional change that draws upon several recent papers written by D. C. North (1989, 1990, 1992, 1994, 1995) and by Denzau and North (1994). At the bottom right corner are the factors normally considered to be exogenous demand-shift variables: prices, technology, and culture. Changes in those variables can cause changes in preferences for economic institutions and for membership in different types of local organizations (such as cooperatives or women’s savings groups) and interest groups. Filtering those preferences are mental models—“internal representations that individual cognitive systems create to interpret the environment” (Denzau and North 1994). Informal institutions—norms and conventions—can change directly as a result of changes in preferences. Formal institutions change as a result of political processes resulting from the interactions between interest groups and organizations and the interactions between these two kinds of groups and the rulemakers.

FIGURE 9.1 A depiction of North’s model of institutional change



SOURCES: Based on North (1989, 1990, 1992, 1994, 1995); Denzau and North (1994).

The outcome of these interactions will depend upon the transaction costs associated with institutional change and the bargaining power of the different interest groups and organizations. North (1990) defines transaction costs as the costs of measuring and enforcing the valuable attributes of goods, services, and performance.

North separates the state into rulemakers and rule enforcers (for example, parliament and the judiciary, respectively). The objectives of rulemakers and rule enforcers may differ and may or may not be consistent with economic efficiency or growth. Political institutions shape the behavior of rulemakers and rule enforcers in the way that mental models shape individual behavior. North also explicitly considers the possibility that there may be economies of scope in the operation and change of institutions. That is, a change in one economic institution may reduce or increase the costs associated with changing a related institution.

Economic actors engage in production and exchange (transformation and transaction) within a given set of economic institutions, norms, and conventions. The level and distribution of income is one of the outcomes.

North is also concerned with the feedback processes by which economic outcomes have impacts on relative prices, technology, and culture and on individual and shared mental-models. The feedback effects take the form of “information”; the process by which that information influences prices, technology, and mental models is “learning.”

A Model of Property-Rights and Land-Use Change for the African Savannah

This section describes a conceptual model of property-rights and land-use change. The model builds upon previous models and the case-study literature reviewed in the preceding sections. The model is most appropriate for studying property-rights and land-use change in semi-arid East Africa. Minor modifications could make it appropriate for other regimes and resource use situations.

Approach

Several components of the model are inspired by North's model of institutional change. First, individuals channel their demands for institutional change through local interest groups and organizations. Second, rulemakers and rule enforcers may be distinct entities that respond to different incentives. Third, endogenous feedback from outcomes to individual decisionmaking may be an important source of institutional change. Fourth, transaction costs and bargaining power are important to the outcome of the interactions between local interest groups, organizations, rulemakers, and rule enforcers.

This study follows a plural legal approach; that is, it looks at the behavior of individual resource users and the institutions affecting that behavior. Resource users respond to a variety of institutions that emanate from different social groupings and are enforced by different types of social and legal authorities. Those institutions are likely to overlap. This is to say that more than one institution will provide sanctions, support, or both for the same type of behavior (Spiertz and Wiber 1996). People will "forum shop" among different institutions to obtain the best interpretation of their position. Other things being equal, the greater the differences between the institutions that affect a particular type of behavior, the greater the incentive for people to forum shop. Individuals, local interest groups, and organizations that seek changes in property rights will also forum shop with local, regional, and national rulemakers and rule enforcers to find the best response to their demands.

Regional- and National-Level Variables

This model focuses on the determination of property rights and land use at the community level. It assumes that property rights and land use are primarily determined by processes that are endogenous to local communities. In addition, the model depicts two-way relationships between the local, regional, and national levels. Institutions that are created and enforced at the national and regional levels affect local-level institutions.

Local interest groups and organizations in turn can have some influence on regional- and national-level legislation. The case studies reviewed in the preceding section suggest that national rulemakers and rule-enforcers have important positive and negative influences on local-level circumstances. In some instances, national rulemakers may be responsive to pressures from local interest groups and organizations. Ensminger (1992) describes a case in which the national gov-

ernment had relatively positive impacts and was responsive to interest groups constituted by Orma people. On the other hand, Kirk (1994) describes a case in which the national government had a number of negative impacts and was unresponsive to circumstances in the Butana of Sudan.

Because external agencies often drive property-rights change in Africa, development-assistance agencies and nongovernmental organizations are explicitly included in the model. Development assistance agencies and nongovernmental organizations have a direct influence on institutional change through local interest groups and organizations, and through various levels of rule-making and rule-enforcing bodies. For example, the World Bank has more influence at the national level, while many nongovernmental organizations have influence at the local level. Development-assistance agencies also have indirect impacts on property rights through their effects on market conditions and technology (for example, distribution of fertilizer, vaccines, and animal-drawn implements) and on the incentive of individuals.

Driving Variables

The main driving forces behind institutional change are changes in population, density, population structure, climatic conditions, market conditions, and the technologies that are available. Population density affects the relative price of labor and land and the demand for subsistence foods. Population density fluctuates in response to endogenous population growth and from net migration into or out of the area.

Changes in population structure are also an important driving force. In the semi-arid regions of Africa, population structure has changed as adult men and women have moved to urban areas in search of employment. Mortality due to auto-immune deficiency syndrome (AIDS) has further reduced the availability of laborers and increased the number of children and elderly people each laborer has to support.

Market conditions and technology are generally regarded as important determinants of the demand for property rights and institutional change. Relevant market conditions include the level and variability of prices, price and income elasticities of demand, market distortions, and transaction costs. Important markets are those for key inputs for livestock and crop production—labor, land, water, veterinary supplies, and fertilizer—and markets for possible outputs—food crops, cash crops, tree products, milk, and meat. Important production and harvesting techniques in pastoral and agropastoral areas include wells and water tanks for providing water for people and livestock, irrigation for crop production, livestock-disease control, livestock feed-production techniques, and techniques for harvesting tree products.

Climatic conditions are also particularly important in the African savanna. Of importance are both the level and distribution of rainfall that people expect in the near future and the level of rainfall recently realized. The case studies pre-

sented above and available literature support several hypotheses about the effects of climatic variability:

- Everything else equal, the more variable the climatic conditions, the greater the incentives people will have to invest in risk-reducing technologies (for example, vaccines against animal disease) and to be mobile (van den Brink, Bromley, and Chavas 1995; Goodhue and McCarthy [Chapter 7]).
- The more variable the climatic conditions, the less incentive people have to keep large numbers of livestock (McCarthy [Chapter 6]).
- The more variable the climatic conditions, the slower the optimal conversion of property rights is from common to private property (Howitt 1995).
- Drought conditions increase the relative-scarcity value of resources that produce relatively reliable outputs. Conversion of land from common to private property is most likely to occur during droughts, but drought-induced conversion is likely to be socially inefficient.

Individual- and Community-Level Variables

This model has endogenous variables at both the individual and community levels. “Individual” here refers to an individual unit that makes decisions about production and resource use. Depending upon the situation, the relevant unit may be a person, a production unit within a household, a household, or an aggregation of households. “Community” here means the lowest-level grouping of decisionmaking units that exerts some control over resource use in a defined land area.

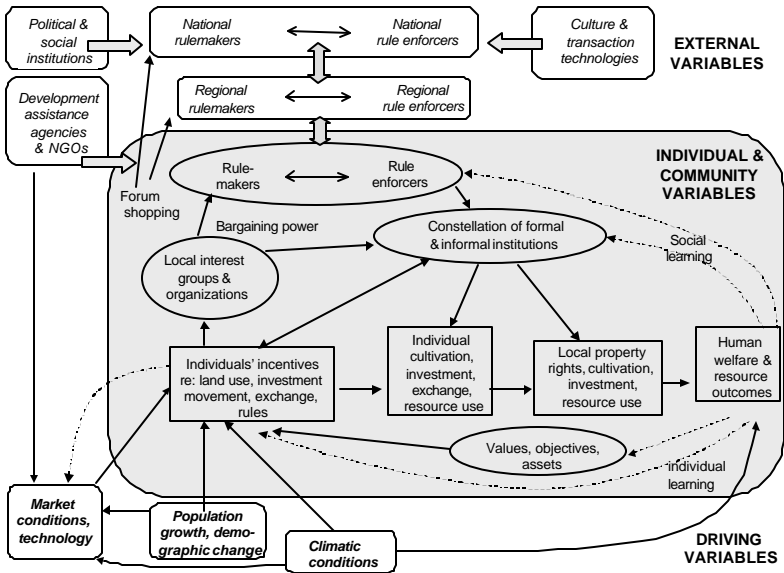
The driving forces described above affect the incentives that individuals have to allocate resources and the incentives for joining organizations, following rules, and demanding more institutional arrangements (Eggertsson 1990). For the case of property rights and land use in semi-arid East Africa, the most important incentives are those for

- changing land use from mobile livestock-production to extensive cultivation;
- investing in assets that are fixed to a particular plot of land;
- exchanging rights to land;
- keeping animals;
- adhering to rules regulating resource use; and
- joining organizations and interest groups to express demand for institutional change.

Figure 9.2 illustrates four types of community-level variables: community rulemakers and rule-enforcers; local interest groups and organizations; the constellation of social and legal institutions, including those related to resource use; and community-level property rights, cultivation, investment, and resource use. Rapid and disruptive changes in local rulemakers and rule enforcers may occur in response to political changes at the regional and national level. For example,

changes in the policies of the Sudanese government between 1969 and 1971 resulted in fundamental changes in local rule-making and rule-enforcing in the Butana. Community rule-makers and rule-enforcers change in a more incremental way in response to pressures exerted by interest groups and organizations or to the changes in the costs of rule enforcement through different types of institutions (Ensminger 1992).

FIGURE 9.2 A framework for evaluating local-, regional-, and national-level processes of property-rights and land-use change



Interest groups and organizations may be somewhat more sensitive to local-level changes, particularly changes in the incentives for individuals to comply with existing institutions or demand new institutions. Most of those changes will be incremental, with many incremental changes adding up to the creation of new organizations or dissolution of existing ones. More rapid and erratic changes are likely to occur in response to the actions of international-development organizations and nongovernmental organizations. For example, the creation of pastoral organizations has been the direct objective of many livestock-development projects since the mid-1980s (de Haan 1994).

The third set of community-level variables—the constellation of social and legal institutions—is responsive to external and local circumstances. Legal institutions will be largely determined by national rule-makers, but they may be interpreted and enforced locally. Social institutions will be more responsive to local circumstances. Some changes will occur in response to the explicit demands for institutional change expressed by local resource-users, either directly in response to demands by local individuals or groups, or indirectly through the

actions of rulemakers and rule enforcers. Other changes may occur when local rulemakers and rule-enforcers change rules in response to human welfare or environmental outcomes.

The fourth set of local level variables—local property rights, cultivation, investment and resource use—is primarily determined by local-level circumstances. In more detail, the variables are as follows:

- *Local property rights.* This refers not to the details of the property-rights institutions themselves, but to their realization at a particular point in time as measured by the amounts of land or other resources in different categories of property rights. The relevant categories will change from case to case. In some cases the full spectrum of rights will govern open-access areas, state property, regional common property, local common property, clan property, and individual property. In other cases, categories may include only different types of common property, clan property, or individual property.
- *Cultivation.* The most important land-use distinction in the semi-arid regions of Sub-Saharan Africa is the amount of land allocated to dryland crop-cultivation. In some cases, the amount of land allocated to irrigation or large-scale mechanized cultivation will also be important, since these uses tend to be less compatible with mobile livestock-production than dryland crop-cultivation (see Kirk, Rahmann, and Weiser 1994). In some cases, distinguishing between different uses of noncultivated land may be desirable; for example, grassland from forest, or permanent pasture from fallow. In general, however, most noncultivated land in the semi-arid regions of Africa is multiple-use, silvopastoral land (Swallow 1997; Williams 1997).
- *Investment.* This study is concerned with investments in agriculture or resource use that are fixed in terms of space. Key investments in much of semi-arid Sub-Saharan Africa are fences, water points, planted forages or legumes, irrigation equipment, conservation measures, and tree planting. Again, the most important of these variables will vary from case to case.
- *Intensity of resource use.* The intensity of resource use is often considered to be the most important measure of economic efficiency. For example, Otsuka and Place (1998) argue that allocation of labor to gathering forest products is a key measure of the economic efficiency of forests managed under private, state or common-property management. McCarthy (Chapter 6) focuses on the stocking rate as a measure of the efficiency of pasture use.

Two other sets of variables can be defined at either the individual or community levels: values, objectives, and assets; and human welfare, resource quality, and environmental outcomes. The first set of variables corresponds roughly to North's "mental models," but is here expressed in terms that are more amenable to quantification and measurement. Of particular interest in the semi-arid re-

gions of Africa are differences in objectives due to differences in risk preferences (in turn related to assets) and differences in values and objectives among ethnic groups that are traditionally associated with pastoralism or agriculture.

The second set of variables are outcomes that can be measured at a particular point in time or for a particular period of time. The relevant outcomes will vary from case to case, but generally the model focuses on measures of efficiency, equity, and environmental sustainability. Clearly, definitions and measures of all of these concepts differ. Goldin and Roland-Holst (1995) distinguish between static efficiency (for example, land allocation, investment, and resource-use levels that maximize the value of outputs produced within a single period) and intertemporal efficiency (for example, land allocation, investment, and resource-use levels to maximize long-term welfare). Outcomes could also be measured in terms of project efficiency: do the costs of a change in rules outweigh the potential benefits?

Direct Relationships among the Variables

The demand for changes in property rights is a function of a number of incentives: for changing land use, making fixed investments in land or water, moving livestock herds around the landscape, adhering to or deviating from the dictates of existing property rights, and using a resource at different intensities. Each of these incentives in turn depends on some factors that apply across the board to a community or locality (for example, climate), some factors that are general to subgroups in the community (for example, factors such as technology, market conditions, values, and objectives), and other factors that are specific to subgroups or individual members of the community (for example, factors such as assets and transaction costs). These relationships are presented in very general terms in equations (1) and (2a–2e):

$$DPRChange_i = f_1 (ICulti, IInvesti, IMove_i, IStocki, ICheati), \quad [1]$$

$$ICulti = f_2 (MkCp, MkLv, MkLb, TchCp, VCp, VLv, CVCpLv, Assi, Tci, Valuei), \quad [2]$$

$$IInvesti = f_3 (MkCp, MkLv, MkLb, TchCp, VCp, VLv, CVCpLv, Assi, Tci, Valuei), \quad [2b]$$

$$IMove_i = f_4 (VLv, MkLb, Assi, ICulti, TchLv, Tci, Valuei), \quad [2c]$$

$$IStocki = f_5 (MkLv, MkCp, MkLb, VLv, Assi, Tci, Valuei), \text{ and} \quad [2d]$$

$$ICheati = f_6 (MkLv, MkLb, VLv, Assi, Tci, Valuei), \quad [2e]$$

where

<i>DPRChange_i</i>	=	demand for property rights change by individual <i>i</i> ;
<i>Iculti</i>	=	incentive for cultivation by individual <i>i</i> ;
<i>Iinvesti</i>	=	incentive to make fixed land investments by individual <i>i</i> ;
<i>Imovei</i>	=	incentive to move livestock around the landscape by individual <i>i</i> ;
<i>Istocki</i>	=	incentive to keep different numbers of livestock by individual <i>i</i> ;
<i>Icheati</i>	=	incentive to comply with or deviate from the terms of existing property rights;
<i>MkCp, MkLv, MkLb</i>	=	market conditions of the crop, livestock, and labor markets, respectively;
<i>TchCp, TchLv</i>	=	techniques for crop and livestock production, respectively;
<i>VLv, VCp, CVCpLv</i>	=	variation in livestock production, crop production, and covariation;
<i>Assi</i>	=	assets held by household <i>i</i> ;
<i>Tci</i>	=	transaction costs for household <i>i</i> ; and
<i>Valuei</i>	=	values and objectives of individual <i>i</i> .

McCarthy (Chapter 6) uses a game theoretical approach to explore equations (2d) and (2e). Goodhue and McCarthy (Chapter 7) use the analytics of fuzzy-set theory to explore equation (2c). Both are based on the assumption that livestock owners seek to maximize utility, where utility is a function of the level and variability of income.

Many changes in the demand for property rights that are more secure and for changes in land use are accommodated within the existing constellation of social and legal institutions. Indeed, many analysts have argued that Africa's customary systems of property rights are flexible enough to accommodate most of the pressures associated with commercialization and population growth (Swift 1995; Platteau 1995). In the framework presented here, those demands for changes in property rights have direct impacts on local property-rights.

However, some demands for changes in property rights, particularly demands regarding the mobility of livestock and exchange of property rights, may not be so accommodated. In that situation, individuals may try to cause direct change in the social and legal institutions, for example, by openly defying the existing institutions. Individuals may also express their demand for a change in property rights by appealing to local rulemakers (for example, village chiefs) or

local rule-enforcers (for example, village courts). Alternatively, individuals may form coalitions—interest groups or organizations, in North's terminology—with others having similar demands, even if those demands are motivated by different factors. The formation of such coalitions, and their effectiveness in undertaking collective action, is the subject of a great deal of economic and sociological theory (for example, Baland and Platteau 1996; Olson 1965; Oliver, Marwell, and Teixeira 1985; Seabright 1993).

Interest groups or organizations will have incentives to forum shop for the best possible avenue for desirable change; there will be different transaction costs associated with lobbying local rulemakers, local rule-enforcers, regional rulemakers, regional rule-enforcers, and national rulemakers. Changes in transportation and communication infrastructure can cause fundamental changes in those transaction costs and discontinuous changes in forum shopping (Ensminger 1992).

Interest groups and organizations may interact somewhat. Those interactions may give rise to greater cooperation and the development of a mutually beneficial alternative to the existing situation. Interactions may also be simple bargaining situations in which the rules are well defined and bargaining power is well balanced (see Colby 1995). On the other hand, interactions may be full-fledged conflict situations in which interest groups have fundamentally different interests. Vanderlin (Chapter 10) is concerned with these latter two cases.

Important interactions will also occur among interest groups, rulemakers, and rule enforcers. The outcome of these interactions will depend on the bargaining power of the different interest groups and the interests and incentives of the rulemakers and rule enforcers. A great deal of evidence indicates that changes in the incentives of rulemakers and rule enforcers is a fundamental cause of the breakdown in the capacity of local institutions to enforce existing property rights or respond to demands for new rights (for example, Swallow and Bromley 1995). Given its importance, however, more research on the incentives of rulemakers and rule enforcers is needed (Agrawal and Gibson 1997). North (1989, 1990) has proposed a theory of the incentives of rulemakers to explain different historical developments of property rights and economic progress.

Research using the plural legal framework is shedding light on one key component of the institutional-change process. One cannot judge the relative ability of different interest groups to motivate change in the constellation of social and legal institutions by their bargaining power compared with a particular rulemaker or rule enforcer. On the contrary, bargaining power must be considered across the range of relevant institutions (Van Dijk 1996; Ensminger 1992).

Internal Dynamics

Completing the conceptual framework requires giving more consideration to the internal dynamics of property-rights change. Again, the authors of this study concur with North that outcomes that are fed back to local rulemakers, individuals, and organizations can be an important source of property-rights change and

that the result of those feedback effects depend on the path taken. Such feedback seems to be evident in the Maasai case study described in the section *Review of Literature on Property-Rights and Land-Use Change in East Africa*. In that case, changes in property rights elsewhere in Kenya apparently generated two types of changes in Maasailand: creation of a new, powerful forum for those demanding more individualized property rights; and decreased security of property rights for other Maasai. These changes created conditions for the adoption of the group ranch; disappointing outcomes associated with the group ranch led to the demand for individualization of group ranches.

Land Use and Property Rights in the Borana Plateau of Southern Ethiopia

In this section the model used in the previous section is used to frame an analysis of land-use and property-rights change in the Borana Plateau of southern Ethiopia.

Physical and Social Dimensions

The Borana Plateau occupies an area of about 95,000 square kilometers in the southern part of the Ethiopian lowlands. The population of about 600,000 people is widely distributed across the plateau, with an estimated density of six people per square kilometer (Coppock 1994). The area is semi-arid, with an average annual rainfall that fluctuates between 499 and 869 millimeters per year. Extensive livestock-production is the dominant land use. Grazing resources on the Borana Plateau (pasture and water) are to a large extent owned communally and administered by traditional elders who formulate rules governing resource use, enforce these rules, and ensure that sanctions and penalties are implemented.

The social organization of the Borana pastoral system is generally based on the *gada*¹ system which divides the Borana community into a number of age groups. A new *gada* is created every eight years. This age-group system is important for distributing duties, responsibilities, and social rights, and for regulating human population. Each *gada* is administered by an *aba gada*, or father of the *gada*, who is traditionally elected to preside, together with his council of ministers, over all issues affecting pastoral life in Borana. A consensus on important community issues—such as redefinition and enforcement of rules, regulations, and norms—is reached through open, participatory assemblies. An assembly of all the Borana, their representatives (*gumi gayu*), or both is held every eight years to discuss resource conflicts, cardinal rules, intertribal issues, and a divination of the future of the Borana society (Coppock 1994). The system is believed to have begun in the 1600s to provide the society with a reliable social framework to cope with resource management and population problems.

¹ For a more comprehensive review of the *gada* system, refer to Legesse (1973) and Coppock (1994).

The traditional Borana communal-grazing system allows access to pasture and water to every member of the Borana society who complies with prevailing rules and regulations and who performs the duties expected of him or her. Every herd owner under this system can increase his herd size to convert more of the communal resource into private wealth. The *gada* system is therefore primarily concerned with regulating the use of the Borana resource base, maintaining peace among the resource users, and protecting them and their cattle from external invasion. The way that the Borana organize land use, settlement, and traditional administration is often noted as very effective when compared with other pastoral systems in Africa. However, this system is now changing quite rapidly.

Institutional Structure, Resource Use, and Property Regimes

The entire Borana Plateau is divided into traditional administrative units called *maddas*. Each *madda* is constructed around a permanent water source (traditional deep well or permanent pond) that is administered by a "father of the well." The wells are of vital importance to Borana pastoralism, and all economic and social life revolves around the wells. There are nine groups of such wells in 35 locations around the central part of the plateau (Helland 1982). The father of a well regulates its use, oversees its maintenance, and coordinates with *madda* elders on the implementation of rules, regulations, and sanctions regarding the water source. Each *madda* is subdivided into *ardas*, and each *arda* is further subdivided into a number of encampments, or *ollas*. Each *arda* has jurisdiction over some form of grazing area, cultivation land, and to a lesser extent, water resources. The *ollas* consist of at least 10 households and are the smallest administrative units in the system. At the *madda*, *arda*, and *olla* levels, officials (usually elders) manage the affairs of their respective communities. At the *madda* level, decisions are made regarding which areas are left open as pasture (unsettled), which are open to settlements, and which can be brought under cultivation.

Pastures can either be *fora*, *warra*, or calf enclosures. *Fora* grazing areas are available to bulls and nonlactating cows (dry herds), and are open to all Borana people. *Fora* areas also include transit areas around permanent water points. Permanent settlement is prohibited in *fora* areas. Such areas are regarded as fall-back areas "for all" during periods of forage scarcity. Otherwise, there are few restrictions on the use of *fora* areas. Their management approximates open access.

Warra areas are grazing areas for lactating cows and sick and weak animals. Those animals are returned to the encampment every day so that they can be milked and monitored. Areas within an *arda* designated as *warra* are open to members of the *arda* and to members of different *arda* under special arrangements. *Warra* areas are not fenced and exhibit somewhat fuzzy boundaries. Membership to a *warra* area is open to all *arda* members and is usually very

large. Grazing time is not restricted except during periods of forage scarcity, when herd-splitting² agreements force dry herds to migrate. Management of *warra* areas approaches the definition of unmanaged common property of Baland and Platteau (1996) and Seabright (1993).

Calf enclosures are thorn-fenced fodder-banks for calves and, to a lesser extent, milking cows. Calf enclosures are only used in the dry season and only by members of a particular *arda* or *olla*. Calf enclosures have clearly defined boundaries demarcated by thorn fences. Group size is small, and membership is restricted only to members of the same encampment; there are also a few instances of calf enclosures belonging to private individuals. Access to an enclosure is restricted only to periods of absolute forage scarcity and for specific types of animals. The rules and regulations here are more strictly implemented; collective investment in fencing and, to a lesser extent, bush-clearing is a common practice. Management of calf enclosures approaches the definition of managed common property of Baland and Platteau (1996) and Seabright (1993).

The private regime in Borana is predominantly observed in communities where communal rangeland has been converted to either cultivation or private enclosures. All cultivated areas³ are under private ownership, and fencing is common to secure private claims. Frequently the areas adjacent to cultivated plots are included in the fence and used as private range for draught animals and, to a lesser extent, for calves. In such communities with private enclosures, communal calf-enclosures have almost completely disappeared. This is evident in communities around Arero and Wachile, among others. Privatization is also associated with some investment, such as fencing and bush-clearing.

Methods Used in Field Research

A survey of Borana pastoral communities (*ardas*) was conducted between September 1997 and August 1998. Interviews were conducted in 40 *ardas*. One reason for the survey was to test the model of property-rights and land-use change described previously in this chapter. Field activities consisted of a community survey of 40 communities, followed by in-depth surveys of a subsample of the communities.

The major criteria used to stratify communities were the level of rainfall, variation of rainfall, and access to markets. The rainfall data used in the stratifi-

² "Herd splitting" refers to the separation of dry herds (nonlactating cattle) from the rest of the animals so that they can be moved over long distances in search of better forage. The duration of stay may vary from a few days to a whole season.

³ The cultivated areas are mainly around the outskirts (10-kilometer radius) of each of the *woreda* administrative settlements. The cultivators around such settlements are mainly highlanders coming from the neighboring Guji, Gabbra, or Konso tribes; or Borans who lost all their cattle and ran out of the "pastoral business." However, there is also a general trend of pastoralists adopting cultivation in almost about 80 percent of all the communities studied.

cation consisted of monthly time-series data from six years (1992 to 1997) from 12 weather stations distributed across the Borana Plateau. *Ardas* that were too far from a weather station, that were without permanent residences, or that were dominated by crop production were excluded from the sampling. Four rainfall categories were identified: low rainfall, low coefficient of variation; low rainfall, high coefficient of variation; high rainfall,⁴ low coefficient of variation; and high rainfall, high coefficient of variation.

In the first phase of the study, participatory rural appraisal-methods were used. Social mapping provided insight into major changes in natural-resource use and the proportions of land area under different land uses—cultivated land, different types of common-property grazing areas, transhumance routes, and private enclosures. Wealth ranking, field visits, geo-referencing of borders, and an intensive interview rounded out the first phase of data collection in each community. The second phase consisted of an in-depth, open-ended interview technique relying on recall information. The survey was further supplemented by information generated through a rapid appraisal of the range condition of the 40 communities by a range expert. For details on the data-collection procedure, see the comprehensive field report of the Borana case study (Kamara [Chapter 15]).

Results

Preliminary analysis shows that several different pathways of property-rights and land-use change have emerged on the Borana Plateau. There is evidence of increasing privatization of rangelands motivated by both endogenous and exogenous factors. The observed trend of property rights described here refers not to the property-rights institutions themselves, but their realization at particular points in time as measured by the amount of land or other resources held under different categories of property rights, as described previously in this chapter.

The privatization path is depicted by the percentage of land under cultivation, the percentage of land reserved for grazing with the enclosed fields, and the percentage of land in individual calf-enclosures. Across the 40 communities, an average of 22 percent of the land is privatized, of which 17 percent is enclosed cultivated fields and 5 percent is private calf-enclosures. About 80 percent of the communities in the sample had some cultivation in the 1997/98 agricultural year. Forty-two percent of the communities had some cultivation 10 years ago, 28 percent had some cultivation 20 years ago, and 10 percent had some cultivation 30 years ago. Thus both the total area cultivated and the number of *ardas* with cultivation have increased rapidly. Rangeland enclosure by private indi-

⁴ This is a semi-arid area, and that the highest mean rainfall that has been recorded does not exceed 900 millimeters per year; therefore, the term “high rainfall” is only used in a relative sense to ease the stratification process, and not in the global sense of area receiving far above 1,500 millimeters per year.

viduals is evident in about 15 percent of the communities and comprises a total of 3 percent of the total area covered by the 40 communities.

Worra grazing is the most significant of all the communal-grazing systems in Borana. It is present in 85 percent of the communities under investigation. Expanded cultivation and privatization of rangelands have encroached a great deal into the *worra* areas. Despite this encroachment, *worra* areas still account for about 50 percent of the total land area of the sample communities, suggesting that it is the most important form of common-property regime that still prevails in Borana. Communal calf-enclosures have increased a great deal in the recent past. About 70 percent of communities now have some communal calf-enclosures and 11 percent of the available land area is in communal calf-enclosures.

Communal-grazing areas for dry herds (*fora*) are present only in about 8 percent of the communities and compose only about 1 percent of the study area. This observation does not imply an insignificantly small *fora* area all across the plateau, but rather highlights the fact that *fora* areas are generally unsettled areas that are open to all Borana during periods of forage scarcity. Since *fora* areas fall outside the borders of the communities under investigation, their proportional representation in terms of community land area is almost nil. The remainder are areas around settlements that are communally grazed by small ruminants, camels, and equines.

Discussion

The increases in cultivated area and privatization of land rights can be attributed to a variety of exogenous and endogenous factors. An important endogenous factor is population growth. The growth rate of the endogenous Borana population is estimated to be at least 2.5 percent (Coppock 1994), and there is evidence of an influx of non-Borana around the towns. Population growth increases competition among resource users competing for the same resource base. As pressure accumulates on the fixed resource base, negative externalities emerge and the desire for private rights among users increases.

However, greater demand for private-property rights did not result in increases in private-property rights until a major policy change occurred in the mid-1970s. Until the socialist revolution of 1974, rulemaking and rule enforcing was the sole preserve of the traditional Borana elders. These elders were resistant to the spread of cultivation and to the privatization of land rights. Thus, even though cultivation started in about 5 percent of the communities some 40 years ago, it never really took off until the formation of the peasant associations in 1975. Peasant associations are local administrative units that are supported by the national government. Peasant associations in Borana follow laws promulgated at the national and regional levels that support the allocation of private use-rights to households wishing to cultivate. In at least one instance, a single peasant association was recently given jurisdiction over two *ardas* and individuals from each *arda* rushed to claim rights to individual plots of land. Increases in

cultivation were also stimulated by the national government's special support program for cultivation. Improved seeds, fertilizer, and extension assistance were made available in the 1980s.

Previous studies also show that market opportunities have been increasing both in terms of better opportunities to sell livestock and livestock products and of improved availability of consumer goods in Borana markets. Moreover, some studies have reported declines in the terms of trade of livestock for grain. These declines were particularly severe in the dry seasons and in drought periods (Cousins and Upton 1988; Coppock 1994).

Private individuals often enclose rangeland under the pretext of increased cultivation. Often, however, less than half of the enclosed area is actually cultivated, while the rest is used for grazing draught animals and calves. The evidence supports two hypotheses for recent increases in private enclosure of rangeland: increased cultivation and increased community enclosure of rangeland has reduced access to dry-season grazing reserves, and the ban on bush fires imposed by the national government in the 1970s led to a dramatic increase in bush encroachment and subsequent loss of grazing areas.

Private enclosure of rangeland requires the construction of thorn fences and some clearing of bushes. Poorer households who cannot afford to erect their own fences often assist wealthier neighbors so that they can be granted grazing rights in the dry season. Poorer households forum shop between two options: aligning themselves with other poorer pastoralists who oppose the enclosures, or joining the wealthy group of investors by occasionally assisting in fencing and other related activities in return for some form of grazing rights in the dry seasons. Interest groups of poorer households that oppose enclosure seem to have made little headway in their opposition to the enclosures. There is evidence that wealthier households have been able to secure their enclosures through affiliation with the heads of the peasant associations. This trend is especially observed in the communities around the towns of Wachile and Arero.

The activities of nongovernmental organizations and other development agencies in Borana have also had effects on property-rights and land-use change. The large ponds constructed by the government agency Southern Rangelands Development Unit and the international nongovernmental organization CARE have contributed to sedentarization and cultivation. The roads and market centers that were constructed to increase access to marketing facilities have in fact had positive effects on stocking rates. Results of these interventions have not been very consistent with expectations, and the reasons for this are numerous (see Coppock 1994). The bush-clearing programs of the German Agency for Technical Cooperation and Norwegian Church Aid have contributed a great deal to the management of *worra* grazing areas (local commons). These programs facilitate the reclamation of grazing areas that can once again be used by the community. The reclamation program is oriented to the community level: investment and management are in the hands of the entire community.

Conclusions and Discussion

The case studies reviewed in this chapter do not suggest a ubiquitous trend toward privatization of property rights or cultivation of crops across the semi-arid areas of East Africa. Instead, many different pathways of land-use and property-rights change are observed. The Gabbra and Turkana case studies suggest that the drier parts of the semi-arid region are somewhat immune to change; however, the Butana experience shows that government policies can indeed reach into the driest parts of the semi-arid region. The Butana case is a classic example of a central government's imposing policies that destroy a functional common-property regime; the Orma case shows a central government assuming the rule-enforcement function from a customary authority that had lost the ability to enforce rules.

The conceptual framework proposed in this chapter builds on the previous literature to provide a fuller understanding of the ramifications of potential effects of precipitation, policies, prices, and people on land use and property rights. The conceptual framework draws attention to the supply-side factors that are particularly important in pastoral East Africa:

- Plural legal and social institutions and forum shopping by different interest groups
- International development-assistance agencies and nongovernmental organizations
- The effects of transport and communication infrastructure on both producer incentives and the transaction costs associated with different forms of government.

The rapid evolution in land use and property rights that has occurred in the Borana Plateau of Ethiopia stems from both internal and external factors. Internally, gradual increases in population density and market access increased the local demand for subsistence food crops and the commercial incentives for livestock production.

Externally, the national government that came to power in 1974 instituted three nationwide policies that encouraged crop cultivation and privatization of land rights. One policy was the active promotion of crop cultivation through the provision of seeds and fertilizer. A second policy was to create local administrative units, called "peasant associations," with the power to grant cultivation rights to individual farmers. The creation of the peasant associations devolved power from the customary authorities that had been resisting cultivation and the private appropriation of land. Wealthy individuals with good access to peasant-association officers have been able to appropriate large tracts of land, ostensibly for cultivation. A real increase has undoubtedly occurred in the demand for cultivated land, and much of the land allocated for cultivation is actually used as private grazing land.

A third important policy was the ban on bush fires. Effective enforcement of this ban resulted in an increase in bush encroachment and a reduction in the

availability of good pasture land. Individuals have demanded greater private rights for two reasons: good pasture land has become increasingly scarce, and individuals are willing to invest labor in manually clearing the bush from private land but not from communal pasture.

The change in government that occurred in the early 1990s also resulted in increased crop cultivation and the privatization of property rights. The new federal structure of government gives much more power to the Oromo regional government. The regional government has increased the size of certain peasant associations by combining two or more preexisting peasant associations. An unexpected result of this in at least one area of the Borana Plateau has been a rush toward privatization of crop and pasture land. The subdivision of group ranches in the Kenyan Maasailand occurred for similar reasons. Another recent policy change that could have major effects on property rights and land use in the Borana Plateau was the imposition of a ban on exports of livestock to Kenya. If maintained, this ban will further increase the price of food crops relative to the price of livestock.

The policies that appear to have had the greatest effect on land use and property rights in the Borana Plateau are policies that were implemented countrywide by the national government. It has been implicitly assumed that "one policy fits all." Policies were not adjusted to the various local contexts in the highlands or lowlands of Ethiopia. The new federal system of government should provide for greater local-level input into the policies of regional governments. It is important that the regional-government authorities recognize the needs of all people living in the Borana Plateau, not just those of the relatively wealthy with good connections in government. The customary authorities of the Borana people should be given voice to effect new policy changes.

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10 Conflicts and Cooperation over the Commons: A Conceptual and Methodological Framework for Assessing the Role of Local Institutions

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Common-pool natural-resources (CPNRs) are natural resources from which exclusion is not trivial (but is possible) and yield is subtractable (Ostrom, Walker, and Gardner 1992). The purpose of this chapter is to propose a conceptual framework for assessing local institutions¹ in terms of their potential to foster cooperation for the management of CPNRs. A theoretical and methodological approach for the application of this framework to property-rights institutions and livestock mobility in the agropastoral zone of Niger is described.

The interest in analyzing the relationship between cooperation and CPNR use lies at two levels. First, an increasing scarcity of resources often leads to open conflicts² that disrupt both social and economic relations (for example, Bassett 1993; Rogers 1995). One major effect of resource-based conflicts is to shift the cost structure that the parties in conflict are facing (Ensminger and Ruten 1991; Platteau 1996). This shift of the cost structure may call for new institutional arrangements. Conflicts appear when perceived competition between parties is more important than cooperative behavior between the same parties. The outcome of conflicts are linked to the level of cooperation that can be established between the parties in conflict during the conflict. If cooperation is impeded, the outcome of these conflicts may be destructive and the adaptation of the institutional environment to the growing resource scarcity may be stalled. The purpose here is, therefore, not to belittle the well-documented positive aspects of conflicts (for example, Deutsch 1973; Jandt 1973; Mack and Snyder 1973; Filley 1975; Fisher and Ellis 1990; Folger, Poole, and Stutman 1993; Ross 1993). The ultimate purpose of this research is to try to find ways to understand how to maximize these positive aspects for CPNR-based conflicts.

¹ Dick Scott's definition of institutions (Jentoft 1997) is used here: "institutions consist of cognitive, normative and regulatory structures and activities that provide stability and meaning to social behaviour." Cognitive structures and activities contribute to the existence of shared expectations, and normative structures and activities contribute to the existence of shared norms.

² Conflict is defined here as "the interaction of interdependent people who perceive incompatible goals and interference from each other in achieving those goals" (Hocker and Wilmot 1985).

Second, stakeholders involved in the joint exploitation of CPNRs are facing a social dilemma. They are competing for as big a share of the same “resource pie” as possible. They also have an incentive for cooperating to manage the resource and thus ultimately increase the size of the “resource pie” through providing a management institution. While these types of social dilemmas have been exhaustively studied, most modeling exercises focus on linking the initial conditions to the possible outcomes while neglecting the negotiation process through which these outcomes are achieved (Putnam and Folger 1988; Putnam and Roloff 1992). Conflict analysis is an important exception. A growing body of empirical evidence shows that, along with initial conditions, social-dilemma outcomes are defined by the negotiation processes and the nature of the communicative events linked with them (for example, Tutzauer and Roloff 1988). Analyzing social dilemmas through the “conflict analysis lens” may help in understanding how the negotiation process and its environment may contribute to the definition of the outcomes.

Conflict Analysis

Several disciplinary fields have analyzed conflict situations. Economists and mathematicians, for example, mostly use a game-theoretic approach, focusing on the initial conditions and on the possible outcomes (for example, Gilson and Mnookin 1992; Varoufakis 1991). Political scientists, on the other hand, focus on the power relationships among parties, while psychologists focus on transactional analysis—that is, the analysis of communication framed as the parent–child–adult relationship (for example, Filley 1975). The integration of these different disciplinary fields has led to the emergence of the relatively recent interdisciplinary field of conflict analysis or resolution theory (Putnam and Folger 1988; Levinger and Rubin 1994). The purpose of this section is to present the key elements of the theory of conflict analysis that will be used hereafter.

All conflicts share some common traits (Levinger and Rubin 1994):

- They stem from a perceived divergence of interests.
- They can be addressed in only a few ways.
- They contain mixed-motive relations (the “share of pie versus the size of

- They can be ended through behavior or attitude changes.
- They lead to outcomes that can range from purely constructive to purely destructive and that stem from a broad variety of causal antecedents.

The ways conflict can be addressed are capitulation, withdrawal, inaction, negotiation, and third-party intervention. However, most of the debate on the impact of cultural differences (for example) on conflict theory lies more in the implementation of negotiation rather than on the conceptualization of conflict dynamic (for example, Gulliver 1979).

In the course of the present work, the focus will be on negotiation having as a goal a constructive outcome. In a conflict situation, the prerequisite for its negotiation or management, which will lead to its settlement or resolution,³ is the existence of cooperation. (It must be remembered here that conflicts are mixed-motive situations.) In this study, the analysis of conflict and the risk of conflict escalation begins with a review of some of the properties of conflict dynamics that can have an impact on conflict outcomes. The first property is linked with the significance of communication patterns in the definition of a conflict outcome. The second property, akin to the “political science” approach to conflict analysis, deals with an important initial condition, the power relationship between parties. The third property is linked with patterns of behavior that may have an impact on the dynamics of conflicts. While the distinction of these properties is important from an analytical perspective, they can interact and be redefined by the conflict dynamic itself.

Conflict actions are embedded in larger interaction sequences (Folger, Poole, and Stutman 1993). Several models exist that describe the different phases of conflict (Folger 1975; Fisher and Ellis 1990; Holmes 1992). The focus in this study is on Walton’s two-phase model (Folger, Poole, and Stutman 1993). Walton divides conflicts into two phases: namely, differentiation and integration. The differentiation phase consists of the parties building a clear assessment or definition of their differences and the rationale behind these differences. The integration phase⁴ occurs after differentiation, and here the parties engage in the search for common ground and work toward a resolution. This distinction is more analytical than chronological (Ross 1993). During the differentiation phase, conflict may be “depersonalized” by separating the issues from the personalities. This allows the parties in conflict to focus on the issues rather than on the persons during the integration phase. Differentiation is a critical part of the conflict process because it can lead to escalation if the differentiation goes too far or it can stall through differentiation avoidance, thereby impeding the move toward integration (see Figure 10.1 for examples). The fundamental importance of these phases led Ausburger (1992) to use their descriptions to differentiate destructive conflict from constructive conflicts.

³ The distinctions among negotiation, conflict management, settlement, and resolution are as follows: *Negotiation* is the interaction entailing two or more parties in conflict, who engage in social interaction to reach a mutually satisfactory outcome (Putnam and Roloff 1992). *Conflict management* is an attempt to feed learning that can make the conflict more productive and less costly into the process of conflict (Boulding 1966). *Settlement* (or *conflict-resolution settlement*) is the situation in which the outcome of negotiation is accepted by both parties (Hinde and Groebel 1991).

⁴ In the description of decisionmaking processes, “integration” can be seen as the equivalent of Habermas’ (1984) concepts of communicative action and communicative rationality. Integration leads the parties to reach a decision with a shared goal rather than with different goals. This again stresses the importance of communications as a central determinant of negotiated outcomes.

FIGURE 10.1 Differentiation phase and conflict outcome—examples

Scenario: Transhumant cattle go astray and eat into a field; conflict begins.			
	Behavior	Result	Consequences
Differentiation avoidance	Herders do not wish to interact with agriculturalist; they settle the issue quickly (pay a fine) and decide not to come again in the area.	Conflict is avoided.	Pastoralists lose access to pastoral resources; agriculturalists lose access to manure.
Escalation during differentiation	Herder and agriculturalists engage in a verbal, then physical “war”; violence erupts.	Conflict escalates.	People get hurt; pastoralists lose access to pastoral resources; agriculturalists lose access to manure.
“Successful” differentiation	Herders and agriculturalists expose their views and identify their needs.	Groundwork is laid for negotiation.	Integration: the parties in conflict have identified their respective needs and may begin to think about possible solutions.

The risk of escalation during differentiation can be attributed to the following behavioral hypotheses that have been validated in empirical settings (Folger, Poole, and Stutman 1993):

- People try to maintain consistency between their beliefs and feelings (balance theory), which may lead to a personalization of the conflict and thus impede a clear identification of the rationale underlying the conflict.
- If a remark is perceived as aggressive, it is likely to induce an unfriendly response (according to research on interpersonal reflexes), thus engaging the conflict in a spiral of escalation and personalization (see also Putnam and Folger 1988).
- Public statements can lead parties to a loss of flexibility (according to research on the nature of commitments; see also Semlak and Jackson 1975).

In mediated conflicts, the mediator’s competence is often assessed in terms of being able to control communication (for example, Semlak and Jackson 1975; Donohue 1989). In successfully mediated conflicts, the mediator minimizes conflict-escalating information while highlighting integrative information. Differentiation and integration as phases are always observed in successfully managed conflicts, and the integration phase is absent in most unsuccessfully managed conflicts.

Conflict interaction is sustained by the moves and countermoves of participants, and moves and countermoves are based on the power that participants exert (Folger, Poole, and Stutman 1993). Central to this property of conflict interaction is the importance of the power relationship between the conflicting parties. Balanced power relationships may help conflicts to maintain a constructive direction (Folley 1975; Semlak and Jackson 1975; Poole, Shannon, and DeSanctis 1992; Folger, Poole, and Stutman 1993; Ross 1993). If a party believes that, because of his or her dominant position, he or she can be inflexible, there is little incentive for this party to compromise. Furthermore, in an unbalanced conflict situation, the weaker party's needs may not be seen as legitimate. A typical example of this can be found in Niger, where, in the agropastoral zone, pastoral authorities are disadvantaged in terms of bargaining power over land issues (Ngaido [Chapter 11]). If a conflict erupts between agropastoralists and pastoralists, pastoralists have very little recourse outside of violence or conflict avoidance.

Patterns of behavior in conflict tend to perpetuate themselves (Folger, Poole, and Stutman 1993). Central to patterns of behavior having the potential to perpetuate conflict are what Folger, Poole, and Stutman (1993) call "trained incapacities." They identify the following as trained incapacities:

- *Goal emphasis.* This becomes an incapacity when it prevents parties from conducting an adequate assessment of the problem underlying the conflict, or when it becomes a way to decide without a complete analysis of the chosen solution.
- *Objective standards.* The conflict can encourage members to presume the existence of an objective standard in cases where there is none. This may lead to the misidentification of the path leading to conflict management.
- *Procedures.* These can become incapacities when they structure interaction so that confrontation and escalation can not be avoided.

An instance of goal emphasis can be found in central Niger, where most regulations regarding livestock mobility are geared toward the avoidance of livestock going astray into cultivated fields. This misidentified objective leads to a marginalization of all interactions between pastoralists and agriculturalists.

In summary, three elements of the general environment may have an impact on conflict dynamics (Figure 10.2): communication patterns, the power relationship between parties in conflict, and patterns of behaviors that predated the conflict. The purpose of the next section is to analyze how institutions as part of a dynamic environment may have a role in the definition of these three elements.

Assessing Institutions

A schematic representation of the situation can be useful in the analysis of institutions and conflict stemming from natural-resource exploitation and management. Once a conflict arises (once parties are competing for the resource), it will

take a path leading to a position in the continuum between total competition and total cooperation. The level of conflict management will depend on the blend of cooperation and competition between parties in conflict (Figure 10.3). The hypothesis that is the basis of the present conceptual model is that local institutions, more or less involved in CPNR exploitation and management, will play a major role in the definition of this blend. The way to analyze this impact is to assess the effect of the institution on communication, the power balance, and patterns of behavior (see Figure 10.4).

FIGURE 10.2 Determinants of a conflict outcome

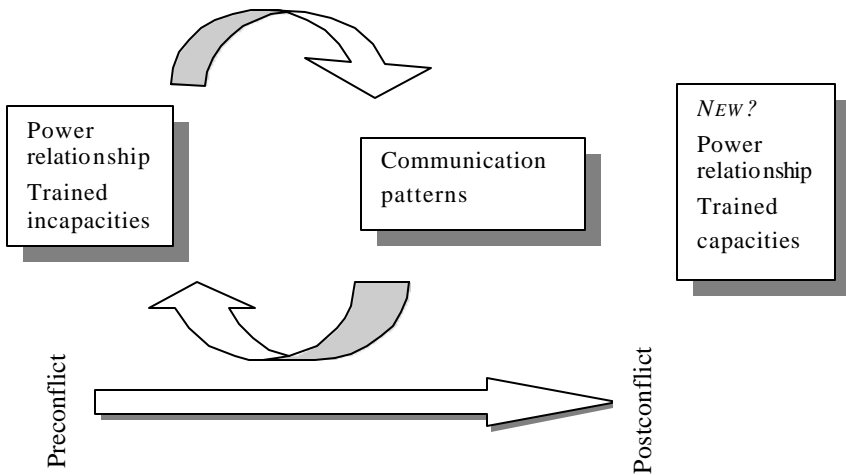


FIGURE 10.3 Cooperation and competition between parties in conflict

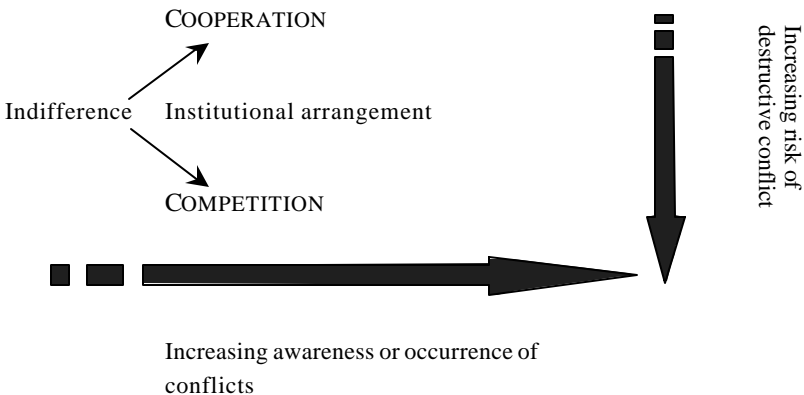
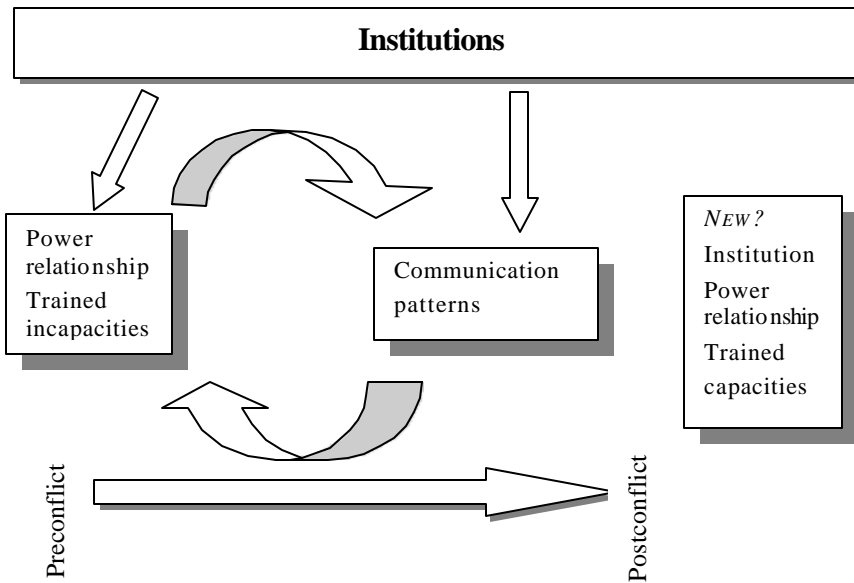


FIGURE 10.4 Impact of the institutional environment



Power

When analyzing the contribution of local institutions to power relationships, analysts must clearly delineate in which realm of socioeconomic activity this imbalance occurs. If an imbalance in power exists between parties, analysts must assess how exactly it manifests itself. Once this is understood, analysts must assess whether this power imbalance is part of a broader context or whether it is due solely to the institution under scrutiny. If it is part of a broader context, the analyst can assess whether the institution being considered replicates, reinforces, or diminishes the power imbalance between parties. This can, and ideally should, be analyzed at the regulatory, cognitive, and normative levels.

Behavior

Through their normative and cognitive structures, institutions can engender misidentified “objective standards.” The regulatory structures of institutions can contribute to the existence of incapacitating procedures.

Communication

For the purpose of the present framework, communication patterns are characterized in terms of localization (the location of the different points or nodes where information is exchanged), in terms of quantity (how often information

exchanged is exchanged), and in terms of content (how the information is transformed when it passes through a node). The assessment of an institution's contribution to communication patterns poses a series of difficulties. First, most of the analysis on the impact that communication has on conflict is limited to face-to-face negotiation, mediated or not by a third party. Communication for resource management can take many forms and may involve an important number of actors. A first challenge lies, therefore, in applying to a "macro" event a conceptual framework dealing mostly with "micro" event analysis. Furthermore, actors competing over resource use may have a large choice of communication media (for example, face-to-face, mediated by the market, mediated by the resource). Identifying the relevant media before focusing on it is, therefore, a second challenge. The way to address this issue is to map communication by characterizing communication nodes, that is, identifying where, when, and through what communication medium parties are communicating. Once this mapping, that is, the identification of the structure (Rogers 1979, Blau 1982) of communication patterns, is realized the importance of the impact of the institution on communication between stakeholders can be assessed.

Communication Networks Analysis as an Integrative Tool for Analyzing Cooperation and Conflict

When analyzing institutions, analysts may be tempted to use the proposed conceptual framework by assessing separately, and eventually with different approaches or methodologies, the aforementioned different elements of conflict—namely, power, behavior, and communication. While such a disjointed approach may seem tempting, it presents the risk of losing the interconnectedness of these elements as well as their possible interactions (see Figures 10.2 and 10.4). Another approach, which is proposed here, is to analyze the structure of the social relationship between parties and assess the contribution of the institutions under scrutiny to this structure. This analysis can be achieved through analyzing the communication network (Rogers 1979; Blau 1982; Weimann 1994) linking members of the parties who are interacting. The analysis of the communication network allows the assessment of the institutional environment in terms of its impact on power relationships, patterns of behavior, and communication.

From a methodological point of view, communication networks can be identified using different approaches (for a review of these and their respective characteristics, see Bernard, Shelley, and Killworth 1987; Monge and Contractor 1988; Weimann 1994). For the purpose of this analysis, the most appropriate method is the use of "name generators" (Burt 1984). Name generators are short questions having a person's name as the answer—for example, "The last time you wanted to use manure on your fields, who is the first person you talked to about your plan?" This technique is particularly appropriate here because it allows stratification of the questions by realm of socioeconomic activity (as discussed more fully below). Finally, this approach allows the use of snowball

sampling, thus giving a partial guarantee that all actors involved will be taken into account.

Communication

Communication can be analyzed in terms of the communication network as a whole. When identifying and characterizing the communication network, analysts have to be particularly careful to “dredge up” (Bernard, Johnsen, and Killworth 1987) the relevant part of the total network. Once the network as a whole is analyzed, the analyst can identify and quantify the contribution of the institutional environment to the communication structure. To identify from which realm of socioeconomic activity this communication structure stems, two analytical approaches can be combined. First, the stratification of the name generators by realm of socioeconomic activity enables the identification of the rationale behind the presence of an individual at a certain position in the network. Second, understanding the institution under scrutiny enables the design of (theoretical) subnetworks that can be compared with the actual network that is observed.

Power Relationships

Power relationships can be proxied using the characterization of key individuals through which information must pass and key individuals having access to more information. This corresponds to the two principal concepts of centrality in social-network theory and is often considered as representing or being a proxy for the analysis of power distribution (Freeman, Borgatti, and White 1991). Again, the two approaches described for the analysis of communication can be combined. Furthermore, an analysis of the linkages between control over information, control over assets, and position of the family in terms of relationship to the traditional authorities can be conducted. This would allow a validation or a rejection of the use of network centrality as a proxy to power.

Patterns of Behavior

Patterns of behavior can be analyzed in terms of the path that information is taking to reach different nodes and in terms of the degree of centralization of the network (Bonacich 1987). Again, the two approaches described for the analysis of communication can be combined.

Testing the Framework: Property Institutions, Livestock Mobility, and Conflicts in Agropastoral Western Niger

The purpose of this section is to introduce a potentially enlightening case study. The focus of the case study under scrutiny is on property institutions and their impact on range-resource use in agropastoral western Niger. The relationship

between transhumant herd managers or keepers and the communities having jurisdiction over the property-rights action-space⁵ where transhumant herds are grazing is emphasized.⁶ In the following sections, “herders” refers to transhumant herd managers or keepers passing through the land of a village practicing agriculture; “agriculturalists” refers to the members of the communities through which the “herders” are passing and their herds are grazing.

The focus on property rights and on range-resource use has several interesting characteristics. First, because land is a multiple-use resource, conflict may stem from scarcity and may also stem from different ways parties perceive how land should be used. This enables the joint analysis of scarcity-based conflicts and value-based conflicts. Second, while a majority of conflicts between transhumant herders and agriculturalists in western Niger are still resolved at the village level, the use of courts to resolve conflicts related to pastoral resource seems to be constantly on the rise (Ngaido 1993a). This seems to indicate that local conflict-resolution structures may be progressively losing the exclusivity to perform their function or that these structures may be undermined and thus rendered ineffective by forum shopping. Finally, Niger is trying to implement a new rural code that should increase the importance of local resource-management structures. Nevertheless, a lack of understanding of how these local structures function is impeding its implementation (Ngaido 1993a, 1993b; H-bow 1996; Gado 1996).

When analyzing the relationship between herders and agriculturalists, analysts need to take two key elements into account. First, land-tenure systems, governing the access and use of the range resource, must be analyzed. Secondly, the management of livestock mobility, which is a prerequisite to the existence of transhumant herds, must be analyzed. Because livestock mobility is, at least in part, a risk-management strategy (for example, Fleuret 1986; Painter, Sumberg, and Price 1992; Swallow 1994; van den Brink, Bromley, and Chavas 1995), its management can be seen as a form of social articulation of environmental risk.

⁵ The property-rights action-space of a community is the geographical unit for which the village head has direct or indirect jurisdiction over land allocation issues. This corresponds to the French concept of *terroir foncier* (Le Bris 1982).

⁶ This distinction, however, is not necessarily linked with any particular ethnic group. Most traditional pastoralists practice agriculture. Most agriculturalists raise livestock. While rural populations in the agropastoral zone in western Niger are therefore mainly agropastoralists, they differ in their origin and their level of crop-livestock integration. Classifications of agropastoralists can be found in Bonfiglioli (1990) and Williams (1994).

The Issues Under Scrutiny in Western Niger: A Short Introduction

Land Tenure

When analyzing the context of land-tenure systems and their associated property rights, analysts must stress the dual nature of property rights. Property rights mediate the relationships between humans (Lynch and Alcorn 1994), and between the resource and humans (Schlager and Ostrom 1992). Therefore, contextual information has to deal with the relationship between humans and resources and with the relationship between humans and humans. Land-tenure systems in Niger are facing pressure on both fronts. Environmental variability and population increase are a source of transformation for the human–resource relationship. Political changes have an impact on the transformation of the human–human relationship. There is therefore a need to stress that, when conducting an analysis of land-tenure institutions, analysts must not lose sight of its dynamic dimension. Nevertheless, the analysis that is proposed here will be limited to the static analysis of current land-tenure arrangements and their historical context.

Despite numerous attempts at land reform (Ngaido 1995), land tenure in western Niger is still mostly governed locally by customary institutions. It is based, for a majority of agricultural land users, on usufruct. A minority of agriculture land users has a tenure status approaching private property. Range land—consisting, during the rainy season, of fields left in fallow and of area uncultivable or never cultivated—is either under the authority of the village headperson, or under the authority of the *chefs de canton*, that is, district chiefs. During the dry season, fields are open for grazing on the residues and weeds. Access to the range resource is generally open provided that pastoral activities do not interfere with agricultural activities. Land tenure in Niger (Table 10.1) consists, therefore, of a mixed system of common and private property that is defined seasonally (see Williams 1997).

Livestock Mobility

While the management of livestock mobility has been described in the past for Niger Fulani and Twareg (for example, Dupire 1972; Bellot 1980; Wilson 1984; Maliki 1981), very little exists on its recent development. Turner (1998) gives a detailed account of the impact of the changing political environment on the herd management practices of Fulanis in the Say *département*—the “death” of grouped herds and the changing roles of the transhumant leaders. However, very little exists on the current herd-management practices of the Fulani, Zarma, Haussa, and Bella in western Niger as a whole. Furthermore, following the two last major droughts, there is evidence from eastern Niger that Haussa herd-management practices may be evolving rapidly, relying increasingly on livestock mobility (for example, Amoukou et al. 1996; Banouin et al. 1996). Before the proposed conceptual framework can be applied to the management of livestock mobility,

TABLE 10.1 A schematic description of land-tenure arrangements in the agropastoral zone of western Niger

Rights	Rainy season		Dry season	
	Range resources (fallow and bush)	Land for agriculture (cultivated land)	Range resources (fallow and bush)	Land for agriculture (land cultivated the preceding rainy season)
Access right	Granted to everyone provided that pastoral activities do not interfere with agriculture (negotiation with the village chief)	Granted to the usufruct-right holder	Granted to everyone (negotiated?)	Granted to everyone (negotiated?)
Withdrawal right	Granted to everyone provided that pastoral activities do not interfere with agriculture (negotiation with the village chief)	Granted to the usufruct-right holder	Granted to everyone (negotiated?)	Granted to everyone when grazed; under the authority of the usufruct-right holder when collected for storage or sale
Management right	Under the authority of the village chief for fallows and canton chief when never cultivated	Management by the usufruct-right holder, limited to decisions relating to fertilization fallow and well digging	Under the authority of the village chief for fallows and canton chief when never cultivated	Management by the usufruct-right holder; limited to decisions relating to fertilization fallow and well digging
Alienation right	Under the authority of the village chief for fallows and canton chief when never cultivated	Under the authority of the primary- or secondary-right holder	Under the authority of the village chief for fallows and canton chief when never cultivated	Under the authority of the primary- or secondary-right holders

NOTE: Tree tenure is omitted.

two key elements need to be considered here. The first is how decisions are reached on where and when to send livestock onto transhumance pastures; the second is whether the access to pasture outside the village is negotiated or not, and, if it is negotiated, on what grounds.

Conflict

Resource-based conflicts between herders and agriculturalists are rather common occurrences in western Niger. Table 10.2 summarizes the findings of a survey conducted in 40 villages in western Niger between November 1997 and February 1998. Two major observations are that, with one exception, no other resource-based conflicts, apart from farmer–herder conflicts, were reported; and that all resource-based conflicts between transhumant herders and agriculturalists, without exception, were settled locally. The imposition of fines on transhumant herders did not seem to be a widespread practice.

These observations seem to be contradicted by the following observations:

- Pastoralist associations point to the fact that the imposition of unreasonable fines and the systematic settlement of conflict in favor of “agriculturalists” (that is, Zarma or Hausa villagers) are growing practices (Magnant 1997).
- Ngaido (1993a, 1993b) reports a growing number of conflicts based on range resources being brought in front of the Nigerian courts.

TABLE 10.2 Importance of land-related conflicts during the agricultural year 1996/97—from a survey conducted in 40 villages of western Niger

	Conflicts with transhumant herders	Other conflicts linked with land tenure
Number of villages reporting these conflicts as common occurrence in 1996 (n = 40)	24	1
Unsettled conflicts	0	1
Number of villages that did not fine the transhumant herders during the settlement of the conflicts (n = 40)	15	n.a.
Number of conflicts related to land tenure where external help was needed for the settlement to go through	0	1

NOTE: N.a. indicates not available.

- Resource-based conflicts in Niger have already escalated up to the point where entire communities have been destroyed.⁷

These apparent contradictions need to be explored.

Expected Nature of the Results and Potential Applications

The results will consist of the following elements: the representation of agriculturalists' communication structure (communication networks are easily represented with matrices); the representation of agriculturalists' communication with transhumant herders; as well as two theoretical subnetworks—one for land-tenure institutions, and one for the management of herd mobility. The comparative analysis of these networks as described earlier may lead to the following results.

Conflict Management

While the literature advocating a greater reliance on local structures to manage local conflict is growing, local structures may fail to be able to achieve this because of their colonial and postcolonial transformations (see Cousins 1996). By focusing on local institutions' role in conflict definition, the proposed framework may contribute to an understanding of the actual needs in terms of conflict resolution structure.

Often the outbreak or escalation of conflicts is explained by transformation in the natural, the socioeconomic, or the institutional environment. If these changes are known, analysts can try to assess how these changes affect the communications between the parties in conflict.

One way of assessing the impact of alternative structures is by evaluating how a proposed structure may transform the structure of intergroup communication. This may allow, through "simulations," a better ex ante design of alternative structures for dispute resolution.

Management of Common-Pool Natural-Resources

While the regulatory structures of institutions are often assessed in terms of their ability to achieve a desired goal pertaining to resource management, the normative and cognitive structures of institutions are very rarely considered (Jentoft 1997). On the other hand, the concept of "social capital"⁸ is often called upon to

⁷ One of the frequently cited instances of extremely destructive conflicts between "pastoralists" and "agriculturalists" is the killing of 2 Haussas and 102 Fulanis in Toda (Maradi) in 1991.

⁸ Social capital is the arrangement of human resources to improve flows of future income (Ostrom 1995). The creation of institutions, networks, norms, and social beliefs are all identified in the literature as investments in social capital (Ostrom 1990, 1992, 1995; Putnam 1993).

explain differences in the ability of communities to engage in collective action (for example, Gardner, Ostrom, and Walker 1994; Ostrom 1995). When the concept of social capital is applied to that of an institution, it is often limited to the following simplistic equation:

$$\text{Institution} = \text{Social Capital} = \text{Better capacity to engage in collective action}$$

While the first equality necessarily holds (by definition), the second equality may hold only when focusing on the regulatory structure of the institution under consideration. When the cognitive and normative structure of the institution is considered, the second equality does not necessarily hold. While the regulatory structure of an institution (through rules and their enforcement) can be an indicator of a proven capacity to engage in collective action for a specific goal, it does not give us information on how the normative and cognitive structures of the institution considered may affect future collective action (crafting of a new institution, for example). The proposed framework may give an evaluation of the potential for investment in new social capital while taking into account all aspects of institutions.

The Case Study

The following specific questions linked with the situation in agropastoral western Niger will be answered:

- How are changing herd-management practices and changing livestock ownership linked to the potential for range management and for conflict management based on range resources?
- What is the impact of the current institutional framework on the institutional adaptation to growing resource scarcity?
- Is the rural code a framework that will increase cooperation between transhumant herders and agriculturalists?
- Is the setting up of formal alternative dispute resolution structures—as in eastern Niger for instance (Magnant 1997)—the answer to the escalation of conflict between transhumant herders and agriculturalists?

Conclusion

The purpose of this chapter has been to propose an approach to the conceptualization and analysis of CPNR use. Through the analysis of communication, and through the use of conflict analysis theory, the proposed framework may enable a different view on the ability of current local institutional frameworks to contribute to the management of CPNR and to the management of conflict stemming from competition over resource use.

While, a priori, this framework looks full of promise, its validity must be ultimately confirmed by testing in the “real” world. Range management in Niger, as a case study, seems to give a unique opportunity to achieve this. If vali-

dated, the proposed framework will provide a supplementary tool for the analysis of institutional environments. In a time of government withdrawal and increasing reliance on local structure, such a tool may be useful.

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PART IV

Empirical Studies

11 Can Pastoral Institutions Perform without Access Options?

TIDIANE NGAIDO

The failure of state ownership and statutory legislation to achieve better resource management has fostered new interests favoring community control and management, and customary tenure-systems (Blaikie 1985; Jodha 1985; Bromley 1984; Bruce 1986; Blaikie and Brookfield 1987; Lawry 1990; Rose 1992; Vedeld 1992; Wachter 1992; Knox Mcculloch and Hazell 1998). The main argument is that most of the externalities associated with resource management result from the failure to protect and guarantee individual and community property rights (Lawry 1990; Ngaido et al. 1997). Initiatives to recognize communities' rights have been ongoing since the early 1910s in Morocco and in the 1990s for Niger. In Morocco, tribes' rights over their territories have been recognized since 1912 and provisions were made to delimit and title these lands in the name of the tribe (Nassif, Boughlala, and Ngaido 1997), and in Niger the new rural code grants rights to priority of use to pastoral communities. These different approaches to common grazing resources have many implications for the capacity and strength of local communities and resource users to manage adequately their resources.

However, these legal approaches merged all resources used by pastoralists into a "single resource" defined as "common-property resources." Though conceptually this may be adequate for targeting policy interventions, it is nevertheless misleading. These approaches, like most common-property studies, neglect the importance of production strategies and resource-access options used by pastoral communities to hedge against risks associated with environmental variability and other external pressures and thus maintain their pastoral systems. "Production strategies" are the set of individual and community responses to demographic, environmental, economic, and political pressures affecting their production system and their livelihoods (Ngaido 1996). "Access options" are bundles of options available to individuals and communities for securing their livelihoods and production in response to the constraints they face. These access options include owned pastures, crop residues, institutional arrangements made with other communities to have access to their pastures, and purchased feeds.

Moreover, the proponents of this model of "single"-resource competition use the framework of internal and external pressures to explain that space is limited and that internal pressures (population growth, herd size growth, and change of activity) and external pressures (climatic changes and environmental degradation) create scarcity and conflicts (Peperkamp 1986; Bos and Peperkamp 1989;

Staar 1986; Evangelou 1984). Strategies adopted by a group of resource users in response to these pressures restrict the competing users' abilities to respond to their own constraints. As a result, competing users are faced with a situation of scarcity. In the Sahel, farmers' encroachments on grazing areas and corridors is a good example of pastoralists' being limited in their ability to conduct their pastoral activities. The reduction and degradation of common pastures have led livestock owners to increasingly rely on crop residues and purchased feeds (World Bank 1995; Anoun et al. 1996; Ngaido et al. 1997).

We postulate that local-resource scarcity has always been a major constraint to pastoral production in dryland areas and has been the major driving force for development of access options based on institutional and market relations. Pastoral communities have always been aware that their local grazing resources will not suffice for more than three to four months and that they need to secure feed for their herds for the remaining eight to nine months. As such, pastoral communities have developed production strategies based on "free grazing" obtained mainly through reciprocal grazing arrangements, which act as risk-coping strategies. In his study of the Beni Meskine in Morocco, Berque (1934) describes the transhumance of 58 percent of Oulad Ali's livestock (estimated at 14,668 sheep in 1934) from El Brouj to Mdakraj. In addition, the Beni-Guil tribe, located in the eastern regions of Morocco, have a territory that is divided into two parts. During winters, the northern fraction of the tribe goes to the south to escape the cold weather; and during summers, the southern fraction moves to the north to avoid the heat (IAVHII and USU 1993; MAMVA 1994). Numerous other examples are found in the Mashreq and Maghreb regions. In Niger, the south-north-south transhumance routes also depend on rainfall. Herders from Nigeria come to graze in the pastoral zone of Niger in the rainy seasons; and a reciprocal arrangement occurs in the dry season, with herders from Niger going to graze in the pastoral zone of Nigeria.

In recent years, however, socioeconomic and environmental changes and increasing demands over pastoral-land resources have affected the possibility of pastoral institutions' solely relying on such arrangements and ensuring the livelihood of their members. For example, pastures and pastoral resources are increasingly being appropriated by individual members or encroached upon by herders and farming communities. These changes induce the loss of local institutions' capacity to provide secure production strategies for their members and weakens the capacity of communities to enforce resource-management rules and win the support of its members. This loss of institutional capacity and strength is translated in the rural areas into increasing disputes over common-property resources, increasing environmental degradation, and increasing reliance of pastoralists on the market for the upkeep of their animals.

This study is intended to contribute to the common-property debate by strengthening the link between property rights and production strategies, and to show how institutional inefficiencies may occur in any system of common-property rights regardless of the degree of control communities have over the

resources. Land disputes over common-property resources are considered as indicators of institutional inefficiencies because it is assumed that, if local institutions were efficient in defining and implementing rules, community members would respect them and would be unlikely to seek support from government institutions. It is argued that what really matters is the capacity of local institutions to meet community demands and adjust to production risks associated with environmental, economic, and political pressures while maintaining the welfare of the community as a whole. This study draws comparisons between the Moroccan and Nigerian experiences to evaluate the factors that have led to institutional inefficiencies.

This chapter is divided into six sections. After this introduction, the second section discusses the institutional framework on the basis of two important concepts: capacity and strength of local institutions. The capacity of pastoral institutions is based on availability of resources both at the local level as well as in the broader vicinity, where they serve as access options. Capacity is also linked to effective resource-management institutions, which embody decisionmaking power and control, and enforcement mechanisms, for resource management. The strength of these institutions depends on the degree to which there are effective and exclusive customary rights over community resources, the existence and relevance of existing rules and regulations, members' adherence to these rules, and the recognition and guarantee of local institutions by the central government.

The third section analyzes how land policies affected the capacity and strength of present pastoral systems to manage their resources. The fourth section evaluates the performance of local institutions by drawing lessons from land disputes from Morocco and Niger. The fifth section assesses new trends and the emergence of new access-options. The last section gives conclusions reached from the results of the study.

Institutional Framework

In the dryland areas of Morocco and Niger, integrated crop–livestock is presently the dominant production system. The dominant land-tenure system in dryland areas of Morocco and Niger is common property. Blaikie and Brookfield (1987) define common-property resources as resources that are “subject to individual use but not to individual possession,” have a limited number of users with independent use-rights, and have users organized as a “collectivity and together have the right to exclude others who are not members of that collectivity.” Bromley (1991) defines common property as the “private property of a group of co-owners.” These definitions suggest that users have equal property rights over resources and that they have the capacity to fix the rules of access and the norms of use of these resources, but typically not every user has the right to define the rules of access and use. The right to make the rules is often confined to few (Ciriacy-Wantrup and Bishop 1975; Jodha 1985; Bruce 1989).

The thrust of common-property studies is to investigate the opportunities and constraints that property rights provide to rural communities and individuals regarding their production decisionmaking. In that respect, property-rights institutions define the possibilities available to individuals and communities regarding their access and use of a given resource (for example, land, water, pastures, and trees) and guarantee that these possibilities are granted to individuals and communities for carrying out and maintaining their production strategies. Property rights define what communities and individuals can and cannot do, to what extent and for how long, with a given resource (Place, Roth, and Hazell 1994; Ngaido 1996). In the dryland areas—areas with less than 350-millimeter rainfall—three types of land rights exist: private property, secured access, and access options (Table 11.1). These broad categories are not static, because there is a range of combinations between categories and large variations within and between communities for the same production system.

TABLE 11.1 Land rights in dryland areas

	Local or tribal level		Access options	
Access types	Private property	Secured access-rights	Institutional (neighboring tribes)	Market
Nature of rights	Tribal and individual ownership	Use rights on tribal cropping and grazing lands	Access rights to pastoral resources of other tribes through reciprocal arrangements	Rental of crop residues and purchase of feeds

Private Property

Private property relates to freehold-property rights that are enjoyed by individuals and families over land, water, and animal resources. The right holder has control over these resources and can bequeath, sell, or lend them. This is the case of *Melk* or *Mulk* lands in West Asia and North African countries, where holders are certain to reap the full benefits of any investment they make on their lands. In Morocco, tribes have private-property rights to their common resources. These rights are recognized by the Moroccan government and sometimes titled in the name of the tribe (Pascon 1980; Mahdi 1997a, 1997b; Nassif, Boughlala, and Ngaido 1997). This situation enables the tribes to decide on the use the resources. However, tribes are required to seek the approval of the Ministry of Interior, who has the trusteeship of collective tribal lands. In addition, individual tribal members can hold private property on tribal lands. In Niger, however, the situation is quite different; pastoral communities do not have pri-

vate claims either at the individual or tribal level on their pastoral resources or on the lands that they cultivate during the rainy season.

Secured Access-Rights or Use-Rights to Common Pastoral Resources

Secured access-rights, which are the dominant rights to pastoral resources, are use rights granted to community members by traditional leaders on their common lands and water resources for production activities. Under such tenure regimes, individuals have only rights to priority of use, which can be maintained for a long period but do not entitle individuals to private property. Community members may also request additional or new lands to avoid depleting the lands. The role of traditional authorities in these systems, therefore, has been crucial for regulating access and use over these resources. The flexibility of this tenure system, which gives tribal leaders the potential to recapture excess lands and redistribute them to needy members, is the basis of the strength of traditional institutions. Furthermore, this system has sustained the capacity of tribal institutions to secure the productive strategies of their members.

Access Options

Access options are bundles of options available to individuals and communities for securing their livelihood and production systems in response to the constraints they face. Access options to land, animal, and water resources affect individual and community decisionmaking, involving different institutions, transaction mechanisms, and costs. Individuals and communities in the dryland areas have developed a large array of tenure arrangements for access and use of resources, which are risk-sharing devices, to buffer against socioeconomic, demographic, environmental, and political pressures.

ENSURING THE WELFARE OF COMMUNITY-MEMBERS WHO ARE RESOURCE POOR. Given that productive resources (labor, land, or animals) are unequally distributed, land redistribution enables granting land resources according to family size. In many cases, large families were allocated access to more lands but had also more people to feed. As long as the system preserved equitable resource access, members were satisfied and abided by the rules. This inequality in land holding becomes a danger, as discussed in later sections, only if the system of redistribution becomes nonfunctional. Animal- and grazing-right issues are more complex because traditional authorities typically have not had animals to distribute to their members, although they may have fostered opportunities for poor members to make grazing contracts with rich community members or outsiders (Berque 1934; El-Youssoufi 1976; Anoun et al. 1996). These grazing contracts, which give herding partners half of the production, permit poor community members to build their herds and exercise their access rights on common grazing pastures. Swallow (1994, 11) argues that

the circulation of group property from richer to poorer households and from one generation to the other has been crucial to the recuperative power of WoDaaBe households in Central Niger.

The possibility of poor herders' contracting with outsiders has served as an incentive for rich community members to secure contracts with poor herders to exclude potential external contracts, and therefore access to their growing resources by outsiders' herds. The cost of excluding outsiders is reflected in the arrangements made between rich and poor community members. The benefits are that owners of large herds can prevent or reduce overstocking on common pastures, and that dividing large herds into smaller ones enables large-herd owners to better use common pastures. However, if poor herders decide to contract with outsiders anyway, this may result in disputes. El-Youssoufi (1976) describes the conflict between large- and small-herd owners in the pastoral perimeter of El Brouj because small-herd owners made grazing contracts with outside herds. In Niger as well as in Morocco, contract herding has been a mechanism for asset building for many poor community-members. This case is illustrated in Example 1, where Oumarou, a Fulani herder, moved from herding village animals to being a livestock owner himself.

ENSURING THE WELFARE OF COMMUNITY MEMBERS: MOBILITY AND RECIPROCITY. Two of the traditional risk-management strategies that are the most well developed are the mobility of pastoral people and reciprocity arrangements for the use of their tribal pastures (Lewis 1981; Neisheiwat 1991, 1992; Masri 1991; Behnke, Scoones, and Kerven 1993; Swallow 1994). These strategies are mechanisms used by pastoral communities to extend their resource availability and ensure their production strategies. These risk-management strategies put pastoral communities under different property-rights systems and decisionmaking spheres. For example, when herders in Niger stay in the pastoral zone, Fulani or Tuareg, tribal leaders facilitate their access to pastoral resources, whereas when they are using grazing corridors and areas in the cropping areas, they rely on village and canton chiefs to give them access. In Morocco, Oulad Fenane have grazing lands and a forest held in common (Anoun et al. 1996). The common grazing areas are under the control of local institutions, while the forest is managed by local collectivities. Cousins (1995, 7) uses the concept of resource "patchiness" to argue that

...recognizing spatial heterogeneity of rangeland resources implies that herd movement as a management strategy should be accepted and facilitated.

However, this resource patchiness is not only environmentally based but also institutionally based because each "patch" is under different jurisdiction and governed by a different set of institutional arrangements to access and use these resources.

As discussed previously, the inherent resource scarcity of local resources makes such access options critical for the maintenance of the pastoral systems (Figure 11.1). The capacity of tribal institutions to arrange access to extra resources during seven to eight months a year using different networks and routes depending on rainfall and pasture conditions strengthened local institutions.

Example 1 Appropriation of the Mozague grazing area by farmers in the Arrondissement of Birni N'konni

The dispute over a grazing area, between Oumarou, a herder, and the Mozague villagers, started in June 1990. The dispute created such hostilities that in July 1990, Oumarou mortally wounded the Mozague village chief.

The traditional grazing area of the Mozague village is located in the western bank of the dam and 1 kilometer southwest of the Rouga-Mozague village. The disputed site, which is a plateau with rocky soils, is 1.5 kilometer in length (east to west) and 1 kilometer in width (north to south), is boarded in the south by Nigeria, the east and the north by basins, and in the west by sorghum fields cultivated by the villagers of Rouga Mozague. The distance to the frontier with Nigeria is approximately 200 meters. The vegetation is composed mostly of brush and some grass. This site of approximately 150 hectares has been reserved for livestock production for more than 70 years.

In the middle of the site are mud houses separated into two compounds. One is composed of six houses inhabited by six heads of households that are members of the same family, and Oumarou inhabits the second. The six heads of households settled in this area in 1954. At that time, Oumarou and his father, who were living in Mozague as village herders, acquired the trust of the villagers as well as of local authorities and were able to settle in the actual site in 1966, where they cultivated their own fields.

In 1983, a dispute broke out between the Fulani and the local farmers. After the mediation of administrative and customary authorities, the area was classified as grazing area and Oumarou became the sole authority responsible for the area. Moreover, Oumarou, whose family originated in Nigeria, continues to maintain close relations with Nigerian herders who negotiate the use of his pastures.

The building of the Mozague Dam has led to soil erosion and has considerably reduced the size of the fields cultivated by the local population. This situation, which started in 1988, prompted farmers to claim ownership over Oumarou's grazing area in 1990 on the grounds that they cultivated these lands before 1954.

The mediation of the conflict by local administrative and customary authorities (canton chief and chief of the Fulani group) have resulted in the following changes:

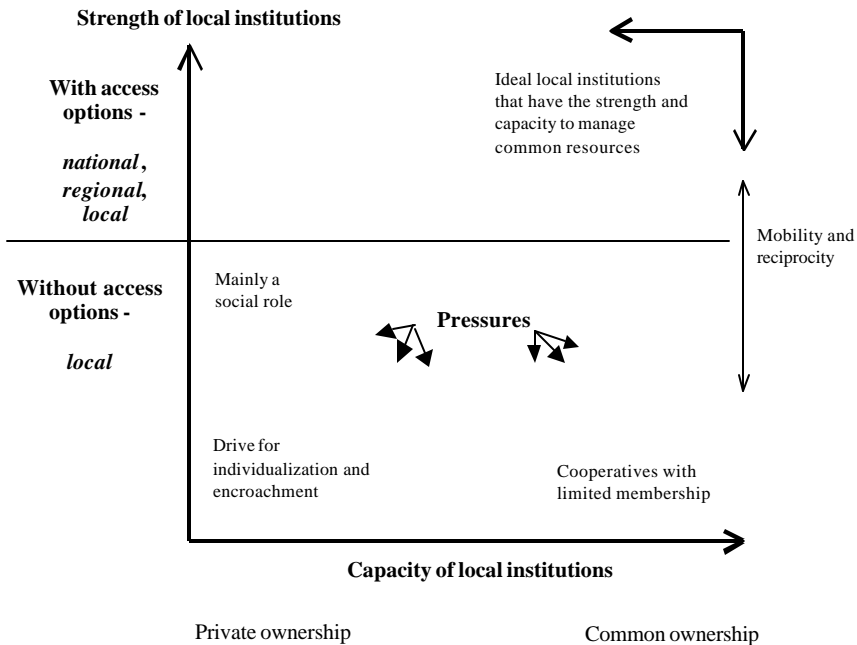
- The areas of the Fulani compounds and the fields cultivated by Oumarou and his son were demarcated.
- A small grazing area for Oumarou's livestock was also demarcated.
- The remaining area was divided into 70 fields and redistributed to farmers of the Mozague village.
- A corridor 15 meters wide links the Fulani camp to the watering point and the traditional grazing area.

SOURCE: Report of Mission by the Mohamadou Athoumane, chief of the service of animal resources, July 25, 1990.

Ngaido (1994a, 1994b) found in Niger that canton chiefs who had land to distribute had more authority over their community members. The existence of these access options has been crucial for sustaining individuals in their production systems. Access options, which play an important role by extending resource availability to community members through institutional arrangements

between community members and with other tribes, strengthen the position of tribal leaders. Figure 11.1 emphasizes that parts of the capacity and strength of local institutions have been based on these access options because it creates greater security to members. Alternatively, changes in these access options hinder institutional performance. In the following section, land policies and their effects on the capacity and strength of local institutions in Morocco and Niger are discussed.

FIGURE 11.1 Framework for institutional capacity and strength



Land Policies and Their Effects on the Capacity and Strength of Local Pastoral Institutions

Land policies of Morocco and Niger constituted different approaches, but their impacts on pastoral communities are similar.

Morocco

In Morocco, tribal rights have been recognized since 1912 and subsequently many legal texts were enacted to strengthen tribal and member rights (Nassif, Boughala, and Ngaido 1997; Chiche 1997; Mahdi 1997a; Qarro 1997). Moreover, the 1916 decree was the first measure recognizing traditional institutions and providing them with a resource management role (Bouderbala, Chraibi, and

Pascon 1977). This role was confirmed by the April 27, 1919, decree that required communities to choose their land-management representatives according to customary rules. Under the trusteeship of the Ministry of Interior, these land managers were organized into an assembly (*jemaat nouab*) to carry out land distribution, conciliate land disputes, safeguard the interests of their communities, and represent communities for any legal matter related to their collective lands (Nassif, Boughala, and Ngaido 1997). Furthermore, the provision, which stated that any opposition against implementing decisions of local authorities is punishable by one to three months in jail and a fee ranging from 120 to 500 Dirhams (Article 4), reinforced the position of tribal leaders.

The focus on tribal resources and the granting of common-property rights gave tribal institutions more control over their resources and prevented the loss of their lands to colonization (Nassif, Boughala, and Ngaido 1997). The recognition of tribal ownership also provided tribal institutions the strength to manage tribal resources and safeguard the livelihood strategies of community members. However, two major shortcomings of the law, which affected the pastoral system as whole, were the granting of perpetual rights to tribal members and neglect of institutional access-options between tribes. In its 1995 study, the International Institute of Agronomic Research (INRA)—Settat found that the rural commune of Oulad Bouali had totally distributed its pastures into cropped fields and that, in the forest areas, Oulad Fenane, communal lands were subdivided between tribes into plots called *tmoutira*. These plots, which were given to individual members, were governed by a special contract established by the district head. The growing individualization of common tribal resources indicates that without the provision made in the 1919 law, which requires approval of any land use change by the Ministry of Interior, many of the common pasture would have disappeared.

Moreover, as argued before, the redistribution of land among community members had been a process that ensured the welfare of all community members. Once this system breaks down because individual ownership claims are being asserted on common resources, the only alternative response to land demands due to population pressures is encroachment or distribution of marginal areas. Consequently, the loss of common lands leads also to the loss of institutional access-options based on reciprocity, weakens traditional resource management systems, and fosters increased disputes. New forms of access options, generally based on market relations, are continuously replacing institutional arrangements. El-Youssoufi (1976) argues that grazing contracts on cropped fields are based on market price evaluated by unit of forage.

Niger

In Niger, however, the land-tenure situation has been quite different. Since the 1960s, the government of Niger undertook a series of measures to regulate ac-

cess and use of pastoral resources and the relations between herders and farmers.¹ However, these different measures aimed at securing livestock production granted only a limited role to pastoral institutions, which did not have a managerial role over grazing areas and corridors in cropping areas. Pastoral resources remained under the control of traditional chiefs. However, even in the pastoral zone, where resources are supposedly under the control of pastoral communities, traditional canton chiefs for agricultural communities were able to override the 61-5 and 61-6 laws by allocating agricultural fields (Delehanty 1988; Ngaido 1993a, 1993b). Example 2 describes a dispute case between Fulani and Hausa farmers who were permitted by the canton chief to cultivate lands that were located in the pastoral zone. Furthermore, the management of these lands was complex because pastoral groups (Fulani or Tuareg) and farming groups (Hausa or Zarma) were from different ethnic groups.

Example 2 Appropriation by farmers of a basin located in the pastoral zone (Cuvette de Tam), District of Maine Soroa

This conflict is between farmers from the Nzoulou village (canton of Chetimari) and 14 Fulani settlement camps, of which 4 are located permanently in the Tam basin and 10 are spread around the basin.

In recent years the lands of the Nzoulou farmers, who also own small ruminants (sheep and goats), have been threatened by sand dunes. Soil degradation, population pressure, loss of soil fertility and rainfall shortages have pushed the villagers to search for new lands. In 1990, with the authorization of the canton chief, 18 farmers from the village developed new lands regardless of the 1969 decision. This decision, which was taken jointly by the Subprefect, the Deputy, the Gendarmerie of Maine, the canton chief of Maine Soroa, the canton chief of Chetimari, and the chief of the Foulatari group, forbade agricultural production in this basin and reserved it for livestock production.

Farmers argued that the reduction of herds and the lack of herds moving in the area motivated them to occupy the Wargaza basin and that livestock production and agriculture could be carried out simultaneously in the basin. They recognized their good relationship with the Fulani herders. Nonetheless, they affirmed that the final decision regarding the use of this basin was in the hands of traditional leaders.

Herders also stressed their good relations with the farmers and this despite the abundance of herds (both local and foreign) during the rainy season. They wanted to confirm the 1969 decision, which allocated the basin for livestock production. They affirmed that the final decision was in the hands of traditional leaders.

Finally, in June 1992, an agreement was reached and the basin was divided into two parts for agriculture and livestock production. Herders from the Fulani camps were also granted fields to cultivate.

¹ The May 26 and 27, 1961, laws (61-5 and 61-6) fix the (200 millimeter rain fall) northern limit of cultivation; and the June 18, 1987, decree (87-077) regulates the circulation and grazing rights to livestock in agricultural zones.

Consequently, the questions of who controls, who has rights to, and who determines the proper use of grazing lands are critical in Niger. The major feature of the management of pastures is the confusion between leaders of farming communities, who consider that grazing areas and corridors fall under their jurisdiction, and pastoral community leaders. The former assert quasi-ownership rights over pastures and take the liberty of allocating land rights to farmers. For leaders of pastoral communities, the lack of control over pastures reduces them to the status of a use-right holder over grazing lands. Even though Tuareg and Fulani pastoral authorities have officially the same rank as canton chiefs, their major role in the control of grazing areas and corridors is to police the use of these resources. They may facilitate access of these resources to seasonally migrant pastoral communities in the pastoral zone, but they cannot change the actual usage of the land. Furthermore, as allocated lands for cultivation are sources of revenues that permit chiefs to respond to the needs of their members, controlling these lands were important.

As a result, local agricultural authorities hold the bundles of rights over pastures while pastoral authorities are beset with the bundles of obligations to be enforced in their communities. In other words, the canton and village chiefs are the authorities capable of changing the usage of the land. This duality creates problems because the former can allocate these lands without consulting pastoral authorities. This is also true in the margins of the pastoral zone, where canton and village chiefs allocate lands for cropping in areas previously allotted for grazing (Ngaido 1994b).

The lack of capacity of local pastoral institutions to ensure the livelihood strategies of their tribal members pushed many cattle owners to develop their own networks for accessing grazing areas or cultivable lands. For example, the "land to the tiller" policy (December 18, 1974) extended cropping into grazing areas and corridors and encouraged many herders to settle and appropriate land to cultivate. Furthermore, land appropriation, which was favored by the 1970s drought that decimated most of the herds, was an opportunity for many pastoralists to secure the welfare of their families. Furthermore, many herders received fields to cultivate from canton and village chiefs. As such, pastoral authorities are increasingly losing control over their people. However, the ethnic dimension continues to be very strong and still acts as cement between pastoralists.

These land policies have had different impacts on the capacity of local institutions to secure the livelihood strategies of their members. In the case of Morocco, it is clear that the main objective was to strengthen and sustain tribal institutions and production systems, whereas in Niger, land policies induced "open access" and land encroachment. In addition, policy measures in both countries were based on the expectation that communities would use their customary institutional arrangements to manage access and use of their respective resources. These expectations were often deluded, because individual members tended to favor their individual welfare at the expense of collective welfare. This is exemplified by growing disputes over common resources.

Performance Pastoral Institutions: Disputes over Common Lands

Quantifying the performance of local institutions is not an easy task because of the complexity of their function. However, two areas of performance can be quantified. The first type relates to the capacity of local institutions to manage their common pastoral resources. The quality of the resource base could be used as an indicator of that performance. If these resources are well managed, it increases the welfare of the community as a whole and reduces its dependency on access options. The performance can be seen as the marginal effects of setting and enforcing the rules over resource use. The second type of performance indicator is the behavior of community members. Are community members abiding by the rules that govern access and use of these common resources? What are the strategies for using common pastoral resources? In this chapter, the second type of indicator, which is assumed to reflect constraints faced by community members and the incapacity of local institutions to ensure their livelihoods, is used to evaluate the performance of local institutions.

The Loss of Capacity and Strength

Increasing demand over land, the incapacity of local institutions to grant land, and inadequate land policies have increasingly led to the hardening of the boundaries between pasture and cultivated lands. The fluidity of the boundaries between grazing and cultivated lands always required the mediation of traditional institutions in granting access and use to different users. Today, the boundaries of these lands are fixed and the rules, which controlled access and use to these resources, lost their effectiveness and are no longer respected. Moreover, pastoralists are settling and appropriating land for cropping (Kirk 1995). Use and access rights are increasingly being transformed into more secured tenure and grazing rights are also being transformed into cropping rights.

Consequently, weaker community members, who depended on institutional capacity for their livelihood, will be negatively affected because land encroachment prevents them from directly accessing common resources and precludes them from making grazing contracts, which were important for asset building. These community members are increasingly relying on migration to generate income and support their families. Boughlala, Ngaido, and Nassif (1999) found in the survey they conducted in the El Brouj district (Morocco) that 33 percent of household revenues came from off-farm activities. Moreover, many herders in Niger as well as in Morocco are increasingly settling in pastoral lands and reverting to agricultural production as their main source of income.

Changes in customary welfare-systems, breakdown of resource-allocation mechanisms, and government land policies negatively affect usufruct rights that had been enjoyed in the past by community members in Morocco and Niger. Moreover, the breakdown of the fallow system, the reduction of virgin lands, and the increasing demand for cultivable lands that has resulted from changes in government policies have unveiled the contradictions between livestock production and agriculture.

As such, changes in property rights not only affect the rights of community members of their tribal resources, but also disrupt risk-management systems based on tribal reciprocity and reduce efficiency in the traditional network of resource users. This loss of reciprocity could be considered as a loss of tribal efficiency in securing the livelihood strategies of their members. The loss of capacity, which generally occurs when tribal common resources are appropriated by the state or transferred to individuals, encourages local users to encroach upon and transform the resource base without regard for other community members. Furthermore, this loss can happen when tribal groups are no longer capable of ensuring the livelihood of different community members because of demographic, economic, or environmental pressures. Besley (1995, 906) argues that loss of efficiency arises when there is “a dysfunction between communal rights and individualized decisions.” Consequently, land policies of Mashreq, Maghreb, and Sahelian countries affect the traditional property rights environment.

Under such situations, the main strategies of members are to encroach into the common resource to guarantee their own production systems at the expense of other community members or rely on the market to feed their animals. Anoun et al. (1996) found examples of livestock owners who enclosed their plots with cereal fields, thereby excluding other tribal members from tribal pastures of Oulad Chouaoua, Morocco. This example illustrates how individual members respond to secure their own welfare at the expense of weakening local institutions that are incapable of enforcing equitable access rules. Such opportunistic approaches fosters disputes between tribal members.

Land Disputes over Common Pastoral Resources

Most of the literature on land conflicts in Africa deals with farmers' encroachment on pastoral lands (Peperkamp 1986; Bos and Peperkamp 1989; Staar 1986; Evangelou 1984). Peperkamp (1989, 4) defines land-use conflicts as situations where “actors are hindered in the conversion of their needs in spatial terms, but in such a way that they wish to take action at the expense of the other party or parties.” Wade (1987) and Staar (1986) support that farmer and herder disputes result from population pressures and reduced soil fertility. Homer-Dixon, Boutwell, and Rathjens (1993) support the idea that scarcity of natural resources contributes to violent conflicts. Moreover, these conflicts over common-property resources are often drawn along ethnic lines, for example Fulani herders against local non-Fulani farmers (Horowitz 1989; Basset 1993).

However, these conflicts are only part of the spectrum of tensions over resources. Conflicts are heightened manifestations of the “erosion” of the social status quo, which was based on the capacity of local leaders to ensure the existence of access options. Decisionmaking responsibilities were embedded in the status quo, governing choices over resource management. Land disputes illustrate the breakdown of the interaction between physical processes and human processes, which formerly provided stable and sustainable reproduction of natu-

ral and social processes. In addition, this chapter supports the idea that internal dynamics that lead to resource scarcity are long-term processes and that actual inefficiencies, environmental degradation, and land disputes over common pastoral resources are worsened by inappropriate land policies based on a single-resource framework.

Disputes between tribal members and between farmers and herders arise not only from competition over land but also from a drive to secure livelihood strategies. Indeed, once common pastoral lands are appropriated for agricultural purposes, the tendency is to consolidate the control over the field and assert ownership rights. In so doing, farmers increase the costs of livestock production because herders are required to spend more time tending their herds and seeking other feeding alternatives. Herders also appropriate land to reduce transaction costs associated with feeding their herds and to avoid completely losing their traditional use-rights. Table 11.2 shows the distribution of land disputes officially reported on common lands in the El Brouj district of Morocco (1986–96) and in the districts of Maine Soroa, Mirriah, Guidan Roumgi, Birni Nkonni, and Boboye of Niger (1989–93). The disputes, which were resolved directly by family or tribal institutions, are not reported here.

In Morocco, 76 percent of the recorded 322 dispute cases were on common pasture, among which 47 percent were cropping encroachments and 16 percent involved fencing using barley rows. In Niger, all the 115 disputes concerned essentially pastoral resources, among which 80 percent were encroachments. These data are just indicators of the difficulties facing local pastoral institutions in managing common resources.

In both countries, the drive for individual appropriation of common resources highlights the loss of capacity and strength of local institutions to govern resource use. Increasingly, pastoralists are relying on themselves to ensure their production strategies. This trend is found all over the Mashreq, Maghreb, and Sahelian regions. Pastoral societies, which are facing resource scarcity, are developing new socioeconomic relations related to production where markets and new structures are increasingly taking over.

Searching for New Alternatives for the Management of Pastoral Resources

Presently, the question of how to stimulate collective action for better resource management is one of the major concerns of policymakers and researchers. Collective action is how individuals and communities jointly translate the opportunities and constraints into concerted resource-use behaviors and practices and property-rights institutions. Resulting behaviors and practices may not always be beneficial, however, and may lead to resource misuse and mismanagement. For example, in the previous section, it was noted that encroachment on common pastures is also inducing conflicts and environmental degradation. The concern here is how to transform these manifestations into positive actions that win the support of all community members and at the same time foster efficient, equita-

TABLE 11.2 Distribution of disputes on common pastoral lands in Morocco (1986–96) and Niger (1989–93)

Type of dispute	Morocco		Niger	
	Collective arable lands	Collective pastures	Grazing areas	Grazing corridors
Cropping	15%	62%	61%	19%
Crop damage			11%	9%
Fencing ^a	4%	16%		
Threshing area		8%		
Harvesting	3%			
Building a house	1%			
Others	1%	5%		
<i>Total</i>	<i>24%</i>	<i>76%</i>	<i>72%</i>	<i>28%</i>
Number of cases	77	245	83	32

SOURCE: The data from Morocco came from Nassif, Boughlala, and Ngaido 1997; the data from Niger data was collected by the author under the cooperative agreement between the Land Tenure Center, University of Wisconsin—Madison, and the U.S. Agency for International Development, from 1992–1994.

^a Fencing, which is a strategy used by livestock owners to exclude other community members, consists of growing two to three rows of barley around a given area.

Growing these rows of barley effectively prevents others from coming in.

ble, and sustainable resource use. To address this issue, many options have been identified and are being implemented in many countries, but discussion in this chapter focuses on three of these options: development of pastoral cooperatives, redefinition of pastoral rights, and development of market-based options.

Development of Pastoral Cooperatives: Sustaining Tribal Systems in Morocco

New pasture- and livestock-improvement projects (Projets de Developpement Pastoral et d'Eleavage de l'Oriental) are being implemented in the eastern regions of Morocco with the support of the International Fund for Agricultural Development. This is an eight-year project. The originality of the new approach consists of granting greater responsibility to local users by using tribal affiliations as the base of cooperative membership and by involving communities in the decisionmaking process (El Alaoui 1997). The major assumption is that building on existing tribal structures provides a stronger base for the project, reduces potential disputes between cooperative institutions and tribal institutions, and reinforces collective action and solidarity among tribal members. Overall, this approach is likely to win the support of tribal members and have higher chances

for success. However, a few constraints have been identified, such as the heterogeneity of local institutions and the neglect of traditional access options.

HETEROGENEITY OF LOCAL INSTITUTIONS. Many types of cooperatives were formed using different levels of social organizations—from the tribe to settlement camps. Difference in membership and degree of organization plays an important role in the effectiveness of cooperative leaders. El Alaoui (1997) noted that the number of cooperative members in 1993 was higher than the number of registered livestock breeders during the 1989 census. In an effort to improve the effectiveness of the cooperatives, the administration decided in 1994 to investigate cooperative composition and exclude all the members who did not meet membership criteria, such as migrant community members, government agents, and private investors.

THE NEGLECT OF TRADITIONAL ACCESS-OPTIONS. The neglect of access options was one of the factors that constrained pastoral systems following the recognition of tribal rights on their territories. In the context of pastoral cooperative systems, it is important to integrate traditional access-options. Moreover, the introduction of pasture-improvement activities adds another complexity to the problem because now range quality does not solely depend on rainfall or climatic changes but also on improvements through investment activities. What are the criteria for granting access to outsiders? Should these access options be based on reciprocal arrangements, or should they evolve and should charging fees for the use of these resources be considered?

Redefining the Rights of Pastoralists: The Rural Code in Niger

The shrinking of pastures following intensification and extension of agriculture renders pastoral activities very precarious. Questions arise, such as the following: How well does the Code secure the resources that are necessary for pastoralists' survival? How can herders be assured access and control over the management of these resources?

Articles 23 to 31 of the Rural Code address the ambiguous issue of pastoral-resource rights by insisting on common access and introducing the concepts of *terroir d'attache* and priority-of-use rights. The code considers pastoral resources as a single resource and grants to all livestock producers "free access" (Article 23) and common use-rights to these resources (Article 24). These provisions are contrary to the situation described in Morocco because the code emphasizes the "openness" of pastoral resources. To correct some of the inefficiencies that may occur under such a system, pastoral communities were granted priority-of-use rights on their grazing areas but have to grant access to water, pastures, and grazing corridors (Article 28) according to customary rules. In addition, to facilitate herd movements, the rural code classifies transhumance routes and grazing corridors as part of state's or community's domain and grant common use-rights to herders, and to livestock owners and breeders. The major shortcomings of this law are the confirmation of the 87-077 decree, the limited ability to exclude other herders, and grants of private property.

CONFIRMATION OF THE 87-077 DECREE. The 87-077 decree, which defined pastures in agricultural areas and granted use rights to herders and managerial roles to village and canton chiefs. In the pastoral zone, which receives less than 200 millimeters of rainfall, this situation did not pose any problem because, in most cases, traditional canton and village chiefs were also the leaders of pastoral communities. As discussed above, however, in areas where chiefs were not from pastoral communities, many disputes occurred following grants of land by chiefs on pastoral areas (Ngaido 1993b, 1994b).

In addition, ethnicity still plays a very important part in the way people perceive resources and ownership. It is rooted in the mentality of many Nigerians that pastoral groups, Fulani or Tuareg, do not and cannot own land. Hence, the mere fact of being a member of a pastoral group undermines de facto herders' possibility to claim ownership rights. These different perceptions and expectations will frame the challenges that will be affecting rural areas and the interaction between different rural actors.

LIMITED ABILITY TO EXCLUDE OTHER HERDERS. Granting common ownership of pastoral resources to all pastoral communities and granting only priority-of-use rights for these resources to local pastoral communities hinders the ability of these communities to effectively regulate or exclude outsiders. Furthermore, by focusing on customary rules of resource access and use, the law does not provide incentives to local communities for managing these resources sustainably, because existing structures lack the capacity to enforce these customary rules. The ability to exclude is even more important when improvements in productivity must come from long-term investments, and leads to the question as to who will be responsible for the cost of pasture improvements.

GRANTS OF PRIVATE PROPERTY. The Rural Code stipulates that, "if their activities necessitate fixed implant on delimited parcels," herders can be granted private property from these parcels if they have customary ownership rights. This provision is a mechanism for sanctioning existing encroachment on common grazing areas for cultivation and will foster more encroachment.

The complexity of tenure issues in Niger, which result from internal dynamics of the traditional tenure-system and changes brought about by government policies, challenges implementing the Rural Code, and the effectiveness of the tenure commissions. The law has its merits, as it attempts to secure livestock production; however, these major shortcomings need to be addressed in the complementary text that is supposed to draft guidelines governing access and use of pastoral resources.

Development of Market-Based Access-Options

Pastoral communities are facing a growing scarcity of their own pastoral resources, which are being encroached upon and used for cropping, and which are being threatened by the breakdown of access options based on reciprocity. It is crucial to determine how reciprocal access-options might be replaced with new options that can sustain livestock production in dryland areas. Many pastoral

communities and individuals are already devising new strategies to cope with the numerous constraints they face by progressively shifting to more market-based access-options and relations. This transformation is, however, very different between Morocco and Niger.

In Morocco, supplementation is becoming very important for pastoral systems because of the lack or degradation of common pastures. Herders and livestock owners are making their own access-option arrangements with farmers or community leaders (Berque 1934; El-Youssoufi 1976). Anoun et al. (1996) found that, among Oulad Fares, small livestock owners used supplementation for four months (September through December), while large owners used supplementation for nine months (April through December). Feeds were either produced or purchased locally. In addition, monetary and "quarter-production" contracts² are becoming the dominant types of grazing contracts between herders and livestock owners. Under the old system of "one-half" grazing-contracts, livestock owners and herders shared production risks. Under present contractual arrangements, however, the risks are completely borne by livestock owners (El-Youssoufi 1976; Anoun et al. 1996). For example, Boughlala, Ngaido, and Nassif (1999) found that, among 14 livestock owners, 57 percent used the one-quarter contract while 43 percent paid cash. As a result, INRA (1995) argues that frequent drought and the high cost of shepherding, together with the shift of collective pastures into individually cultivated lands, have contributed to the development of fattening activities and sedentary livestock-production systems.

In Niger, the major transformation is in access to crop residues. Contrary to the Moroccan case, farmers pay herders to graze on their fields. Direct deposit of manure by herds is an important strategy for improving soil fertility in agricultural fields (Murwira 1995; Bosma, Bengaly, and Defoer 1995). Traditionally, herders had free access to harvested fields because both parties benefited from this activity. Pastoralists had good feed on their way to their own villages, while farmers improved soil fertility. Since the droughts of the 1970s and 1980s, however, farmers are increasingly contracting Fulani herders, who are paid in millet, according to the number of animals and duration, to graze on the crop residues (Gavian 1993; Hopkins, Berry, P. Gruhn 1995). A survey conducted in 1994 by the Land Tenure Center team found that for 105 fields, 7 percent of the cultivators paid cash for animals to graze their fields, 47 percent paid with millet, 30 percent engaged in a some form of tenancy contract to guarantee deposits of manure, and 16 percent used their own herds. Tenancy contracts (30 percent), which is the second-largest mode used by landowners to manure their field, highlights the increasing participation of herding communities in agricultural production.

² Under a "quarter-production" contract, the herder receives one-quarter of the herd production.

Conclusion: How to Better Target State Intervention

So far, new pastoral development initiatives have been centered on introducing new technological innovations and institutional reforms. However, in most cases, these initiatives disregarded

- the production strategies and access options developed by pastoral communities to ensure their livelihood and reduce production risks,
- were divorced from existing socioeconomic and political constraints, and
- focused on narrowly defined “community” resources.

If the future solution of pastoral communities depends mainly on their internal resources, then what are the institutional mechanisms that will ensure the welfare of pastoral communities?

There are two institutional-reform pathways for the development of pastoral systems in dryland areas: privatization and common property. However, for each pathway, the role of the state is crucial and should include pastoral production strategies and various market and institutional access-options, which pastoralists are presently using to sustain their livelihood.

In the case of Morocco, the opportunistic behavior of community members and breakdown of traditional access-options suggest that privatization might be the most desirable pathway. This would be also be the best way to promote the improvement of pastoral resources. For example, Ngaido et al. (1997) found that agropastoralists were making long-term improvements on their tribal lands where they were assured long-term usufruct. Additionally, the Tunisian government, which also recognized tribal ownership rights in the 1910s, has also been pushing for individualization and privatization of tribal properties. It is important to remember, however, that many equity issues need to be taken into consideration during the evolution process toward privatization, and land grabbing for the purpose of establishing a claim may lead to increased degradation in the short term. Another interesting aspect in the Tunisian case that may be applicable to the Moroccan case, is that the Tunisian government has made a provision in the Forest Code that allows communities that still have collective tribal lands to work with Forestry Services on a contractual basis. Under this contract, the community gives the Forest Services the responsibility to improve their common pastures. In return, the Forest Services will control the management and uses of improved pastures and levy an access fee, of which two-thirds will be kept by the Forest Services to recoup the improvement costs. Such provisions have many positive effects on the sustainability of resource use and cost sharing of resource improvements.

In the case of Niger, the pastoral-development pathway will consist of recognizing and granting ownership rights to pastoral communities similarly to those granted in Morocco. Priority-of-use rights, as granted by the Rural Code, will not permit rural communities to effectively manage their pastoral resources, and conflicts between herders and farmers are likely to increase. It is important that complementary texts regarding pastoral resources provide a stronger role to

pastoral communities in the management of their resources and only grants a policing role to the farming communities to reduce land appropriations. If the grazing areas are to remain under the control of farming communities, farmers and community leaders will have many incentives for transforming these lands into croplands.

There is no going back. Pastoral communities are dynamic and have developed various strategies through the years to cope with socioeconomic, environmental and political pressures. Moreover, many traditional institutions have lost their effectiveness. That is not to say they are not relevant, but rather that customary legitimacy as the basis for allocating decisionmaking roles may not presently be desirable to community members. As such, states should promote flexible frameworks that provide more options to community members, because it is unlikely that traditional access-options based on reciprocity could be recreated and made functional solely through legal frameworks.

Moreover, given the individualization of production strategies, the central government's role may be to promote institutions that are likely to be accepted by pastoral communities and enable better interaction among communities, members, and users. In both countries, the central government should promote the development of market relations, which already dominate pastoral transactions, between communities and users. Market relations are also important for the improvement of pastoral resources, because one of the key resource-management issues is the definition of the relations between communities when one of the communities has improved its pastures. Reciprocity may not be the proper mechanism, because only one party is paying for the costs of pasture improvement, while the other is reaping full benefits of improvements. The best way to secure access options and at the same time promote sustainable resource would be to develop market-based access-options, which require users to share the costs of improving or maintaining the resource base.

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12 Experimenting with the Commons: A Comparative History of the Effects of Land Policy on Pastoralism in Two Former Homelands/Reserves, Southern Africa

RICK ROHDE, M. TIMM HOFFMAN, AND BEN COUSINS

The settlements of Leliefontein and Okombahe came into being as a result of the impact of merchant capital and colonial expansion on pastoral societies made up of small, interrelated, kin-based clans. In a number of respects, the unfolding of the effects of colonialism in Namaqualand foreshadowed events in Damaraland by several decades, as waves of traders, mercenaries, missionaries, and displaced population groups pulsed northward away from the Cape. Leliefontein became a Baptist mission station in 1824, and Okombahe was settled by a Rhenish missionary in 1870. Both missions came about as a response to the chaos that *trekboers* (mobile settler farmers), traders, and commando groups brought to the lives of indigenous pastoralists. Weakened by raids, the curtailment of migratory herding practices, drought, and disease, local populations converged on the missions, initially as a place of safety (Leliefontein) or as destitute refugees (Okombahe). There they were converted to Christianity, encouraged to cultivate crops, and often became indebted to European traders. Both populations were made up of a disparate ethnic mix: Leliefontein was predominantly Nama speaking but soon incorporated Afrikaans-speaking “Basters”; Okombahe was predominantly Nama and Damara coexisting with small groups of Baster and Herero.¹

Leliefontein was first given formal recognition by the Cape government in 1854; Okombahe was afforded German “protection” 40 years later in 1894. By the early years of the twentieth century, the control of mission lands had passed to the state: Okombahe became a Native Reserve in 1904; Leliefontein, in 1909. It was not coincidental that such administrative developments accompanied the exploitation of minerals and the appropriation of the most productive land by White farmers in both areas.

During the first half of the twentieth century, communal areas were gradually transformed from refuges of peasant production of crops, livestock, or both to wage-dependent economies in which many households were semi-proletarianized, although livestock farming remained the only viable internal

¹ The Baster surnames of Cloete, Beukes, and Josephs are common to both settlements—the first missionary to Okombahe was a Nama speaker by the name of Cloete.

economic activity. The economic depression of the 1920s, followed by the severe drought of 1930–33 throughout much of southern Africa, put pressure on production by peasants, but because reserve borders were still permeable at the time, communal farmers were able to migrate and exploit grazing on adjacent state or commercial land. During the following decades, livestock numbers soared, as did the reserves' human populations as a result of government policy (South African Department of Native Affairs controlled both reserves), which simultaneously consolidated White-settler farming on reserve borders, but also promoted territorial segregation hand in glove with the migrant-labor system.

Both reserves were governed by Management or Reserve Boards consisting of a number of locally elected representatives and a number of government appointees, the latter invariably having the power to overturn decisions made by the former. Formal rules governing rights of residence and access to grazing were instituted along with various taxes on livestock and on arable and residential land. The details of these arrangements varied between Leliefontein and Okombahe, as did the administrative reforms that were instituted in each reserve from time to time, and yet broadly similar systems were practiced in each reserve.

The Native Affairs Boards, Native Trusts, Boards of Management, and Advisory Boards, which were set up to administer the internal affairs of the reserves, were in effect institutions designed to ensure that the economic development of these areas was in line with the interests of White farmers. The flexibility inherent in early pastoral systems was first undermined by colonialism, but the livestock production systems that evolved under the "tribal" management structures imposed by the state were adapted by reserve inhabitants as a necessary but *useful* parody of precolonial herding and subsistence practices. Throughout the twentieth century, underfunding and overcrowding forced many reserve residents into the wage sector. The little agricultural development that was initiated by the state was tightly controlled, and support services were minimal. It was hardly an accident that communal agriculture in the Okombahe and Leliefontein "reserves" was effectively reduced to a residual, not a subsistence, sector by or before mid-century (Adams and Werner 1990). Neither was it an accident that these communal areas were agriculturally marginal. Both are arid rangelands bordering the desert that skirts southern Africa's Atlantic seaboard. Highly variable rainfall of about 200 millimeters per year² permits extensive livestock farming with a notional carrying capacity of approximately 30 hectares per large-stock unit.³ During the first half to the twentieth century, both

² Rainfall on the Kamiesberg, where the Leliefontein village is situated, goes up to 400 millimeters; however, across the reserve as a whole, the average is closer to 200 millimeters.

³ Stocking rates in Okombahe between 1970 and 1994 ranged from 16 to 100 hectares per livestock unit (an average of 32 hectares per livestock unit); stocking rates in
(continued on the following page)

reserves were very similar in size, population density, socioeconomic conditions, and political structure. In 1947, Okombahe's population had exceeded 2,000 people dispersed across an area of 1,700 square kilometers; Leliefontein had a slightly larger population residing on 1,920 square kilometers.

Significant divergence in the policies that affected the Damara and Namaqua communal areas coincided with the ascendancy of the National Party in 1948, after which Namibia was increasingly treated as a fifth province of South Africa. Coinciding with many of the pernicious and ludicrous laws that this government enacted in pursuit of "separate development" based on race, from then on the Damaras (African Blacks) and Namaqualanders (Coloureds) were to be subjected to different policies based on the assumptions inherent in apartheid ideology. Put very simply, the expansion of communal tenure was thought the only suitable solution for "Blacks" such as the Damaras, while Coloureds, who were considered more "civilized" (whiter) were encouraged to take up commercial farming on "economic units," albeit only within their own Coloured Rural Areas.⁴

Economic Development and Agricultural Decline

Okombahe Reserve, 1947–63

Okombahe Reserve would eventually become one of 12 wards in an expanded Damara homeland, but its 1,700 square kilometers were only expanded piecemeal after 1947, when the reserve boundaries were extended to the north and west, effectively doubling the reserve's grazing-land base. As if to verify that nature abhors a vacuum, several waves of "immigrants" were forced to settle within the expanded reserve around this time. As the human population grew, so did livestock numbers, which also doubled during this period (Köhler 1959). The allocation of rights to these new resources involved a large degree of give and take among livestock farmers. Residence patterns were often determined by kinship, but a large degree of accommodation according to need was practiced. Access to limited natural resources—such as grazing, water, and wetlands for crop cultivation—were in theory open to all. Where conflict over resources arose, the headman and his councilors were responsible for resolving disputes: the internal affairs of Okombahe were to a large extent under the political control of the reserve residents and their elected officials, where a continuity in the

Paulshoek (Leliefontein) during this period ranged from 22 to 72 hectares per livestock unit (an average of 36 hectares per livestock unit).

⁴ Legislation from the early twentieth century was aimed at encouraging the creation of "economic units" in Coloured areas. Attempts were made to strengthen the law in 1963, and again in 1978, although actual implementation did not take place until the 1980s. Unlike for Damaras (who were classified as Blacks), it was not compulsory for Coloureds to remain domiciled within the reserves.

operation of informal institutions was maintained within an imposed formal “tribal” structure.

In 1947 a dairy scheme was also introduced in Okombahe, leading to a rapid growth in cattle numbers; within a decade the livestock and dairy industries became a widespread and significant source of income for Okombahe’s inhabitants. During the 1950s, nearly every family owned cattle and one in three of these sold cream on a regular basis.⁵ Very few Damara men (less than 6 percent) were employed at local mines, but up to 25 percent of men between the ages of 20 and 60 left the reserve as migrant laborers, many of whom reinvested at least some of their earnings in livestock in the reserve.⁶ A combination of factors, including favorable climatic conditions (rainfall averages were almost double those of the previous 30 years), *laissez-faire* internal political control, highly developed marketing networks, and improving opportunities for education and health contributed to the positive advance in Okombahe’s fortunes.

The late 1950s and early 1960s were a watershed for Okombahe’s social economy. Around this time, the Republic of South Africa began a process leading to the full administrative integration of Namibia into the republic and the implementation of “grand apartheid” principles of division and fragmentation.

This process required a deconstruction of the integrated colonial South West Africa. Administration was, at the time, based on a racial division between settler and native but not then on apartheid principles of “ethnic” divisions and fragmentation. It appears that the agricultural effect of adopting apartheid was an almost immediate decline in dairying, crop cultivation, and individual or cooperative enterprise in the reserves (Lau and Reiner 1993).

By the 1960s, Okombahe’s surplus in marketable meat and dairy products was declining and the dependent nature of Namibia’s economy in relation to that of South Africa was more than apparent (Gurirab 1988). The severe drought between 1958 and 1962 decimated the cattle herds of Okombahe—a process that was exacerbated by the rigorous enforcement of pass-laws, the ever tightening restrictions on herder migration to state land, and the final appropriation of surrounding grazing land by White settlers.

These political, economic, and demographic trends meant that “traditional” responses to drought were no longer possible; the focus of social reproduction became concentrated within the village as it became a magnet for the population exodus from surrounding stock posts. Many elderly Damara farmers remember the drought of 1958–62 as a time when they lost all of their cattle. With the col-

⁵ One in every two adults (including women) owned livestock in 1957. Distribution of livestock ownership was relatively even, with the median of 20 large-stock units per owner falling close to the mean of 25 large-stock units per owner. (These data were derived from Köhler [1959].)

⁶ A seemingly disproportionate number of elderly people inhabited the reserve during this time, contrary to the commonly held assumption that this skewing of the population is only a recent phenomenon; in fact it was more prevalent in the past.

lapse of the dairy and livestock industries, goats and sheep constituted the bulk of Okombahe's livestock.

During the next 10 years, the population of Okombahe reserve remained static while the village expanded four-fold to absorb almost half the reserve population. Many of these new villagers had lost their stock in the recent drought and arrived from outlying settlements seeking government work; others were nearly destitute and had nowhere else to turn. These processes of impoverishment and the growth of disparities in livestock ownership that accompany drought and the introduction of a wage or cash economy are similar to those that have been well documented in many other parts of Africa.⁷ The growth of village populations in the Leliefontein reserve were a result of the same processes, many of which had begun several decades before those described for Okombahe.

Leliefontein, Namaqualand, 1940–62

Leliefontein, like its counterpart Okombahe in Namibia, was one of a cluster of several small, fragmented communal reserves. Here in Namaqualand, the Land Settlement Act of 1940 provided grazing licenses to White farmers that were eventually converted to ownership rights. Up until this time, many Whites were little better off than the reserve inhabitants, both of whom had suffered during the prolonged depression (Sharp and West 1984). In 1950 almost 10 percent of Leliefontein's population consisted of Whites (some of whom had immigrated from as far afield as Cornwall and St. Helena) and mixed marriages were common (Leeuwenburg 1972; Sharp 1984). All this would change with the introduction in 1950 of The Group Areas Act, which confined "Coloureds" to the reserve areas, thereby denying communal farmers access to nonprivatized, state land across the reserve borders (Archer and Meer 1995).

Not only did the Group Areas Act result in a dramatic increase in the reserve population as a result of forced removals from other parts of the country, but with the provision of pensions, many retiring Coloured farm workers "returned" to the reserves, often with their families and livestock. This expansion of the reserve population within a limited land base was exacerbated as the new owners of adjacent commercial farms now fenced their land on the reserve boundaries.

After 1950, copper and diamond mining and the fishing industry expanded rapidly, producing low unemployment, "a modest prosperity for most, and a resurgence of the material differentiation within the reserve population which had begun in the nineteenth century" (Sharp and West 1984, 11). Employment opportunities gave both White and Coloured Namaqualanders a chance to overcome the uncertainty attached to farming in a marginal environment with an

⁷ Choosing from a large body of literature on the subject. See, for example Dahl and Hjort 1976; Horowitz 1986; Baxter and Hogg 1987; Glantz 1987; De Waal 1989; Vedeld 1994; Hiernaux 1996.

unpredictable climate. Whites were able to invest capital in commercial farming by amalgamating private farms, while many non-Whites moved off the land altogether. This depopulation of privately owned farms made it possible for Whites to increase the size of individual land holdings, making commercial livestock farming that much more viable.⁸ White commercial farmers often bought second farms in the summer-rainfall Bushmanland region to the west of Leliefontein, or in the succulent rich *sandveld* toward the coast, thereby increasing their management options and effectively mimicking precolonial transhumance herding patterns, a practice that continues today among some White farmers.⁹ The effect of this economic growth on local people who had in the meantime been classified as Coloureds was somewhat different: the continuous process of class differentiation found its most perverse expression in racial separation (Boonzaier 1984), which was objectified in the physical division between private and communal land. The viability of commercial livestock farming was enhanced at the expense of communal farming: newly erected fence lines coupled with a prohibition against Coloureds' farming outside of the reserve meant that from now on pastoral mobility, as a response to drought and seasonal grazing conditions, became increasingly difficult for communal farmers.

The socioeconomy of Leliefontein was similar to that of Okombahe insofar as it depended considerably on migrant labor. It has been argued (Sharp 1984) that, since Coloured people were not restricted by pass-laws and they were not forced back into the reserves from urban areas like many Africans (Hendricks 1997), permanent out-migration from the reserves made it possible for remaining reserve inhabitants to engage in local agriculture. Such out-migration also enabled social relationships of reciprocity to evolve (Sharp 1984), while it freed the reserves from the leveling effects of progressive overcrowding leading to absolute poverty. However, in contrast to Okombahe during the 1950s, many reserve inhabitants did not own livestock. The processes of agricultural marginalization had come to Leliefontein 20 years earlier than Okombahe. Severe drought would be the final mechanism of impoverishment for communal farmers in both areas, but a lack of markets coupled with population growth within a limited and static land base resulted in a steady decline in the economic importance of agriculture in Namaqualand.

⁸ The surveying and allocation of farms in much of Damaraland also took place around this time—the size and the multiple ownership of extensive livestock operations in both areas mimicked precolonial and communal pastoral systems insofar as this enabled seasonal transhumance and migration during drought years. The advantages of the “camp system,” which commercial farming introduced to these arid areas, was that it focused less on the management of grazing resources per se and more on saving on the costs of herding labor.

⁹ More than 40 percent of the farmers on the borders of the Leliefontein communal area also own land in other areas (Archer, Hoffman, and Danckwerts 1989).

At this stage, at the low ebb of communal agricultural production, it is tempting to assume that the fault lies with the communal system itself, rather than with the structural constraints within which communal farmers are forced to live. Up until the 1960s, both reserve areas had been subject to roughly similar conditions and policies. All this changed with the imposition of grand apartheid, when a schizophrenic government implemented a set of opposing policies (ostensibly to address the social and economic problems that had evolved in the reserves)—privatizing the commons on the one hand, expanding the commons on the other.

Land Reform under Apartheid

Contracting the Commons: Economic Units in Namaqualand

The Coloured Rural Areas Act of 1963 gave power to the Minister of Coloured Affairs to radically reform communal land-tenure within the reserves. It was now possible for the minister to unilaterally divide and allocate communal land on the basis of individual tenure to “bona fide farmers,” although this would not happen until the 1980s under even more radical legislation. It was in keeping with the prevailing dysfunctional policy of grand apartheid that this reform should have come at the same time as the publication of the Odendaal Report regarding the creation of “homelands” in Namibia.

Leaving aside for the moment the validity of claims that uncontrolled communal access leads to environmental degradation, the notion that communal tenure itself is to blame for poverty, social conflict, and low productivity is based on flawed assumptions. The function of communal agriculture as an instrument of redistribution—as a medium of reciprocity—was ignored in official thinking. No one seems to have inquired into the actual workings of communal tenure in Namaqualand or to have arrived at the obvious conclusion that the communal system’s greatest weakness was a land shortage. It was simply assumed that the system of community membership that gave all residents access to the commons, even when most of them were not actively engaged in using these rights at any one time, was superfluous to the social reproduction of reserve communities (Boonzaier, Hoffman, and Archer 1990).

Such assumptions were implicit in the legislation aimed at “reforming” the communal land base of Leliefontein (and the other Namaqualand Reserves) in the 1970s and 1980s. Moves to implement such policies were activated in the context of the destabilization politics that underpinned national governance at the time: a clear political interest in privatizing the reserves was aimed at maintaining a Coloured middle class as part of an overall strategy of control by cooption (Marinus 1997). The provisions of the 1963 Coloured Rural Areas Act, its amendment in 1978, and its successor, the 1979 Rural Areas Act, all provided for the separation of residential and agricultural zones and promoted the subdivision of agricultural commonage into privately leased, so-called economic

units. This scheme was first applied in the Namaqualand during 1978 and implemented in Leliefontein during 1984.

Leliefontein was subdivided into 47 farming units ranging in size from 1,500 hectares to 6,175 hectares, 30 of which were rented to individuals or syndicates (Archer, Hoffman, and Danckwerts 1989). The remaining 17 units were set aside for communal use by 230 farmers who had been excluded from the "economic-unit" scheme. The timing of implementation could not have been worse, coming as it did in the midst of drought. As a result of being even more confined to limited grazing, many of the herds of these 230 farmers were decimated.

The implementation of the economic-unit system exacerbated existing class divisions. Those who supported the economic units tended to be the holders of these new units: they were mostly Management Board members and their immediate families, who also happened to be the wealthier and larger livestock farmers. The Management Boards were, on the whole, unrepresentative, incompetent, unaccountable, and unpopular. On the other hand, the supporters of the communal system tended to be the majority of poorer people who were obliged, under the reserve system, to apply to the Management Boards for basic land-tenure rights and who suffered directly from the unfair privatization of common land under the economic-unit system (Archer 1993).

Apart from the technical issue of whether or not the subdivision of communal land actually constituted economic farming units,¹⁰ the social and economic costs to the majority of communal farmers and their families seemed to have been completely left out of the reform equation. No compensation was offered to all those who had lost access to the commons; recommendations that progressive Coloured farmers be given access to land within the White commercial farming areas were also ignored. The result was grossly unfair, technically incompetent, and led to tremendous hardships in the Reserves. Bitter opposition to the reforms finally resulted in a case being brought before the Cape Supreme Court in 1988, which ruled in favor of the communal farmers on a technical point of law. Communal land was officially reinstated in Leliefontein, as well as in other Rural Areas.

The struggle that polarized the Reserve population between those who were for and those who were against the economic units had its origins in a long-standing process of class formation and the destabilization politics of the ruling National Party. It is hardly surprising that such a division should have arisen in circumstances that blatantly favored the advancement of the elite section of the community at the expense of the majority. With the reinstatement of communal land, bitter divisions remained that have yet to be completely re-

¹⁰ These units were in fact far from "economic." Using the Department of Agriculture and Water Supply's own calculations, the size of these units would need to be doubled to be potentially profitable. See Archer, Hoffman, and Danckwerts (1989) for a technical analysis of farm viability in relation to economic units in Leliefontein.

solved by the reform of local government and a redefinition of the democratic structures that will henceforth regulate communal land.

Land policy in the communal areas of Namaqualand has consistently failed to recognize that land has always been used in common and has been open to all community members.¹¹ While control of community membership and access to residential sites and crop lands have been more or less formally regulated by reserve authorities, control over grazing has been left in the hands of farmers themselves. As the reserve populations grew, effectively intensifying grazing resources, the patterns of transhumance narrowed. During the last 50 years, farmers have been more or less restricted to their village grazing areas, ranging in extent up to 25,000 hectares (or approximately the size of a large, White-owned commercial farm). Within this area, farmers practice a variety of grazing strategies ranging from the relatively sedentary, to seasonal transhumance, to more frequent movements between stock posts, water points, and seasonal grazing depending on a variety of complex factors. These include the availability of grazing, water, and labor; changes in herd composition or ownership; seasonal conflicts related to arable crop production; the exigencies of the family life cycle; sickness; employment opportunities; and other factors relating to individuals' personal circumstances.

Up to a point, communal farmers in Leliefontein make collective decisions about the setting aside of grazing reserves or the resting of heavily used areas.¹² While in theory all community members have access to the commons, in practice stock posts are "informally conceptualized by local farmers as a "territory marker" in which the grazing area available to the whole community is divided into loosely defined grazing areas around each stockpost" (Marinus 1997, 70). Cooperative and kin-based networks for herding and stock-post management are examples of how informal arrangements determine the manner in which the land is managed by particular farmers. Social sanctions and controls relating to communal property relations are expressed in deeply held social values and beliefs. These are often based on the need to maintain broad networks of reciprocity and exchange. The ethos underlying such informal systems of resource management reflect an awareness that survival depends on the conservation of the land. While farmers in Leliefontein have successfully resisted the repeated attempts by the state to curtail access to and control over communal grazing, the ability of

¹¹ Membership of the community is automatically conferred through kinship and family. "Outsiders" have become community members after a probationary period with the approval of local authorities. Under the new South African Constitution, rights to reside in the Namaqualand Rural Areas is no longer restricted to formal membership.

¹² The issue of the effective management of grazing resources by communal farmers is addressed at length later in this chapter. However, at this point, it is relevant to point out that farmers are much better at responding to climatic variations and grazing resources governed by "pulse activity" in response to rain than to governments or any other rigid structure of authority.

farmers to conserve their grazing resources has been severely restricted by the scale of the commons.

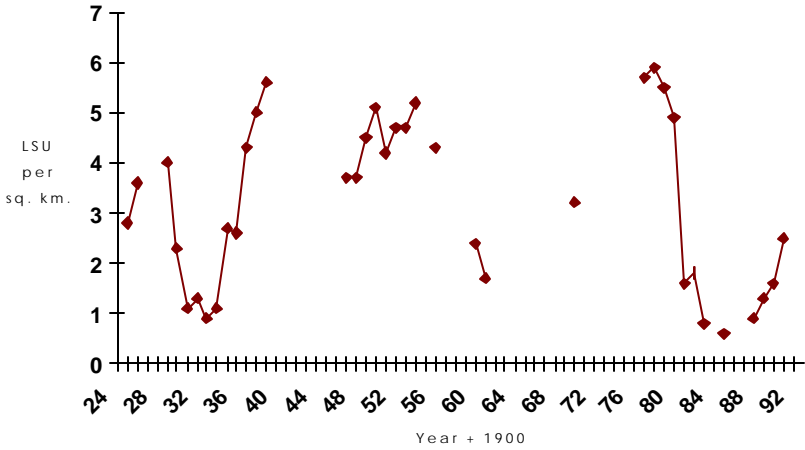
Expanding the Commons: The Creation of Damaraland

The creation of a Damara homeland was proposed during the 1960s as part of the Grand Apartheid scheme and put into effect during the following decade. The Odendaal Report of 1963 formulated the creation of the communal area of Damaraland, an administrative entity equivalent in size and agricultural potential to the whole of the magisterial district of Namaqualand. Two hundred twenty-three commercial farms, most of them only surveyed and settled since the 1930s, were to be bought from their White owners at land values that included generous allowances for improvements. These farms varied in size from 4,000 to 25,000 hectares and were typically extensive cattle and small-stock enterprises depending almost entirely on Black labor. These previously White-owned, commercial farms, comprising an area of nearly 20,000 square kilometers, were amalgamated with existing "Native Reserves" (one of which was Okombahe) and state land, thereby expanding the communal land base by a factor of five (Odendaal Report 1964; Wellington 1967). Bear in mind that this scheme was proposed in the same year as economic units were legislated for in Namaqualand.

Damara farmers began moving into the new "homeland" during the late 1960s and early 1970s. During the early years of resettlement, permits were issued by White commissioners, under the existing pass-laws, which allowed Damaras access to farms on an ad hoc basis. With the abolition of Namibian pass-law legislation in 1976, Damaras willingly "immigrated" or were forcibly resettled here from various parts of the country; what little planning existed was based on trying to disperse the population as evenly as possible by restricting the numbers of farmers at each settlement according to a notional "carrying capacity." No formally codified, "traditional" land-allocation systems were in place, unlike in most other communal areas of Namibia. It took until 1978 to set up a "second-tier authority" in Damaraland and only in 1985 did the Damara Council finally codify the structure of a "tribal authority" in accordance with the ethnic obsessions of state apartheid. In the meantime, informal institutions continued to operate effectively.

During the communalization of Damaraland, the process of establishing settlement rights was nominally carried out through the administrative framework of extension officers working within the Damara Council's Department of Agriculture. In practice, rights of access to land were negotiated on an informal basis, and disputes were rarely taken above the level of the ward leadership. Furthermore, it was common for headmen to consult their councilors and community before granting or denying rights of residence to incomers. Incomers generally gravitated toward farm settlements where relatives already stayed, thereby minimizing social resistance to the sharing of water and grazing. Refusal of applicants was uncommon. Membership of a specific—largely ethnically defined—community, conveyed automatic rights to land (Fuller 1993). In cases

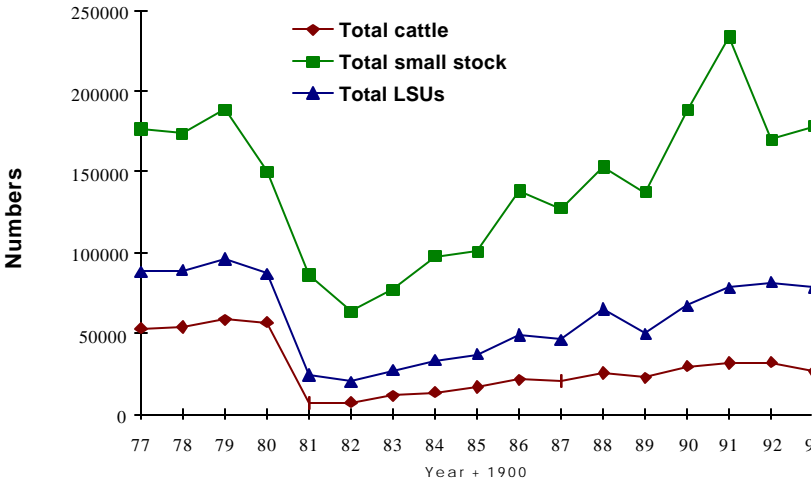
FIGURE 12.1 Livestock population (large-stock units per square kilometer) for Okombahe Reserve, 1924–92



SOURCE: Rohde 1997b

NOTE: LSU indicates large-stock unit.

FIGURE 12.2 Total livestock population in Damaraland, 1977–93



SOURCE: Rohde 1997b.

NOTE: LSU indicates large-stock unit.

farmers to migrate to areas of better grazing in northern Damaraland. In 1994, this pattern was reversed when drought affected northern Damaraland and once again mass movements of people and livestock were accommodated in previously drought-affected areas in the south.

The collapse of Damaraland's administrative structure did not result in a "for-all" open-access regime leading to the collapse of resource management institutions: although rights of access and rights of exclusion were not codified or controlled by formal institutions, they existed. Neither were predictions of imminent environmental degradation, due to the drought-induced migrations of people and livestock, subsequently borne out. Grazing management and boundary regulations were maintained in a flexible, permeable state subject to constant revision. Access to water and grazing were negotiated on an ad hoc basis, with few if any strict rules governing the resolution of inevitable conflicts of interest. In cases where incursions into grazing areas were recurring against the express wishes of the farm occupier, overt violence was rare. While the notion of restricting rights to grazing was commonly expressed by those who had conserved some grazing for their herds, in practice, some form of accommodation was the norm. The result was a pattern of social interaction arising from necessity, shrewd opportunism, hard negotiation, and a large measure of tolerance among farmers.

It is tempting to view these movements of people and livestock across this expanded communal landscape as chaotic—a desperate scramble for scarce resources—and yet something almost intangible seemed to order this fluid process. Communal farmers were able to accommodate substantial influxes of livestock from drought-affected areas with a minimum of conflict and in the absence of strict regulation of pastoral resources. Damaraland might be conceived of as one large farm, supporting more than 33,000 people and 100,000 large-stock units within its borders; the equivalent amount of land in adjacent, privately owned commercial farms supports only a fraction of this human population and produces less per hectare in spite of its higher agricultural potential.¹³

This "do-it-yourself" system has its roots in Damara social order and the exigencies of environmental constraints. It works because it "makes sense" that livestock farmers are able to respond quickly and intelligently to unforeseeable challenges and opportunities (Behnke 1994). Such common-sense management

¹³ The old administrative district of Outjo contains some 330 commercial farms, and its usable farming area is roughly equivalent in size to that of Damaraland, which borders Outjo to the west. (Commercial farms in Outjo District total 24,000 square kilometers; only 46 percent or approximately 19,500 square kilometers of Damaraland is suitable to livestock farming.) Outjo District receives more than twice the average annual rainfall as Damaraland and yet sustains fewer livestock per hectare. In 1993, Outjo's stocking rates equaled 20.5 hectare per large-stock unit, while Damaraland's averaged 20 hectare per large-stock unit. (Statistics were derived from the Department of Agriculture, Veterinary Services Livestock Census 1993.)

is a form of adaptive coping rather than optimization and control. It presupposes a quid pro quo of use rights in marginal nonequilibrium environments where migratory “tracking” strategies depend on the negotiated use of other farmers resources. Such mechanisms are essential to coping with the extreme situation arising out of prolonged drought.

The process of defining boundaries and rights to communal resources by farmers in Damaraland exhibits a certain conceptual and practical flexibility that has its counterpart in other areas of communal life, such as kinship, settlement patterns, economic strategies, and politics. These sociological constructs are lived as a total, whole, and unbounded environment in which expedience and the practicalities of survival are the grounds of improvised action, rather than as rule-bound domains of “social life.”

Discussion

Farming Systems and Control of Grazing

In tracing the parallel and yet divergent histories of Okombahe and Leliefontein this chapter has emphasized those aspects of land policy that have had a direct impact on the ability of farmers to cope with living in an uncertain environment. The many variables that intersect this history make an exacting comparison impossible, but enough similarities of socioeconomic trends and farmer responses to episodic drought, government policy, and economic opportunities exist to draw some broad lessons.

One of the most striking constants that can be observed in Damaraland and Namaqualand throughout recent history is the communal farming system itself, along with indigenous conceptions and practices relating to communal grazing—indeed they go hand in hand. The farming system, based on movable stock posts, is a practical response to herding in a marginal environment. In spite of the state’s tendency to regulate every other aspect of communal life, control over grazing was (and is) almost always devolved to the most local level on an informal basis (see Krohne and Steyn 1991). In the expanded commons of Damaraland, farmers are able to exploit kinship and exchange networks across a much wider landscape than in the Namaqualand reserves. This mobility and geographic interconnectedness reveals an essential facet of social and economic relations implicit to pastoral practice: conceptions of property, rights to natural resources, and flexible notions of kinship are inherently malleable and contested areas of communal life. “Certain critical ambiguities as to who owns what and can go where provide a degree of fluidity which suits everyone’s purpose” (Behnke 1994, 15).

Several different and noncomparable forms of wealth exist in the communal social economy: access to water, housing, land, livestock, kinship networks, commodities, consumer goods, and cash are all “domains of wealth” connected or excluded from commodity “pathways” that structure the whole notion of

property and exchange (Ferguson 1992). However, grazing land is an overarching environmental given, not a commodity in itself—it is a domain of exchange upon which kinship and the cash economy pattern relations of production. Communal-tenure systems in Damaraland and Namaqualand assign different rights to various types of grazing land—to different categories of water points, arable field sites, transhumance routes, trees, riparian woodlands, wet-season pastures, and so on. Different categories of resources are not generally held by a single “ownership” unit, nor are these ownership types territorially distinct; mobility is possible precisely because overlapping and potentially conflicting rights to different categories of resources exist in one area (Behnke 1992).

This pattern of property relations among farmers, and the interrelationships between farmers and their environment generally correspond to a central tenet of complexity theory that posits that such living systems are adaptive, responding to outside influences or internal contradictions. In such systems, selection or learning drives the system toward the edge of chaos. As Stewart (1993, 3) says,

Systems which are too simple do not survive in a competitive environment because more sophisticated systems can outwit them by exploiting their regularities. But systems which are too random do not survive either. It pays in survival terms to be as complicated as possible without becoming structureless.

The expansion of the commons in Damaraland has not only enabled farmers to move across a wider geographical area in response to localized conditions of drought, it has also enabled them to expand existing kinship and exchange relationships across this landscape. The resulting “complexification” of the social matrix—involving flexible, negotiable, and reciprocal rights and obligations—has enhanced the range of coping or survival strategies available to farmers. Leliefontein, on the other hand, illustrates the deleterious effects of oversimplifying the communal system by imposing strict, formal bureaucratic structures of control and trying to make it a parody of private commercial farmland.

Questions of Productivity and Degradation

Several objections to the view of the commons outlined above have become common justifications for policies of reform. Communal tenure is said to result in a degraded environment, low productivity, and the creation of irreconcilable class divisions. Even the most generous assessment of communal tenure in contemporary southern Africa rarely goes beyond the observation that “problems exist to the extent that what is actually present in the Rural Areas is a departure from communal tenure” (Sharp 1990, 15). The definition of such a departure usually implies that the only “real” communal system is one that replicates practices that existed before colonialism.

The same argument also suggests that pastoral practice before colonialism was somehow more environmentally attuned and “sustainable.” The myth of the “balanced community” and the distinction between “stable nature and disturbing

humanity” (Griffiths 1997) is part and parcel of western scientific thought and the ensuing imperial history that created the reserves in the first place. Degradation narratives have clothed colonial endeavors and political agendas all over the world—Namaqualand and Damaraland are no exceptions. The problem has been that imperial science has consistently ignored communal areas, so that very little empirical evidence exists to substantiate such claims, let alone to understand the dynamic ecological relationships between communal farming and “disequilibrium” environments.

Recent studies of environmental history in Damaraland (Rohde 1997b; Sullivan 1997) are consistent with environmental studies of other African communal areas¹⁴ that suggest that the human, livestock, and environmental interactions that evolve within communal systems are often environmentally beneficial rather than the opposite. Studies of Okombahe and similar settlements in Damaraland (Rohde 1997a) found that woody vegetation in such highly stochastic arid environments is “patchy,” even in the absence of intense human impacts. Disturbance in the form of either climatic or human and livestock impacts tends to increase the effects of “patchiness”: resilience in vegetation recovery, recruitment, and regeneration in response to the stochastic disturbance associated with heavy use of vegetation would seem to be a defining characteristic of this environment, up to certain limits. The discovery that these limits are far higher than previously accepted is one of the most important results of this analysis.

One indication of the resilience inherent in the Okombahe’s environment and communal farming system is reflected in the fluctuation of stocking rates, which shows a high correlation to cyclical rainfall patterns. Stocking densities have ranged between less than 1 large-stock unit and more than 5 large-stock units per square kilometer several times during the twentieth century, in response to drought and subsequent recovery. With the expansion of the commons in the 1970s, Damaraland’s communal farmers were able to withstand this century’s deepest and most prolonged drought, recovering to predrought stocking levels within 10 years.

Stocking rates in Namaqualand have decreased by more than 50 percent during the twentieth century and recent studies¹⁵ have concluded that these decreases are directly related to a decline in rangeland productivity, rather than to state policy or market forces. Dean and Macdonald (1994) argue that irreversible degradation has taken place because of overstocking in the past. According to them, stocking rates in Namaqualand have fallen from 4.27 large-stock units per square kilometer between 1911 and 1931 to 1.41 large-stock units per square kilometer between 1971 and 1981. However, livestock data from the communal rangeland of Leliefontein show just the opposite: here stocking rates have risen

¹⁴ Such as Fairhead and Leach 1996; Leach and Mearns 1996; Tiffen, Mortimer, and Gichuki 1994.

¹⁵ See Dean and Macdonald 1994; Milton et al. 1997.

steadily from 2.3 large-stock units per square kilometer in 1890 to 3.8 large-stock units per square kilometer between 1972 and 1987.¹⁶

Ecological research in Leliefontein indicates that some communal rangelands are degraded compared with adjacent commercial farms (Todd 1997; Vetter 1996). Preliminary studies of vegetation change, using repeat ground and aerial photos in Leliefontein,¹⁷ suggest that recruitment and diversity have increased rapidly on destocked commercial farms during the last 30 years, while the communal areas have remained relatively static in terms of vegetation cover, diversity, and livestock productivity. If Namaqualand's communal farmers had been given access to an expanded commons, recruitment of palatable plants (similar to that which occurred on the destocked commercial farms after they were fenced during the 1950s) probably would have increased as a result of fallow periods made possible by increased mobility.

Policies of confinement have resulted in patchy environmental degradation, where palatable perennials have been replaced by weedy annuals and toxic perennials, especially in overgrazed, continuously stocked village pastures. The cumulative effect of land policy in Namaqualand has been to severely restrict the ability of farmers to move during times of drought, thereby enforcing sedentarization. Property relations have become objectified in rigid, communal farm-boundaries and formal, village-based institutions of resource control. While this can be seen as an expedient response to the confinement of relatively large human and livestock populations in a marginal environment, it has curtailed the ability of farmers to reduce risk, leading to increased poverty and the exacerbation of social divisions.

Questions of Productivity and Equity

When critics of communal land-use raise the specter of "lost traditions" (Sharp 1990; Hendricks 1997), they are forgetting that such "traditions" arise directly out of real social and physical conditions, and not out of some imagined past situation. Communal tenure is a "natural" response to the high transaction costs inherent in controlling low-productivity, marginal environments. The example of Damaraland is a case in point. Here is a group of people who were defined by apartheid as ethnically residual precisely because of their perceived lack of traditions but who, when they were thrown together in a newly expanded commons, quickly created appropriate "traditions" of leadership, pastoral practice, and resource management (Rohde 1994; Sullivan 1996, 1997).

The attempt in Namaqualand to promote economic units, apart from its obvious class bias, was premised on assumptions about the relationship between

¹⁶ Data were derived from Leeuwenburg (1972) and Simon Todd (through personal communication in 1997).

¹⁷ From research being conducted by R. F. Rohde as part of the Global Change and Terrestrial Ecosystems project's Global Change and Subsistence Rangelands of Southern Africa—Paulshoek Project, 1998.

ownership and productivity. What is often ignored in the analysis of communal productivity is the social function of livestock, and the economic context in which communal farmers live. Many communal economies have been reduced to a subsistence level, where livestock and livestock products are integral to people's survival but are not easily computed in cash terms. The few detailed studies that have quantified the use value of communal livestock show that communal farming is far more productive than previously thought.¹⁸

Until very recently, even critics of the failed economic-unit policy were wondering whether land reform should promote "a revamped version of communal tenure or a renewed attempt at individualisation" (Hendricks 1997, 56). The premises that underlie such questions are often concerned with the historic development of class divisions within the Namaqualand reserves. Conflicts of interest between large and small livestock farmers are not inevitable—the same processes of class formation existed in Okombahe, but there, in an expanded commons, the interests of both large and small farmers converged around common interests. In Damaraland, when the transaction costs of communal farming outweigh the risks involved in buying a private farm, the wealthiest communal farmers leave the commons. The farmers with large herds who remain in the communal areas are often the spokesmen and -women who champion the cause of their poorer neighbors. Wealthy farmers are employers, entrepreneurs, politicians, and businessmen. Without them, the rural population might be reduced to an even more impoverished residual category. It is not the communal reserves where disparities of wealth and class divisions are critical; it is in the postapartheid society at large, where inequality frames the conditions under which the poor of the communal areas survive.

Land Reform and the Future

Land reform is on the political agenda once again: both Namibia and South Africa are actively involved in seeking ways of transforming the socioeconomic legacies of apartheid through a restructuring of land ownership. A National Land Reform Conference was convened in Namibia shortly after independence in 1991 and resolved to work within the terms of the constitution to bring about just redistribution of private land and to retain the principles of communal tenure in the former homeland areas. Since then, very little has taken place in the way of legislation. Draft reform bills addressing communal land suggest that Namibia will follow the model of Botswana and create a number of (tribal) land boards that will function as the tools of central government to control communal tenure and resource use. This formalized regulation of communal land on a national basis is likely to be insensitive to local social, economic, and environmental variations; in this way, an opportunity to strengthen local government and grassroots democracy will be lost. Draft legislation also provides for the

¹⁸ See Lane 1991; Maddox, Giblin, and Kimanbo 1996; Scoones et al. 1996.

granting of 99-year leases at the discretion of the central-government ministers. This will have the effect of privatizing significant tracts of communal land. Such “reforms” are being consolidated under much the same alliance of interests as that of the old regime: the conservationist or environmental lobby, bureaucrats and planners, politicians, and the elite all have an interest in controlling the use of communal resources. The hegemonic discourse continues.

In contrast, South Africa has moved quickly to institute wide-ranging legislation on land reform, within which land-tenure reform aims to provide legally secure forms of land rights with a variety of options as to what form these rights take—ranging from fully individualized, to strong group, systems of tenure. New legislation is being drafted that will create strong, protected rights on land that is nominally state owned, with the option that full ownership may be taken if a legal entity is formed to hold land. In group systems, these rights will be vested in the people who are the holders of land rights, not in institutions such as local or tribal authorities, and give to those rights holders the power to choose which bodies they wish to administer their rights (for example, in land allocation procedures). This policy, if implemented, has potentially major implications for the administration and management of communal land.

Presently, communal Namaqualanders have two basic routes to transforming the status quo with regard to land. One option open to individual villages in Leliefontein is to create a network of communal property associations (CPAs) under the Act of 1996, which will in effect give each small community ownership rights over its land and control over membership and resource use. While this might enable communities to share grazing and other resources through formal channels (for example, in times of drought or for purposes of establishing seasonal migration patterns), such arrangements might tend to become bureaucratic and contentious as the need for flexible grazing patterns asserts itself over formal “ownership” boundaries. Another danger is that the formal rules created under the CPA legislation will be ignored as informal patterns reassert themselves in favor of powerful interest groups. However, these are not inevitable outcomes. Given the strong rationale for sharing grazing territories, it is surely not beyond local decisionmakers to agree on flexible grazing patterns, effectively making the CPAs strong vehicles for local democracy and thereby preventing the imposition of outside bureaucratic control.

The other option is through the Department of Land Affairs’ policy on commonage, under which local authorities in Namaqualand are applying for additional common land. Commercial farms on the borders of Leliefontein are in the process of being purchased for this purpose. Part of the criteria for securing such additions of commonage is the agreement on a management plan between the local authority and the “community,” with the stipulation that such land will not be used for settlement. Impending legislation that will transform local government structures makes this process somewhat uncertain, as does the difficulty of defining a “community” of interests among the various villages of Leliefontein. However, apart from this, the thrust of the policy is one that is in danger of

being usurped by the proponents of the old idea of economic units. In spite of the intention that additional commonage should benefit the poorer, disadvantaged members of the community, the prohibition on settlement and the necessity for contractual leases and management agreements mean that larger, wealthy farmers will be in a much better position to take advantage of this opportunity. Under such a scenario of “born-again economic-units,” there is little possibility of achieving the critical scale necessary to creating a dynamic, self-regulating, expanded commons, however, the process is at present a “terrain of struggle,” and the final outcome remains, for the time being, an open question.

At the time of writing, we, the authors of this chapter, remain hopeful that the eventual creation and management of an expanded commons will be based on broad democratic principles aimed at the resolution of disputes and conflicts, rather on rigid, top-down rules and regulations. However, a strong bias inherent in the planning and development process tends toward the atomization of the commons into small, easily administered units controlled through formal rules that limit stocking rates and tenancy arrangements according to a notional carrying capacity: a rebirth of economic units. Instead, we would support a more egalitarian, decentralized, flexible institutional order based on access to an expanded commons. In such a scenario, the modern democratic state becomes an essential ally in this process only to the extent to which it acts to enable and facilitate the process of majority (local) decisionmaking in order to ensure equity and transparency in the (local) control of communal land.

On Sustainability

Most, if not all, contemporary debates about common-property rights, pastoral risk-reduction strategies, and livelihoods center on the effects of pastoral–environmental interactions, and are predicated on an ideal of sustainability. In presenting this case study of the effects of expanding or contracting the commons, we have followed this pattern. While this presentation of the empirical evidence (such as the analysis of stocking rates, productivity, climate and vegetation change, social and cultural processes, and farming practices) has many gaps, and much work remains to be done in substantiating the environmental history of Damaraland and Namaqualand, we would also support the contention that explicit knowledge and rationality are insufficient tools for the sustainable management of ecological relations (Hornborg 1996). The human imprint on the natural world is so deep “that we must confront the awkward reality that we may search in vain for a recognizable and definable state of nature” (Beinhart and Coates 1995, 3). Human knowledge of the “natural” world is neither a representation of something that exists outside the human species, nor merely a social construction—it is a negotiated relationship based on meaning (rather than fact), which actually reconstructs nature in the process of representing it. We argue, therefore, that localized, embedded, and decentralized social systems are better suited to regulating local ecosystems sustainably than the global economy or its

instrument, the state, although we recognize that global and state structures interpenetrate the local in complex and inevitable ways.

The concept of the ecosystem is not simply descriptive, “it is also “performative”; the ecosystem concept and actions informed by it are “*part of the world’s means for maintaining, if not indeed constructing, ecosystems*” (Archer 1990, 69 [italics added]). Understanding the people and their environment in places like Leliefontein or Okombahe might best be conceived of in terms of performances, and seeing these performances as embedded in social relations rather than in terms of “systems of knowledge” or human nature dichotomies. We wish to stress that environmental knowledge is as much to do with the “physicality of “living in the world,” the interlocking *habitus* of action, belief, experience, engagement” (Bender 1993, 248) as with anything that we identify as objective, empirical, or disembedded.

While we believe that research into human ecology and environmental history is relevant and urgent, we also believe it is time for the debate to become somewhat more reflexive about the effects that researchers’ attempts at conceptual encompassment have upon local meanings and ecological resilience. The danger is that normative statements of what constitutes environmental sustainability will usurp the place of apartheid ideology. One way of avoiding this is to recognize the sheer complexity and specificity of fluctuating ecosystemic interrelationships, while at the same time conceding that optimal strategies for sustainable resource-management are best left in the hands of those who have direct and long-term experience of a specific environment and with a special stake in the outcome. We have tried to show that the goal of expanding the commons to increase complexity, and at the same time devolving decisionmaking over the management of common land to the lowest possible level, is a more effective and sustainable policy option than attempting to impose regulatory control-systems based on highly formalized definitions of property rights and decontextualized models of ecosystem dynamics.

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13 Niger Case Study

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The purpose of this chapter is to describe preliminary results in the attempt to model the linkages between property rights, risk, and livestock development in Niger. Rainfall variation is often identified as the major environmental risk faced by agropastoralists (for example, Swallow 1994). Among the many risk-management strategies that are identified, livestock mobility is seen as one of the most valuable by agropastoralists (for example, Fleuret 1986; Painter, Sumberg, and Price 1994; Swallow 1994; van den Brink, Bromley, and Chavas 1995). Sivakumar (1989) and Sivakumar, Maidoukia, and Stern (1993) show that one of the major climatic characteristics in Niger is rainfall variability and the recently increased frequency of droughts. In Niger, land tenure consists of a mix of quasi-private and common property, enabling both fixed agricultural production and mobile cattle raising.¹ Nevertheless, the combination of population increase, low and variable rainfall, and a changing institutional environment creates stress on land-tenure systems.

Since 1993, the Niger government has been implementing a new rural code that should redefine the access, use, and management of natural resources in Niger (Secrétariat Permanent 1993, 1997). This calls for a clear understanding of how environmental variability, and the use of land for agricultural and pastoral activities, must contribute to a definition or redefinition of land tenure in Niger. The purpose of the modeling exercise that is envisaged is therefore twofold: to contribute, using quantitative methods, to the common rangeland and mobility debate; and to contribute to a better understanding of the situation in Niger—a prerequisite for developing changes in the land-tenure system that benefits all users.

This chapter includes a short review of the literature specific to Niger; a description of observations made in the study area; and a preliminary, reduced-form econometric model, which is presented for discussion purposes.

Property Rights, Livestock Development, and Risk: A Short Introduction to the Situation in Niger

Property rights, livestock development, and risk form a nexus the untangling of which may seem artificial. However, this untangling can be begun by separating

¹ A general description of Niger and of the work area is in Chapter 5.

property rights and livestock development as they relate to risk, so that their linking element in Niger—namely, livestock mobility—can be identified.

Property Rights and Risk

Land tenure in Niger is under stress. A first source of stress is the changing natural and demographic environments, while the second source of stress comes from political changes.

A FIRST SOURCE OF STRESS: THE POPULATION–ENVIRONMENT NEXUS. Land-tenure systems mediate the relationship between humans and the resource (Schlager and Ostrom 1992). Once this relationship is under stress, the mediating institution is also under stress. For instance, Grégoire (1982) shows that the increase of population led to an increase of cultivated area in the village of Gourjae (in eastern Niger). This change put stress on the local land-tenure system and led to an adaptation of pastoral practices and the creation of rainy-season livestock-corridors, thus changing some of the rules regarding land use.

When population increase occurs in an area prone to drought and desertification (Arrignon 1987; Agnew 1995), it may lead to further degradation of the land-resource base. The increase in population, when combined with the decrease in the land-resource base in terms of quality, leads to greater relative and absolute scarcity of agricultural land. Agriculturalists claim more agricultural land, pushing pastoralists onto highly fragile marginal land.² The effect of the population growth in the semi-arid areas of the Sahel has been exacerbated by a trend of increased rainfall variability and a decrease in absolute rainfall quantity. Comparing the long-term average rainfall before and after 1969 shows that the 400 millimeters isohyet (which corresponds to the limit of the area where rainfed agriculture is possible on a regular basis) moved from the 15th parallel to the 14th (Sivakumar 1989). This pattern is also accompanied by an increase in variability, which has led to changes in agropastoral and pastoral practices. Under increased environmental variability, pastoralists and agropastoralists may increase their level of mobility while decreasing herd size (see, for example, Amanor 1997; Amoukou et al. 1996; Banouin et al. 1996).

A SECOND SOURCE OF STRESS: CHANGING POLITICS. The impact of colonization on agricultural land-tenure has taken several forms. The use of local authorities by the British colonial administration to exercise an indirect control over land led to a weakening of traditional structures (Berry 1992), sometimes because of their “reconstruction” (Cheater 1990). The nationalization of the *terres vacantes et sans maître* in Francophone coastal West Africa and the French colonial administration’s subsequent dedication to cash-crop production is another instance of deep transformation imposed by the colonial power. Nevertheless, the impact of the French rule in Niger on agricultural land-tenure is not very important. This can be explained by the fact that Niger, because of its unfavourable

² See Cleaver and Schreiber 1994. For detailed Nigerian case studies, see Colin de Verdière 1995; Banouin et al. 1996.

avorable environmental conditions, was only seen as a reservoir for labor. In Niger, land was a secondary concern for the colonial power (Raynault 1988).

It is difficult to assess the impact of the colonial rule in Niger on rangeland tenure; however, the colonial power had an important impact on pastoralists' traditional structures. For example, the social organization of the Twareg Kel Dinnik pastoralists, mainly based on slavery, went through deep transformations. From vertically integrated socioeconomic structures, able to withstand important environmental variation, a shift occurred toward smaller-scale and riskier cattle raising (Starr 1987). It seems reasonable, therefore, to believe that this decrease of resiliency to poor rainfall realizations may have led to a greater reliance on livestock mobility for managing environmental risk.

Originally, land tenure in Niger's agropastoral area was characterized by the existence of three different types of tenure status. Up to the time of independence, landowners—composed of aristocratic and warrior families (village chief and their lineage, and canton chiefs and their lineage)—held a primary-ownership right. They could allocate land and receive tithe payment. Their control over land was attributed to the fact that they were members of the families who arrived first on the land considered. Use-right holders formed a second group. Having a secondary-ownership right (they received land from the village and canton chiefs), they had to pay tithes. Their use right was secure and could be inherited by their children. A third group was formed by tenant farmers renting fields, who were vulnerable because the owner could reclaim his field at any time (Ngaido 1993).

Following independence, the first regime (Hamani Diori, 1960–74) abolished tithe payments and recognized customary ownership. This created two classes of land owners. The first was nobles and aristocrats, who saw their customary rights recognized and therefore could alienate land in their possession. The second was the use-right holders and tenants who, through the suppression of the payment of the tithe, were considered *de facto* owners (nonpayment of the tithe being the sign of ownership) but who could not alienate or divide their land (Ngaido 1995). It must be noted, however, that a majority of tenants and use-right holders continued to respect their traditional obligations and were therefore not considered as owners.

The second regime (Seyni Kountché, 1974–87; and Ali Saïbou, 1987–90) introduced a policy of “land to the tiller” that was supposed to increase tenure security to use-right holders and tenants. However, this policy was not supported by any legislation (Ngaido 1995). Again, many use-right holders and tenants kept on paying the tithe—asserting, therefore, the fact that they were not owners (Lund 1996). Following the demise of Kountché's military regime, traditional landowners began to reclaim land that was lost during the land-to-the-tiller policy period; their task was facilitated by the lack of legal framework supporting this policy.

The final result of these successive reforms was a confusion in terms of land tenure, generating tension and increasing conflicts over land tenure (Ngaido

1995). Presently, while an initiative (the Rural Code) to redraft legislation related to land tenure is being implemented (or stalled, according to some—for example, Gado 1996), village and canton chiefs remain de facto the principal authorities regarding land-allocation decisions; customary tenure arrangements still prevail (Gavian and Fafchamps 1996). In terms of tenure security, owners and use-right holders can be considered as having secure tenure over land, while tenants always face the risk of losing their fields.

In terms of rangeland, since 1959 Niger has been divided into two areas. One being where agricultural activities are theoretically mostly prohibited, the *zone de modernization pastorale*; the other, where agricultural and pastoral activities are supposed to coexist, the *zone agropastorale*. Most of the following paragraphs concern the *zone agropastorale*, which encompasses all of the geographical area where the present research has been conducted.

Rangeland consisted, up to independence, of uncultivated areas under the control of the village chief (fallows) or canton chiefs (land that had never been cultivated). These lands were considered as *terres de chefferies*. Under the Diouri regime, these lands were nationalized if they had never been cultivated in the past or were considered as common village land when they were fallow (Ngaido 1993). Under the Kountché regime, the nationalization of virgin land was confirmed, while the status of fallow land was left unclear. After the Kountché regime, more rangeland was allocated to farmers (for cropping) by village chiefs. This allowed the traditional authorities to assert their “traditional right” over these lands (Ngaido 1993). It must be stressed, therefore, that at the present time rangeland is under the control of groups with a strong agricultural tradition.

Concerning present use, during the rainy season any uncultivated land can be used as pasture land (although it is not necessarily used as such). During the dry season, all fields are open to “anyone in the world” for grazing on the residues (Williams 1997). This illustrates the fact that property or use rights are defined seasonally (Ngaido 1993). More recently, concerns have been raised about the impact of development policies on land use and land allocation to rangeland. An example of development policy that has been under scrutiny is the *terroir* approach. This approach to land-use planning by development projects has, in recent years, been favored by French development agencies and by governments of former French colonies in the Sahel (Elbow 1996). The concept of *terroir* is originally an analytical unit describing the physical space on which sedentary villagers get most of their means of subsistence. This analytical unit is now used as an intervention unit in a drive to give rural communities greater responsibility in the management of their resources. Although it may be early to assess the impact of the *terroir* approach on land tenure, some elements need to be highlighted here. Because it has essentially been used as a concept linked with sedentary agriculture, the concept of *terroir* is not compatible with highly mobile lifestyles (Painter, Sumber, and Price 1994; Marty 1996). The exclusion of mobile populations from the current mainstream development paradigm may risk contributing to a further transformation of land-tenure arrangements that

were traditionally adapted to mobility (existence of corridors for transhumant livestock, for example).

The current situation of land tenure in Niger can be summarized by saying that it is characterized by the existence of traditional tenure arrangements that are facing challenges posed by population increase, by unfavorable changes in climate, and by the changing political environment. The tenure system seems to be shifting, a priori, from one geared toward an equilibrium between pastoral and agricultural activities to one geared toward agricultural activities. This is mainly attributed to an increasing relative and absolute arable-land scarcity combined with a growing importance of agriculturalists in the local political sphere. Following the droughts in 1973–74 and in 1981–82, pastoralists lost most of their cattle through death or sale to other segments of the population (White 1987; Habou and Danguioua 1991). Marginalization of pastoralists in terms of land tenure occurred, therefore, in particularly difficult times.

If land tenure in Niger were analyzed in terms of the rights and duties associated with the tenure system, the situation could be summarized as presented in Chapter 10, Table 10.1. The bundle of rights associated with the use of land is defined seasonally and involves actors at different levels. Table 10.1 shows that a mix of private property, common-pool resources, and open-access resources.

Livestock Development and Risk

While livestock represented a major contribution to Niger's economy in the past, the successive droughts as well as the influx of money due to the "Uranium Boom" of the 1980s somewhat reduced this importance up to the mid-1980s. Recently, following the "Uranium Crash" and the progressive diminution of cash crops, and because of political instability in areas normally visited by tourists, the relative importance of livestock has been growing steadily (Colin de Verdière 1995). Livestock development in Niger is nevertheless facing a series of challenges that will be briefly reviewed hereafter:

MARGINALIZATION OF PASTORAL SPACES. As Colin de Verdière (1995) demonstrated, the gradual colonization of pastures by agricultural activities has a multiplicative effect. First, areas that were traditionally suited for pastoral activities disappear and are replaced by fields. Second, because these areas are not ideally suited for agricultural activities, the area cultivated needs to be quite large to achieve the production objectives of agriculturalists. This has the double-negative effect of pushing pastoral activities onto highly marginal land and of preventing herds from being as mobile as in the past.

TRANSFER OF LIVESTOCK OWNERSHIP. As White (1987) and Habou and Ganguioua (1991) have shown, the successive droughts in the past 25 years has led to a transfer of ownership from pastoralist groups to groups not historically practicing pastoral activities (merchants, government officials, and agriculturalists). This transfer of ownership led to a situation where ethnic groups having an expertise in pastoral activities ceased tending herds composed of their own animals. This may have shifted their incentive for managing the pastoral resources,

and diminished autonomy in making decisions about managing rangelands. Furthermore, the arrangements between absentee owners and livestock keepers (payment in kind, or in money, for the services rendered) did not allow pastoralists to reconstruct their herds.

While the secondary sources reviewed up to now enable a general understanding of how property rights, risk, and livestock development interact in Niger, recent detailed information is missing. More crucially, very little exists on the development nexus, for agropastoral production systems, of property rights, risk, and livestock. While often pastoral production and agricultural production are viewed as mutually exclusive, in the consideration of agropastoral production systems, these activities must be considered as complements. Before a model is developed, therefore, it is important to understand how these interactions occur in the field. The preliminary results of community surveys that were conducted are presented in the next section.

Property Rights, Livestock Development, and Risk: Community Surveys

Survey Procedure and Sample Description

A stratified sample of 40 villages was selected. The stratification criteria were average annual rainfall and rainfall variability. To minimize soil variations, all villages were chosen on the edge of the continental shield between 12 degrees, 30 minutes north, and 14 degrees, 30 minutes north, and between the second and the fourth eastern meridians. Villages were selected near meteorological stations for which rainfall data were available from 1990 to 1996. Seventeen meteorological stations had all monthly data for the period considered, while 11 needed the interpolation of a minority of their monthly data (Table 13.1). When necessary, monthly rainfall were interpolated using the iterative polygon method as described in Morel (1992).

PARTICIPATORY MAPPING. In each village, community-level interviews with key informants (village chief and their advisors) were conducted. The participatory mapping consisted of the community members' progressively drawing in the sand the village land, including the location of fields, pastures, water, and areas of particular geographical interest. While the different elements of the map were identified, questions were raised regarding their use and eventually their management. The participatory mapping contributed to the building of a healthy relationship between investigators and subjects, as well as to a common understanding of the research theme and objectives. The next step consisted of a field survey conducted with the village chief, his representative, or both.

RESOURCE ASSESSMENT. Following the participatory mapping exercise, a precise determination of the village land boundaries and an assessment of the village's grazing resources were conducted. The preparation of this field survey consisted of the preliminary identification of the different geographical units of the village land using a 1/50,000 base map.

TABLE 13.1 Meteorological stations used and nearby one or several of the villages surveyed

Meteorological station	Longitude (degrees, north)	Latitude (degrees, east)	Average rainfall (mm)	Rainfall standard deviation (mm)	Rainfall coefficient of variation (percent)	Some data needed interpolation?
Ballavara	13.77	2.07	458.0	61.0	14.1	No
Beylande	12.75	2.87	614.2	156.1	25.4	No
Birni N'Gaoure	13.08	2.9	518.6	100	19.3	No
Bolbol						
Goumande	12.97	3.55	638.4	136.6	21.4	Yes
Bonkougou	14	3.07	475.1	122.8	25.8	No
Chikal						
Chinyasu	14.42	3.43	392.2	109.5	27.9	No
Damana	13.9	3.07	437.3	78.4	17.9	Yes
Dosso	13.02	3.18	586	161.7	27.6	No
Falouel	13.52	3.58	575	136.6	23.8	Yes
Fillingue	14.38	3.32	363	136.9	37.7	No
Goube	13.87	2.08	418	55.8	13.3	Yes
Guecheme	12.92	3.88	648.8	194.9	30	No
Hamdalaye	13.55	2.4	481.3	37.2	7.7	Yes
Harikanassou	13.18	2.83	500.3	88.1	17.6	Yes
Kara Kara	12.8	3.63	702.5	125.9	17.9	No
Kolo	13.3	2.35	533.5	96	18	Yes
Kore Mairoua	13.33	3.95	538	98.8	18.4	No
Koure	13.3	2.57	450	111.5	24.8	Yes
Loga	13.6	3.23	525.3	91.4	17.4	No
Moko	13.16	3.27	529.9	147	27.6	Yes
Ouallam	14.23	2.08	436.8	110.5	25.3	No
Sadore	13.23	2.28	552	122.2	22.1	No
Say	13.1	2.35	552.1	167.6	30.4	No
Simiri	14.13	2.13	340.5	85.3	25	No
Tessa	12.77	3.4	634.2	201.9	31.8	Yes
Tibiri	13.1	4	585.1	163.6	28	No
Toukounous	14.5	3.28	334.7	114.3	34.2	No
Yeni	13.43	2.98	556.5	133.8	24	Yes

When research-team members could be physically present on the village land boundaries, they recorded the location of the boundaries (under digital format), using a 12-channel global-positioning system. The boundaries were also recorded by drawing them on an overlay to the 1/50,000 map. When physical presence on the boundaries was not possible because steep hills or ravines, the base map was used to interpret the information given by the village chief before the borders were drawn on the overlay.

The resource assessment consisted of a survey conducted for each of the geographical units that was identified during the field-survey preparation. For each geographical unit, the following information was geo-referenced and was visually estimated: proportion of fallow, bush, cultivated, and barren land; millet density on cultivated fields; species composition (three dominant species) for the herbaceous layer and species composition for the tree layer (three dominant species); and level of grazing on the pastures. The maps were digitized and stored using a geographic-information system. For each village, the mapping exercise in the fields is currently supplemented by a visual interpretation of satellite images (Spot multi-spectral). This ultimately allows a scoring of the different grazing areas.

GATHERING OF SOCIOECONOMIC DATA. Once the field survey was completed, group interviews were conducted to gather socioeconomic data. Some descriptive statistics of the sample communities surveyed are presented in Tables 13.2 and 13.3. The community surveys in their totality took 1.5 to 4 days per village. The duration of the research team's stay in the villages had a major impact: namely, increasing the reliability of the data gathered.

LIVESTOCK-PRICE SURVEY. A separate livestock-price survey was conducted in 10 markets that were identified during the community surveys. Each market was visited six times during a 12-week period. Small ruminants were weighed, and girth measurement was taken from cattle to estimate their liveweight. The physical conditions of cattle were scored using the method explained in Nicholson and Butterworth (1986).

Property Rights and Mobility in the Survey Area

PROPERTY RIGHTS. Regarding agricultural land, the pattern that is described earlier applied to all the villages that were surveyed. Regarding rangeland, the situation was a bit more complex. While access to rainy-season and dry-season pastures was considered open by all the communities surveyed, some of them managed to reduce this access through the enclosure of pastures with fields, or through the enclosure of watering points. The informants of 25 villages reported that the pastures of the village were not used by neighbors during either the dry season or the rainy season. The only outsiders that were reported in these villages were transhumant herders during the early and late dry season.

In the villages where rainy-season pastures were actually used by neighbors, their contribution to the total stocking rate rarely exceeded 10 percent.

As

TABLE 13.2 Descriptive statistics of the sample of communities surveyed

	Average	Median	Standard deviation	Minimum	Maximum
Age of the settlement (years)	212	150	159	40	700
Number of household	99	83	68	20	307
Size of the village land (square kilometers)	22.69	20.79	21.52	1.21	104.69
Household density (households per square kilometer)	8.72	4.43	9.33	0.83	42.61
Millet production per household (bundles—bundle weight between 16 and 25 kilograms)	173	150	121	30	500
Distance to regional livestock market (kilometers)	35	32	23	1	79

TABLE 13.3 Descriptive statistics for livestock holdings in the sample of communities surveyed

	Average	Median	Standard deviation	Minimum	Maximum
Proportion of households engaged in cattle raising (percent)	57	55	31	7	100
Proportion of households engaged in sheep raising (percent)	83	100	26	0	100
Proportion of households engaged in goat raising (percent)	84	100	25	0	100
Cattle holdings	1,130	380	2,220	10	10,000
Sheep holdings	1,043	500	1,423	0	6,000
Goat holdings	1,680	1,000	2,620	0	15,000

for the exercise of a management right on the pastures, no village reported such a practice. However, one of the most obvious management practices, the exclusion of outsiders, is not considered as proper behavior and manifests itself rather informally (see Turner 1998).

MOBILITY. Of the 40 villages surveyed, a majority (25) had part of their livestock away from their village land during some part of the rainy season. The results of the surveys can be used schematically to represent the pastoral action-space of a community (Figure 13.1). First, there is the village land corresponding to the French concept of *terroir foncier* (Le Bris 1982). The land encompassed in the *terroir foncier* is under the jurisdiction of the village chief. Decisions regarding land use are taken at the individual level (short-term fallow) and at the village-chief level (long-term fallow). The quantity of rangeland available on the *terroir foncier* will, therefore, be the result of decisions at the household and community levels. Outside the village land, village members have access to any pastures of the “outside” world. This, of course, is at the cost of labor to keep the animals and at the cost of the sometimes increased risks of livestock losses. The rationale for range use and its timing in the outside world is a function of the distance separating the pastures that are used and the village.

Daily movements to pasture shared with other villages in the direct vicinity occur generally during the rainy season. These pastures were often situated on plateaus bordering the village. These daily movements are justified by the need to have the animals graze in a place where they do not interfere with agricultural production. These pastures can be under the jurisdiction of a nearby village or under the jurisdiction of the *chef de canton* (district chief). No communities reported negotiating access to these pastures.

Short-term movements (those of less than one month) to pasture areas less than 50 kilometers away occurred generally (but not necessarily every year) toward the end of the dry season. When the rainy season started early in areas less than 50 kilometers away, livestock could be sent to graze in these areas. Access to these pastures can be negotiated or not. In the research sample, negotiations occurred in cases where the destination area was under the jurisdiction of a traditional Fulani encampment area.

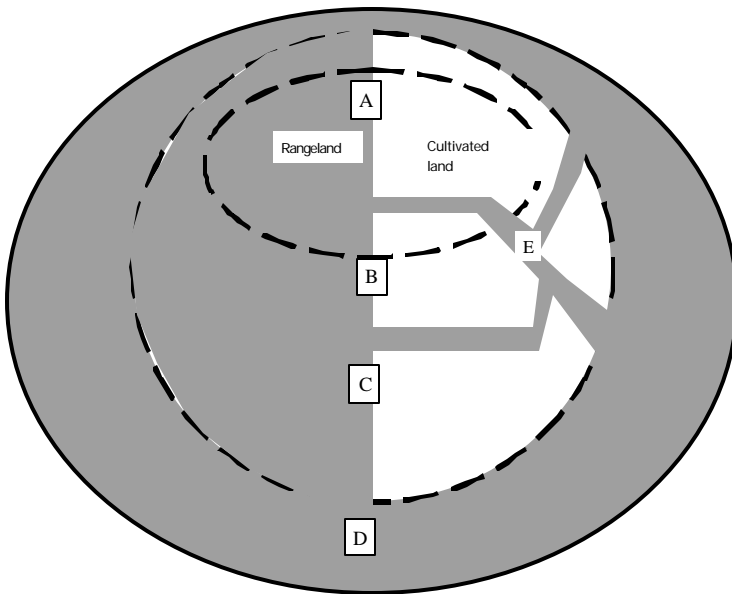
Long-term (four-month) transhumance movements during the rainy season, which gives access to the outside world in its “totality,” have as destinations pastures in northern Niger and, more recently, southern Benin. Informants across different Fulani encampments agreed that transhumance to Benin dated from the 1982–83 drought and that, while pasture quality is inferior, pasture quantity and livestock safety are better in Benin. What we see, therefore, is that the pastoral action-space consists of several subspatial units defined by the rationale for their use and tenurial status. The spatial subunits can touch each other, allowing a passage from one to the other, or can be connected by transhumance corridors. What must be noted also is that mobility has different justifications, each of which have characteristics that analysts should keep in mind

when modeling property rights, environmental variability, and livestock development.

In communities where no livestock movement outside of village land was reported, two rationales given were: grazing resources on the village land are sufficient for the need of the livestock, or the expected cost of movement through livestock losses was too high to justify movement.

In the dry season, the pastoral action-space changes. As the fields are open for residue grazing, they become part of the pastoral action-space. Nevertheless, the use of the dry-season space is constrained by water availability. If water is available year round on or near the village land, livestock will normally be left grazing on and around the village land.

FIGURE 13.1 Schematic description of the rainy season pastoral action space



NOTE: The different spatial subunits are separated by the discontinued line. The first subunit consists of the village rangeland (A). The second unit consists of rangeland nearby (B) under the jurisdiction of nearby villages or under the jurisdiction of the district chief. Access to this rangeland is never negotiated. A third subunit consists of rangeland that is 20 to 50 kilometers from the village (C) and that are used during the late dry season, when rain onset in the village is late. Access to this rangeland is sometimes negotiated. (It used to be strictly negotiated.) Finally, the pastures reached during transhumance are 100 to 200 kilometers away (D), for which there is no negotiation for access. These subunits can be directly connected, enabling a smooth passage from one to the other, or more often, they are connected by transhumance corridors (E).

Modeling Decisions Regarding Rangeland Management at the Community Level

The information gathered during the community surveys provides a basis for modeling decisionmaking regarding range management. The focus here will be on the rainy season. It is important to identify the purposes that the model will serve. Several issues must be considered:

- *Analyzing how and whether village rangelands are actually managed.* As White (1987) and Habou and Danguioua (1991) contend, the transfer of livestock from traditional pastoralists to other segments of the population in Niger led to a loss of incentive, or a loss of capacity, for the traditional pastoralists to manage the range. From this study's surveys among agropastoralists, it seems that traditional agriculturalists have a tendency to be engaged in pastoral activities to appropriate the management rights of the rangeland in their village. A first purpose of the modeling exercise could therefore be to analyze how and whether village rangelands are actually managed.
- *Quantifying the relative importance of different rationales for mobility.* Mobility is often analyzed in terms of a risk-management strategy allowing ex post adaptation after inadequate rainfall. When agropastoralists in our sample justify their practice of rainy-season transhumance, risk management seems to be one among other reasons for being mobile. Other reasons include avoiding destruction of crops (giving priority to agriculture), benefiting from earlier onset of rain when rains are late in their own villages (risk management), and benefiting from better pastures (rent capture). Quantifying the relative importance of these different rationales will contribute to a better understanding of mobility and its importance in the face of environmental variability.
- *Determining other factors in land-use decisions.* Subsumed in most of the literature on the colonization of pastoral land for agriculture is the assumption that the two major (if not only) driving forces are population densities and rainfall diminution, as described above. However, agropastoralists are likely to take into account other pastoral activities and exogenous factors, such as prices for livestock products, or wages from external sources of employment in their land use decisions. These should be determined.

Figure 13.2 represents an attempt to identify different important characteristics of agropastoral production systems. What can be noted from this figure is that the degree of complexity involved in modeling agropastoral production systems is quite high. Identifying the linkages among variables and focusing on the most important relationships is necessary. Theoretical developments and empirical studies from elsewhere should allow a better conceptualization of the questions at hand.

FIGURE 13.2 Some key characteristics of agropastoral production systems

<i>Natural environment</i>		Rainfall quantity	Rainfall variability	Geomorphology	Prevalence of pests
<p>Community</p> <p>KEY CHARACTERISTICS</p> <ul style="list-style-type: none"> ▪ Land (size of property rights action space) ▪ Land (potential productivity of property) ▪ Range quality ▪ Social capital ▪ Political integration ▪ Geographical integration ▪ Numbers of households ▪ Heterogeneity <p>DECISIONS</p> <ul style="list-style-type: none"> ▪ Land-tenure arrangements, including local property rights, management of common property, and access options for outsiders ▪ Collective investments 	<p>Household</p> <p>KEY CHARACTERISTICS</p> <ul style="list-style-type: none"> ▪ Labor (number of adult household members) ▪ Land (area of land with a secure right based on its productivity) ▪ Social integration ▪ Access to technology ▪ Human capital ▪ Risk aversion ▪ Access to off-farm income <p>DECISIONS</p> <ul style="list-style-type: none"> ▪ Allocation of resources to the different activities ▪ Technology adoption ▪ Investment in social relations ▪ Investment in human capital <p>OUTCOMES</p> <ul style="list-style-type: none"> ▪ Livestock holdings ▪ Area of land actually cultivated ▪ Off-farm income ▪ Capital (human, physical, and social relations) 				
<p>Socioeconomic and political environment</p> <ul style="list-style-type: none"> ▪ National policy ▪ Development project ▪ Prices ▪ Drought relief 					
				<p>Overall Outcomes</p> <ul style="list-style-type: none"> ▪ Stocking rate ▪ Income ▪ Equity 	

Range Management

As a preliminary approach, to begin exploring the data set (which will not be done in this chapter), no structural equations will be developed. Instead, results (and equations) from McCarthy (1998) and McCarthy, de Janvry, and Sadoulet (1998) will be adapted to the situation at hand. Results given by McCarthy (1998), for situations where there is no livestock mobility show that, under environmental risk, the stocking rate will be low under any management regime, and it will be lower still under perfect cooperation versus noncooperation. Without mobility, and under environmental risk, the stocking rate is a direct function of the level of cooperation exhibited by community members in their efforts to manage their range.

However, the present case study is a bit more complex because of the possibility of livestock owners' sending away livestock to pastures not under their control and because of the fact that outsiders may use the village rangeland.

Nevertheless, this study does not consider a situation where village members engage in cooperative agreements with outsiders in their efforts to manage their range. This is consistent with the observed property-rights structure within which outsiders do have an access right to pastures, but outsiders certainly do not have a management right over these pastures. As noted before, some communities manage, through social pressure or physical exclusion from the range or from watering points, to exclude outsiders up to a certain extent. This partial or total exclusion can be seen as a manifestation of cooperative behavior to manage the village rangeland. The outsiders' contribution to the stocking rate on village rangeland will be a direct function of the ability of the community members to enter into cooperation for the management of the range.

The mobility of the community members will, of course, affect the stocking rate. Taking into account the village mobility in a stocking rate equation is therefore important. This leads to equation (1):

$$SR = f(RQ, Ra, SD, p, Me, Mo, Ic, We, Di), \quad [1]$$

where

SR = the actual stocking rate on the village rangeland,

RQ = the range quality,

Ra = the average rainfall,

SD = the standard deviation of rainfall,

p = the relative price of livestock to millet,

Me = the number of community members engaged in livestock raising,

Mo = the level of livestock mobility,

Ic = a cooperation index,

We = the wealth of the community, and

Di = the distance to the nearest regional livestock market.

The linearization of this equation gives the following econometric specification:

$$SR = \mathbf{b}_1 + \mathbf{b}_2 RQ + \mathbf{b}_3 Ra + \mathbf{b}_4 SD + \mathbf{b}_5 p + \mathbf{b}_6 Me + \mathbf{b}_7 Mo + \mathbf{b}_8 Ic + \mathbf{b}_9 We + \mathbf{b}_{10} Di + \varepsilon, \quad [2]$$

where

\mathbf{b} ($i = 1$ to 10) = unknown parameters, and

ε = the stochastic disturbance term.

The estimation of this equation should allow the testing of the following hypotheses:

- *Hypothesis 1.* Changes that increase livestock profitability (increased prices, better market integration, better range quality) increase the stocking rate.
- *Hypothesis 2.* Increases in rainfall variability leads to decreases in stocking rates. For a given level of cooperation, a negative coefficient on this term implies that that rangelands in higher rainfall variability areas face a smaller risk of being overstocked.
- *Hypothesis 3.* Increases in the level of cooperation lead to decreases in the stocking rate. (See the first issue in the list above.) This would demonstrate that management of the range, while difficult to measure quantitatively, is in fact important.

To avoid an endogeneity problem, this equation must be estimated simultaneously with a “mobility” equation.

Mobility

When deciding whether to be mobile, livestock owners have to compare the cost of mobility with the benefits of mobility. As stated above, mobility has three benefits: reduction of damage to crops, risk reduction, and rent appropriation. The cost of mobility is the labor cost of tending the animals and eventually the increased risk of livestock losses. Again, a purely preliminary reduced-form model is proposed in equation (3):

$$Mob = f(RQ, CV, SR, Ic, CoMo), \quad [3]$$

where *CoMo* is the cost of mobility.

The following hypotheses will be tested:

- *Hypothesis 1.* As environmental variability increases, mobility increases. (See the second issue described above.)
- *Hypothesis 2.* As the stocking rate increases locally, mobility increases.
- *Hypothesis 3.* As range quality increases locally, livestock mobility decreases.

Description of the Variables or their Proxies

Given the variables entering into the models described above, the next task is to discuss how these variables will be defined given the data set collected:

- *Stocking rate.* The stocking rate will be expressed as tropical livestock units per hectare.

- *Range quality.* The range for each of the geographical units identified on the village land will be scored from 1 to 5. Range quality for each village will be computed using the following formula, where i is a pasture score and A_i is the proportion of the area available for pasture with the score equal to i :

$$RQ = \sum_{i=1}^5 i * A_i .$$

- *Relative price of livestock to millet.* The price per kilogram liveweight gathered during the livestock price survey will be divided by the price of millet per kilogram.
- *Level of livestock mobility.* The level of livestock mobility will be computed using the following ratio:

$$NI/Ntot,$$

where

NI = the tropical livestock unit equivalent of the animals absent from the village land during the season that is considered, and

$Ntot$ = the tropical livestock unit equivalent of the total livestock holding.

- *Cooperation index.* The cooperation index will be constructed using principal-component analysis. (See McCarthy et al. 1998.)
- *Wealth of the community.* The wealth of the community will be proxied by the total millet production as a proxy of land quality.
- *Cost of mobility.* Cost of mobility will be the sum of the labor cost of tending the animals while away. Where relevant, the expected livestock losses will be added to the labor cost.

Remark on Dry-Season Modeling

This modeling exercise is focusing on rainy-season behavior. Supplementary insight may be gained with the analysis of dry-season behavior. This would nevertheless pose a series of problems in terms of data requirements (very little can be known of the contribution of dry-season transhumant stock to the stocking rate), or in terms of institutional environment (for example, interstate conventions on transhumance). Furthermore, since the major limiting factor in the dry season is water, it is widely agreed that water is the major driving force behind decisions on livestock management during the dry season.

Conclusions

The review of the existing literature on property rights, risk, and livestock development in Niger, combined with field surveys, enables the development of a clear definition of the objectives of a tentative modeling exercise: identifying whether in western Niger village rangeland is managed, and quantifying the determinants of rainy season mobility. The adaptation of existing theoretical frameworks enabled some key linkages to be defined. Developing sound structural equations for the case study and running the estimations will most certainly give a unique insight on the research theme in this chapter: property rights, risk, and livestock development in Niger.

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14 Implications of Population Growth and Declining Access to Transhumant Grazing Areas for the Sustainability of Agropastoral Systems in the Semi-Arid Areas of Niger

BRUNO BARBIER AND PETER HAZELL

Sahelian pastoralism is encountering difficult problems as population growth leads to the expansion of cropland at the expense of traditional pastures. Many analysts believe that pastoralism is bound to disappear and is likely to be replaced by mixed crop–livestock farming systems, where livestock stay near the farms and provide milk, draft power, and manure for soil fertility (Boserup 1965; Ruthenberg 1980; Pingali, Bigot, and Binswanger 1987; Beets 1990; Landais, Lhoste, and Guerin 1990;). However, other studies suggest that mixed crop–livestock farming systems are less suited than pastoralism to the low and erratic rainfall patterns of the Sahel. Sedentary farming systems have limited means for coping with drought, while traditional pastoral systems, which rely on walking animals to other regions that have received better rainfall, are much more able to cope (Scoones 1995; Toulmin 1995).

The shift from pastoralism to more settled farming is driven in part by increasing population pressure and greater commercialization of agriculture. These forces create new opportunities as well as new needs for intensifying the farming system within rural communities. At the same time, these forces might also lead to greater enclosure and settlement of traditional grazing areas, leading to diminished access rights to these areas. Thus, the decline in traditional pastoralism can be seen as a cause as well as a result of diminishing access to transhumant grazing areas, and to a shift to increased cropping.

To better understand the economic forces driving these transformations, and to assess their implications for future livelihood standards and environmental sustainability, we have developed a bioeconomic model of a typical community in the semi-arid areas of Niger.¹ The model is used to simulate the longer-term consequences of changes in population growth and reduced access rights to transhumant grazing areas. Particular attention is given to the role of drought risk in conditioning the model's results, and how improved methods of managing drought risk affect the development pathway that the community follows.

¹ We used the solver CONOPT from the GAMS Software (Brooke, Hendrick, and Meeraus 1988).

The Study Community

The village of Banizoumbou is a typical community of the Sahel, with low rainfall (450 millimeters) and sandy soils. Most farmers are barely self-sufficient in raising millet. Sale of animals and temporary migration are the main sources of cash income. Banizoumbou has good access to a paved road and to several active markets.

The village has a population of around 1,300 people and a total land area of 6,200 hectares. This gives a population density of 22 persons per square kilometer, which is about average for this part of the Sahel. There are 860 Zarmas and 475 Fulanis in the village territory. The Zarmas live in hamlets, while the Fulanis live in more isolated nuclear families that are scattered across the village territory. Zarmas are mainly settled farmers, while Fulanis are agropastoralists who cultivate some land but also are transhumant for large parts of the year.

The population is growing rapidly in Banizoumbou, probably at close to the national rural average of 3 percent per year. Permanent migration is restricted because Nigeria, the main place of destination, is in a deep economic crisis.

The main crop produced is millet, which is grown during the single rainy season that extends from June to September. Yields are low and vary between 200 and 400 kilograms per hectare. One worker can cultivate between 2 to 3 hectares. Availability of phosphorus and nitrogen in the soil are important limiting factors on yields, and the prime source of loss of these nutrients is through removal of the harvest. Where fertilizers are applied on millet, yields increase but rarely to more than 600 or 700 kilograms per hectare. The sandy soils are very poor but easy to work, which explains the extensive agropastoral system that has traditionally prevailed in the area. Agropastoralists usually have much smaller plots than farmers, but their yields are twice as large because of intensive manuring (Beauvillain 1977). Agropastoralists are usually less self-sufficient in grain than farmers and compensate for this potential nutrient and economic shortfall by buying millet and by drinking milk from their livestock (Collin de Verdière 1995).

The prevailing land-tenure system in Banizoumbou provides farmers and agropastoralists with relatively free access to land. They have to ask the traditional chiefs for permission to cultivate a plot, but they can still obtain this permission readily.

Agropastoralists from the area go north during the rainy season, where there are more pastures and the grass is of better quality. Herds that do not migrate seasonally stay in the village territory and have lower productivity. The areas that they can graze in the village during the rainy season are restricted because the crops are growing. Agropastoralists move back into the area after the rainy season to let their herds graze crop residues. If not enough residues and grass are available around the village during the postharvest season, some agropastoralists migrate to grazing areas around neighboring communities. The general strategy is to gain the maximum livestock weight during the rainy season and to lose as little weight as possible during the dry season.

Some authors (Scoones 1995; Toulmin 1995) suggest that, in the Sahel, overgrazing has no major long-term effect on forage production. It seems to be true for the sandy soils that characterize Banizoumbou, where grazing does not compact soils as it does in areas with soils that are richer in silt and clay. However, intensive grazing during the rainy season can lead to a change in the species composition of the pastures—toward shorter-cycle grasses and less palatable species. However, if grazing is less intense the following season, the new species composition rapidly becomes more palatable, confirming that the effect of overgrazing on subsequent pasture production is mild.

Livestock production in the area is cyclical between droughts. The two exceptional droughts of 1973 and 1984 drastically reduced the national livestock herd in Niger, perhaps by as much as 50 percent (FAO 1997). This led many farmers and agropastoralists to increase their holdings of sheep and goats, which are more drought resistant than cattle. The recovery of herd size after a drought is conditioned by the number of breeding cows that survive, and agropastoralists usually sell their bulls but keep as many fertile cows as possible. This policy is also consistent with herders' preferences for building up larger herds as a major source of wealth and for protecting their food security in drought years. Selling a cow can mean a significant loss of future income. Also, an old cow that has survived the harsh conditions of the Sahel may well have a more drought-resistant genetic makeup than cows that do not survive. Another reason not to sell cows is that in the current context of open access to grazing areas, a larger herd is more productive than a smaller herd for an individual herder.

Labor is generally not a limiting factor in the agropastoralist community. Many agropastoralists lost their herds during the severe droughts of the 1970s and 1980s, and fewer heads of livestock are in Niger today than before those droughts. Yet the agropastoralist population has almost doubled, hence there are far fewer heads of livestock per herder today.

Until recently, crop- and livestock-production systems were considered to be symbiotic in the region because agropastoralists used to exchange animal manure for grazing rights, and milk for grain. Farmers even used to contract to have their livestock tended by agropastoralists. Now, farmers have started to manage their livestock themselves, and they increasingly restrict agropastoralists' access to pasture, crop residues, and water points. Agropastoralists are also intensifying their own crop production because pastoralism is becoming more risky and because they have the manure to intensify crop production.

Analysts have conflicting views over which system of property rights should be implemented to help improve productivity and natural-resource management. Many analysts consider that the current open-access system for pastures leads to the overuse of these resources, while a system of individual property rights would lead to more responsible resource management and higher levels of productivity. Under individual property rights, pastoralism is more likely to be replaced by sedentary production systems where livestock are fed with locally produced or purchased forage. In contrast, other analysts argue that

more settled crop–livestock systems are not environmentally sustainable in such low-rainfall and drought-prone areas as Banizoumbou, and that continued pastoralism is required.

However, it is not clear that the return to the traditional patterns of resource management is a viable alternative today given the livelihood needs of a larger and rapidly growing rural population (see Chapter 11). Resolution of these conflicting views requires a serious quantitative analysis of the options open to Sahelian communities such as Banizoumbou, including an assessment of the longer-term consequences for sustainable resource-management. The next section describes a bioeconomic model constructed specifically to analyze these issues.

The Modeling Method

The literature on suitable models for simulating integrated crop–livestock systems is growing (for recent reviews, see Breman 1993; Oriade and Dillon 1997). The most recent models include biophysical components for simulating the productivity of pasture areas, and the status and yield consequences of soil-nutrient balances and the amount of organic matter in the soil. Several models have also been applied to Sahelian situations. Until recently, most models were designed at the farm level. However, given the prevalence of common and open-access land, new village- and community-level models have been developed to explicitly include these lands (Kebe 1992; Deybe and Butcher 1996; Barbier and Benoît-Cattin 1997). Given also the importance of climate and price variability in the Sahel, several models have incorporated risk (production variance) and risk-averse behavior using such methods as MOTAD (Hazell 1971); Target MOTAD (Tauer 1983); Focus-Loss constrained programming (Boussard and Petit 1967); and discrete stochastic programming (Cocks 1968; Rae 1970, 1971).

In this study we use a dynamic and discrete stochastic programming model to conduct long-term simulations of alternative development pathways available to the village of Banizoumbou. The model describes the crop and livestock-production systems and their interactions at the village level. The scale of the model is the full village territory plus the open-access pastures where the pastoralists from the village migrate and that are not included in the village territory. The data for the model are taken mainly from International Livestock Research Institute (Hiernaux et al. 1998), although some technical coefficients come from the technical literature about Sahelian situations (French Cooperation Ministry 1991; Breman et al. 1986; Milleville and Serpantiér 1994; Collin de Verdier 1995).

A key characteristic of the model is the way risk is specified. Farmers and pastoralists are assumed to be risk averse, and to conform to a decision framework with a mean standard-deviation in making their decisions at the beginning of each rainy season. However, not all decisions have to be made at the beginning of the rainy season, and many can be delayed until later in the season when

more information about the season's rainfall outcome is available. Optimal adjustments (or recourse decisions) to the emerging rainfall pattern is an extremely important part of risk management in the Sahel. For example, while many decisions about planting crops (such as type, area, seed rate, and manuring) have to be made early in the year before the rains have arrived, and hence have to be based on expectations about the forthcoming rains, other decisions (such as feeding livestock, buying and selling animals, transhumance, and storing food) do not have to be made until later in the year and can be adjusted according to the emerging rainfall pattern and the known availability of foods and feed. To model this type of sequential decision problem, we use the discrete stochastic programming with recourse (DSPR) approach developed by Cocks (1968) and Rae (1970, 1971).

DSPR models have a decision-tree structure where the nodes of the tree are the decision points and the branches correspond to different states of nature (or rainfall outcomes in our application). As such, these models can quickly become very large, and to avoid this we made the simplifying assumptions that only two decision stages occur during the year (planting and postharvest), and only two rainfall outcomes of interest (drought and normal). With a four-year planning horizon (see later), this results in a $2^4 = 16$ sequences of states of nature.

The drought event is taken to be the level of rainfall that has a 10 percent chance of occurring (a catastrophic event), whereas a normal year has a 90 percent chance of occurring. Rainfall outcomes are assumed to be independent over time.

The two decision stages in the model are the planting period and the post-harvest period. All decisions made in the planting period have to be taken before any season-specific knowledge about the rainfall is available. These *ex ante* decisions can only be informed by prior knowledge of the probability distribution of rainfall. All decisions in the postharvest period are assumed to be taken once the actual rainfall outcome (drought or normal) is known. These *ex post* decisions take the form of optimal adjustments to the available crop production and fodder and grazing resources. The planting-period decisions include the amount of area to plant for each crop as well as the quantity of manure and inorganic fertilizers applied. The postharvest decisions include choices about storing, selling, buying, and consuming the harvest that are based on actual yield outcomes and market prices, and most of the livestock-management decisions.

Livestock production has much more recourse than cropping. In fact, no significant livestock decisions have to be made during the planting season in the model. In the model, animals can be bought or sold. In the postharvest period, the model will adjust the planned duration of transhumance depending on the rainfall outcome and the availability of feeding resources and market prices (especially for animals). Temporary human migration is also a recourse decision in the model. Migration of males to Côte d'Ivoire and Ghana to work there during the dry season generates valuable earnings on average.

Model Specification

We adhere to the following notation in this analysis:

- Endogenous variables are capitalized.
- Coefficients are denoted by small letters.
- Indexes are subscripts.
- Index t is time in years, p denotes periods within years, r the discount rate, n the two states of nature (drought and normal), and m denotes a sequence of states of nature over four years.

All variables and coefficients are listed and defined in Table 14.1. The model has three seasonal periods: the rainy season, from June to September; the harvest season, from October to January; and the hot and dry season, from February to May. Decisions made during the rainy season are made on the basis of prior expectations about rainfall, whereas decisions made during the other two seasons are based on the actual rainfall in the previous rainy season.

The Utility Function

The model maximizes the aggregate welfare of the community, measured as the discounted value of future income adjusted for risk, *EXPUTILITY*. Income is defined in the Becker sense to include the opportunity cost of leisure, while risk aversion is specified in mean-standard deviation form (Markowitz 1959; Hazell and Norton 1986; McKarl and Spreen 1997). We assume that the length of the planning horizon is four years.

The objective function is

$$EXPUTILITY = EXPINC - 1.65\sqrt{VARINC}$$

where *EXPINC* is the expected value of discounted income over the four-year planning horizon, *VARINC* is the associated variance of discounted income, and 1.65 is an assumed risk-aversion coefficient.

To calculate these variables, we begin with the definition of the income outcome in year t , INC_t , defined as follows:

$$\begin{aligned} INC_{n,t} = & \text{primil}_n * \text{MILSEL}_{n,t} \\ & + \text{priliv}_n * \sum_{p=1}^P \text{LIVSELP}_{n,t} + (\text{priliv}_n + \text{primlk}_n * \text{livmilk}_n) \text{LIV}_{n,t} \\ & - \text{priliv}_n * \text{LIV}_{t-1} + \text{priop}_p * \text{POPLEIS}_{n,t} \\ & + \text{priwage} * \text{POTEMPF}_{n,t} + \text{priwage} * \text{POTEMPA}_{n,t} \\ & - \text{prinpk} * \text{FERTNPK}_t - \sum_{p=1}^p (\text{priwlk}_p * \text{LIVTRANS}_{n,p,t}) \\ & - \text{pribuy}_n * \text{MILBUY}_{n,t} - \text{prifeed} * \text{DMFEED}_{n,p,t} \end{aligned}$$

Table 14.1 Model notation and definitions

Notation	Definitions
Variables	
$BUSHCUT_t$	Reduction of bush area, in hectares
$BUSHNEW_t$	Cropped area returned into bush, in hectares
$BUSH_t$	Bush area, in hectares
$DMCONS_{n,p,t}$	Animal forage requirement, in tons ^a of dry matter
$DMDEF_{n,p,t}$	Dry-matter deficit
$DMFEED_{n,t}$	Purchased animal food, in tons
$DMSUBU_{n,p,t}$	Dry-matter surplus in the village pastures
$DMSURE_{n,p,t}$	Dry-matter surplus from crop residues
$DMSUTR_{n,p,t}$	Dry-matter surplus in transhumance area
$DMTRANS_{n,p,t}$	Dry matter consumed during transhumance
$FERTCOM_t$	Compost produced from crop residues, in tons
$FERTCOR_t$	Manure produced by corralling, ^b in tons
$FERTMAN_{n,t}$	Manure produced by stabling, ^c in tons
$FERTNPK_t$	Inorganic fertilizers, in tons
$LIV_{n,t}$	Number of livestock, in standard tropical units
$LIVOUT_{n,p,t}$	Livestock from neighboring villages
$LIVP_{n,p,t}$	Number of livestock, in standard tropical units per period
$LIVSELP_{n,p,t}$	Livestock units sold per period
$LIVTRANS_{n,p,t}$	Transhumant livestock units
$MILBUY_{n,t}$	Quantity of purchased grain, in tons
$MILCONS_{n,t}$	Human grain consumption, in tons
$MILCUT_t$	Abandoned crop area, in hectares
$MILNEW_t$	New cropped area, in hectares
$MILPROD_{n,t}$	Total millet production
$MILSEL_{n,t}$	Crop sale, in tons
$MILSTORE_{n,t}$	Millet stocks, in tons
MIL_t	Crop area, in hectares
$PHOSDEF_{n,t}$	Phosphorus deficit in the soil, in tons
$PHOS_{n,t}$	Phosphorus in the soil, in tons
$POPA_{n,t}$	Population of agropastoralists
$POPF_{n,t}$	Population of farmers
$POPPEIS_{n,t}$	Number of nonworked weeks during the peak periods
$POP MIGA_{n,t}$	Number of permanent emigrants among agropastoralists
$POP MIGF_{n,t}$	Number of permanent emigrants among farmers
$POPTempa_{n,t}$	Number of temporary migrants among agropastoralists
$POPTempF_{n,t}$	Number of temporary migrants among farmers
$UFCONS_{n,p,t}$	Animal-forage energy requirement, in forage units
$UFDEF_{n,p,t}$	Forage-unit deficit for animals
$EXPUTILITY$	Expected utility, in local currency
$INC_{n,t}$	Annual income in local currency
$EXPINC$	Expected value of discounted annual income in local currency
$VARINC$	Variance of discounted annual income in local currency

Table 14.1 (continued)

Notation	Definitions
Coefficients	
<i>Actbu_p</i>	Days of labor required to reclaim a hectare of bush
<i>Acth_p</i>	Days of farmers' labor available per period
<i>Actman_p</i>	Days of labor to produce and apply 1 ton of stabling manure
<i>Actplan_p</i>	Labor time required for crop planting, in days per hectare
<i>Actp_p</i>	Days of agropastoralist labor available per period
<i>Actrans_p</i>	Days of labor required to tend one livestock unit
<i>Area</i>	Cultivable area in hectares
<i>Areatrans_t</i>	Pasture area available for transhumance, in hectares
<i>dmbus_{n,p}</i>	Dry matter provided by 1 hectare of forage crop
<i>Dmdung_p</i>	Dung produced by one unit of livestock, in tons
<i>Dmfeed</i>	Dry matter provided by 1 ton of concentrated feed
<i>Dmlossbu_p</i>	Village forage loss between seasons, in percent
<i>Dmlossre_p</i>	Crop residue forage loss between seasons, in percent
<i>Dmlossstr_p</i>	Transhumance forage loss between seasons, in percent
<i>Dmneed_p</i>	Upper limit of dry-matter consumption per unit of livestock
<i>Dmres_p</i>	Dry matter provided by 1 ton of residues
<i>dmtran_{n,p}</i>	Forage yield in transhumance areas
<i>Livmilk_n</i>	Milk produced per tropical livestock unit, in liters
<i>Livpot_p</i>	Coefficient of livestock growth potential
<i>Milcons</i>	Cereal consumed, in tons per person
<i>Milconsd</i>	Cereal consumed per year, in tons per adult migrant
<i>Milyi_p</i>	Average crop yields, in tons per hectare
<i>Nitcom_n</i>	Tons of crop production produced by 1 ton of compost
<i>Nitcor_n</i>	Tons of crop production produced by 1 ton of corralling manure
<i>Nitman_n</i>	Tons of crop production produced by 1 ton of stabling manure
<i>Nitnpk_n</i>	Tons of crop production produced by 1 ton of inorganic fertilizers
<i>Phosass</i>	Fraction of assimilable phosphorus
<i>Phoscomp</i>	Tons of phosphorus provided by 1 ton of compost
<i>Phoscor</i>	Tons of phosphorus provided by 1 ton of corralling manure
<i>Phosd_n</i>	Effect of phosphorus deficit on millet yields, in tons per ton of deficit
<i>Phosex</i>	Tons of phosphorus extracted from the soil by 1 ton of crop
<i>Phosman</i>	Tons of phosphorus provided by 1 ton of stabling manure
<i>Phosnpk</i>	Tons of phosphorus generated by 1 ton of inorganic fertilizers
<i>Phosthr</i>	Tons of phosphorus in the soil below which a deficit occurs
<i>Popg</i>	Population growth rate
<i>Pribuy_n</i>	Price of purchased grain, in local currency per ton
<i>Pridisc_t</i>	Coefficient discounting future incomes
<i>Prifeed</i>	Price of concentrated feed, in local currency per ton
<i>Priliv_n</i>	Livestock prices, in local currency per unit
<i>Primil_n</i>	Millet production prices, in local currency per ton
<i>Primlk_n</i>	Price of 1 liter of milk, in local currency per unit

Table 14.1 (continued)

Notation	Definitions
<i>Prinpk</i>	Inorganic fertilizer prices, in local currency per ton
<i>Priop_p</i>	Opportunity cost of leisure, in local currency per day
<i>Priwage_p</i>	Wage of off-farm activities, in local currency per period
<i>Priwlk_p</i>	Cost of transhumance, in local currency
<i>Prob_m</i>	Probability of occurrence of one sequence of state of nature
<i>Ufbu_{n,p}</i>	Energy content of 1 ton of forage from the village
<i>Uffeed_p</i>	Energy content of 1 ton of purchased feed
<i>Ufneed_p</i>	Forage units required by one unit of livestock
<i>Ufres_{n,p}</i>	Energy content of 1 ton of crop residues
<i>Ufstres</i>	Loss of animal weight due to forage deficit
<i>Ufthres</i>	Forage energy threshold below which animals lose weight
<i>Uftrans_p</i>	Energy content of 1 hectare of transhumance pastures

^a In this chapter, “ton” means metric ton.

^b Corralling is a method for producing manure from letting cattle rest and produce manure in some fields, which benefits the next crop.

^c This is actually a mixture of dung and crop residues produced by keeping cattle in stables.

Income is the sum of crop production, milk sales, wages from seasonal migrants, and livestock sales, adjusted for changes in livestock inventories and the opportunity cost of leisure, less the costs of cash expenses for farm production, transhumance, and grain purchased for the family.

The expected value of discounted income is then

$$EXPINC = \sum_{m=1}^m prob_m * \sum_{t=1}^T pridisct * INC_{mt}$$

In addition, the associated variance of discounted income is

$$VARINC = \sum_{m=1}^m prob_m * \left(\sum_{t=1}^T pridisct * INC_{mt} - EXPINC \right)^2$$

The Constraints

MILLET PRODUCTION. Total millet production is a function of yields, planted area, and fertilizer. Yields depend on the amount of organic and inorganic fertilizers applied. Organic fertilizer includes stabling manure, corralling manure, and compost, as described in Table 14.1. Currently farmers use only corralling manure. Producing manure from stabling and producing compost require much more labor than corralling. It is also assumed that when the phosphate content reaches a threshold level, yields begin to decrease:

$$\begin{aligned}
MILPROD_{n,t} = & \text{milyi}_n * MIL_t + \text{nitpk}_n * FERTNPK_t \\
& + \text{nitman}_n * FERTMAN_t + \text{nitcor}_n * FERTCOR_t \\
& + \text{nitcom}_n * FERTCOM_t - \text{phosd}_n * PHOSDEF_{n,t}.
\end{aligned}$$

The quantity of stabling manure and compost available for millet production during year t is a function of the crop residues stored during year $t - 1$:

$$FERTMAN_t + FERTCOM_t \leq \text{dmres} * MILPROD_{n,t-1}.$$

Millet may be stored, consumed or sold:

$$MILSTORE_{n,t} + MILSEL_{n,t} + MILCONS_{n,t} = MILPROD_{n,t} + MILSTORE_{n,t-1}.$$

FOOD CONSUMPTION. The population (minus temporary migrants) is assumed to consume a fixed amount of millet throughout the year. Millet may be produced in the village or bought:

$$\begin{aligned}
MILCONS_{n,t} + MILBUY_{n,t} \geq & \text{milcons} * (\text{POPF}_{n,t} + \text{POPA}_{n,t}) \\
& - \text{milconsd} * (\text{POPTMPF}_{n,t} + \text{POPTMPA}_{n,t}).
\end{aligned}$$

LAND USE. The village territory is either cultivated for millet or left in fallow (*BUSH*), which can be grazed:

$$MIL_t + BUSH_t = \text{area}.$$

The initial millet area can be increased or decreased:

$$MIL_{t-1} + MILNEW_t - MILCUT_t = MIL_t.$$

The millet area can be increased by converting bush:

$$MILNEW_t = BUSHCUT_t$$

Similarly, the bush area can be increased or reduced:

$$BUSH_{t-1} + BUSHNEW_t - BUSHCUT_t = BUSH_t.$$

POPULATION AND LABOR. The local farming population is assumed to increase in accordance with the United Nations Environment Programme's projection for Burkina Faso (Stephen et al. 1991). This implies a progressive decrease in population growth until the middle of the next century, when the population size will stabilize. However, in the model, emigration options (*POPMIGF* and *POP MIGA*) permit the size of the population to fall if this is more profitable for the village. This will happen whenever the population size reaches the point where another person consumes more than he or she produces:

$$\text{Popg}_t * \text{POPF}_{t-1} - \text{POPMIGF}_{n,t} = \text{POPF}_{n,t}.$$

A similar equation is also assumed to apply for agropastoralists:

$$Popg_t * POPA_{t-1} - POPMIGA_{n,t} = POPA_{n,t}.$$

The sum of labor requirements, temporary migration, and leisure (*POPLEIS*) has to equal the total days of labor available from the population during each seasonal time period. Labor is required during the peak time of planting and establishing millet, bush clearing, manuring, applying inorganic fertilizer, and transhumance to the northern pastures:

$$\begin{aligned} &actplan_p * MIL + actman_p * (FERTMAN_t + FERTCOM_t) \\ &+ actbu_p * MILNEW_t + activ_p * LIV_{n,t} + actrans_p \\ &* LIVTRANS_{n,p,t} + POPLEIS_{n,t} \\ &= acth_p * (POPF_{n,t} - POPTMPF_{n,t}) \\ &+ acth_p * (POPA_{n,t} - POPTMPA_{n,t}). \end{aligned}$$

Transhumance can only be performed by agropastoralists who do not migrate:

$$actrans_p * LIVTRANS_{n,p,t} \leq actp_p * POPA_{n,t} - POPTMPA_{n,t}.$$

PHOSPHORUS BALANCE. Phosphorus is said to be the most limiting factor for millet growth in the Sahel (Breman and de Witt 1983; Bationo and Mokwunye 1991). The soil has considerable phosphorus, but its assimilable fraction is insufficient for millet growth. Phosphorus becomes assimilable through complex processes that depend upon an equilibrium among different nutrients and organic matter. Application of organic and inorganic fertilizers increases the assimilable phosphorus. However, removal of crops depletes the amount of available phosphorus:

$$\begin{aligned} &PHOS_{t-1} * MIL_{t-1} + PHOSB_{t-1} / BUSH_{t-1} * BUSHNEW_t \\ &- PHOS_{t-1} / MIL_t * MILCUT_t - phoex * MILPROD_{n,t} \\ &+ phosman * FERTMAN_t + phoscom * FERTCOM_t \\ &+ phosnpk * FERTNPK_t = PHOS_{n,t} * MIL_t. \end{aligned}$$

We assume that the same equation applies for phosphorus on land under bush, but in this case phosphorus loss from grazing does not occur, because phosphorus is mostly restored through manure.

Exports of assimilable phosphorus by crops is limited to a fraction of the available phosphorus, plus the phosphorus coming from fertilizers (which is assumed to be assimilable):

$$\begin{aligned} &phosex * MILPROD_{n,t} \leq phosass * PHOS_{t-1} + phosman \\ &* FERTMAN_t + phoscomp * FERTCOM_t. \end{aligned}$$

Below a certain level of phosphorus in the soil (*PHOS*), a deficit occurs (*PHOSDEF*) which negatively affects the millet production function:

$$PHOS_{n,t} \geq phostr \cdot MIL_t - PHOSDEF_{n,t}.$$

LIVESTOCK AND MANURE. The amount of stabling and corralling manure available for millet production at the beginning of the year is limited by the number of livestock from the previous year that did not migrate:

$$FERTMAN_t + FERTCOR_t \leq \sum_{p=1}^p dmdung_p * (LIV_{t-1} - LIVTRANS_{n,p,t-1}).$$

LIVESTOCK BALANCE. Livestock production is managed by agropastoralists. Their income is the aggregation of milk sales, animal sales, and the value of herd growth (the increase in stock value). Livestock activity in the model is measured in standard tropical livestock units, where one unit is equivalent to an adult tropical cow. Changes in livestock activity are determined by selling animals and by herd growth. The latter has two components: weight growth over time and weight losses if forage deficits exist; the latter can offset the former. We assume that farmers do not consume meat themselves, but they can sell animals for meat.

Livestock carry over from one period to another in the model. Transfers occur between seasons within a year,

$$LIVP_{n,p,t} = livpot_p * LIVP_{n,p-1,t} - LIVSELP_{n,p,t} - ufstres * UFDEF_{n,p,t};$$

and between years,

$$LIVP_{n,p,t} = livpot_p * LIVP_{n,p-1,t} - LIVSELP_{n,p,t} - ufstres * UFDEF_{n,p,t}.$$

At a certain point of energy deficit, some animals have to be sold:

$$\sum_{p=1}^p UFDEF_{n,p,t} \leq ufthres * LIV_{n,t} + \sum_{p=1}^p LIVSELP_{n,p,t}.$$

The number of livestock (units) that can be transhumant is calculated by dividing the forage consumed outside the village by the requirement for dry matter per animal per period:

$$LIVTRANS_{n,p,t} = DMTRANS_{n,p,t} / dmneed_p.$$

LIVESTOCK AND FORAGE. Livestock per capita consumption of dry matter is fixed:

$$dmcons_p * LIV_{n,t} = DMCONS_{n,p,t}.$$

Total forage dry matter is produced by the village pastures, village crop residues, or the transhumance pastures, or comes from purchased feed:

$$DMTOT_{n,p,t} = DMBUSH_{n,p,t} + DMRES_{n,p,t} + DMFEED_{n,p,t} \\ + DMTRANS_{n,p,t} + DMTRANS_{n,p,t}.$$

The amount of energy consumed depends on the amount of dry matter ingested and its energy content. If basic energy needs are not satisfied, an energy deficit (*UFDEF*) will occur:

$$ufneed_p * LIV_{n,t} - UFDEF_{n,p,t} \leq DMCONT_{n,p,t} * DMCONS_{n,p,t}.$$

Energy content is the ratio of total energy over total dry matter:

$$DMCONT_{n,p,t} = DMUF_{n,p,t} / DMTOT_{n,p,t}.$$

The total forage energy consumed is produced by the village pastures, by the crop residues, by purchased feed, and by the transhumance area:

$$DMUF_{n,p,t} \leq ufbu_{n,p} * DMBUSH_{n,p,t} + ufres_{n,p} * DMRES_{n,p,t} \\ + uffeed * DMFEED_{n,p,t} + uftrans_p * DMTRANS_{n,p,t}.$$

The next equation defines the available, edible dry matter, including transfers from one period to the next of any fraction of the grass that was not previously grazed:

$$DMBUSH_{n,p,t} + DMSURPB_{n,p,t} = dmbu_{n,p} * BUSH_{n,t} \\ + dmlosbu_p * DMSURPB_{n,p-1,t}.$$

A similar equation applies for crop residues:

$$DMRES_{n,p,t} + DMSUPR_{n,p,t} = DMRESFOR_{n,p,t} \\ + dmlosre_p * DMSUPR_{n,p-1,t}.$$

A similar equation applies for the transhumance areas. In addition, the productivity of the transhumance areas is assumed to decline over time (*dmlostt_p*) because of continuing population growth in the region and an associated loss of grazing areas to crop cultivation:

$$DMTRANS_{n,p,t} + DMSUTR_{n,p,t} = dmtran_{n,p} * areatrans_t \\ + dmlostt_p * DMSUTR_{n,p-1,t}.$$

In the baseline scenario, forage from transhumance areas decreases at 3 percent per year.

Residues derived from millet production can be used for forage or for manure production:

$$dmre_p * MILPROD_{n,t-1} = DMRESFOR_{n,p,t} + DMMANURE_{n,p,t}.$$

Recursive Solutions

Although the model is solved as a dynamic four-year optimization program, it is also solved recursively each year to provide a series of moving four-year plans. This approach enables the model to be used to track much longer time periods than four years. It also provides a realistic way of simulating farmers' ability to adjust their plans each year on the basis of outcomes of the previous year. In the recursive framework, the results of the first year of the planning horizon—in

terms of livestock, millet stock, and soil phosphorus—become the initial resources of the revised model that is solved for the following year. We ran the model 100 times, representing 100 future years, for each of the simulations undertaken.

The recursive framework also enables adjustments to be made between expected and actual outcomes each year, given that production of millet and forage are affected by stochastic rainfall events. We use one of the two states of nature “drought” to introduce “climatic shocks” between some years in the various scenarios. The model adjusts total production and recalibrates the closing stocks of livestock and grain that enter the constraint set for the multiperiod model in year $t+1$.

Model Simulations

We ran the simulations over 100 years because difficulties with soil fertility (phosphorus deficit) and with livestock only become critical in the long term. In all the simulations, we shocked the model to simulate droughts every 20 years (from 1997). Droughts are simulated by exogenously reducing millet and forage yields, forage quality, and livestock prices, and by increasing the price of millet. These shocks are based on historical data. In the baseline scenario, transhumance is allowed, but purchasing supplementary feeds is not an option. Three alternative scenarios were also simulated to help identify the effects of changing access rights to transhumance areas and of the possibility of purchasing supplementary feeds. In all scenarios, population is assumed to grow exogenously according to the United Nations Environment Programme projections, stabilizing around year 2030 (Figure 14.1).

The Baseline Scenario

In the baseline scenario, the millet area first expands because of population growth but later decreases again because an increasing phosphorus deficit in the soil requires a shift back to longer fallows (Figure 14.2). Millet yields (Figure 14.3) are affected from the beginning by the phosphorus deficit. The model tries to reduce the phosphorus deficit by rotating the millet area with manured pastures, but after a while the pasture area becomes too small to fulfill this role as a phosphorus provider. Similarly, the manuring technique selected by the model (corralling) cannot adequately compensate for the removal of phosphorus through crop yields. To maintain millet production, inorganic fertilizer is finally adopted by about the 40th year (2030). Use of inorganic fertilizer allows for a regular increase in millet yield (Figure 14.3) and enables total millet production to grow in step with the population’s consumption needs (Figure 14.4). This yield increase compensates for the decrease in the millet area.

Figure 14.1 Projected growth in village population and of in-migration into the village

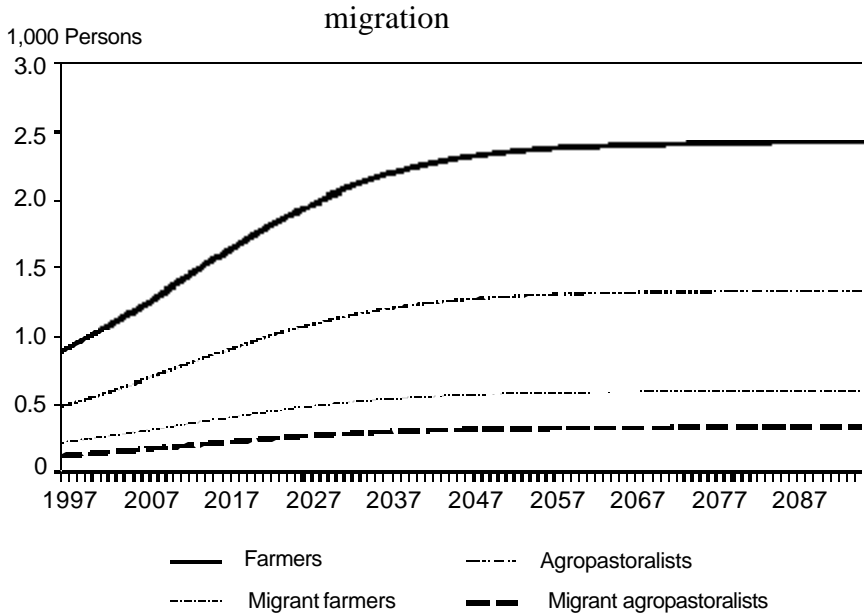


Figure 14.2 Evolution of land use

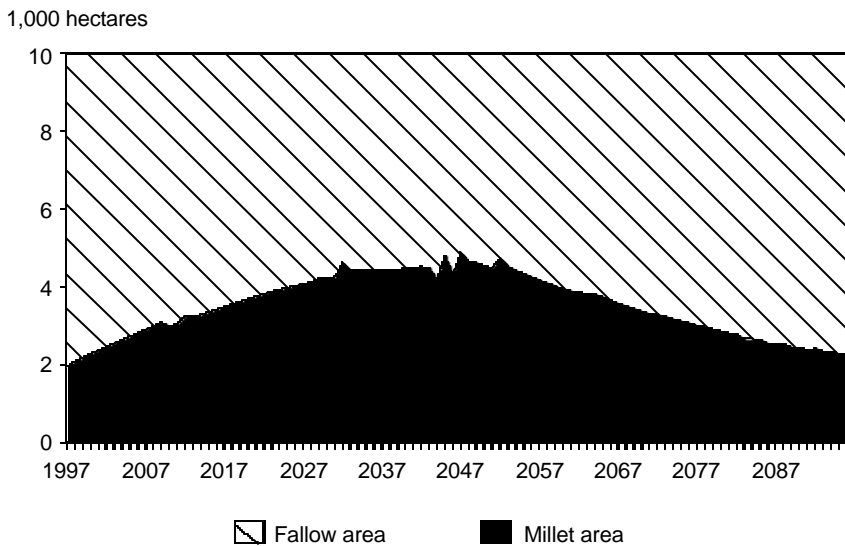


Figure 14.3 Evolution of millet yield and fertilization

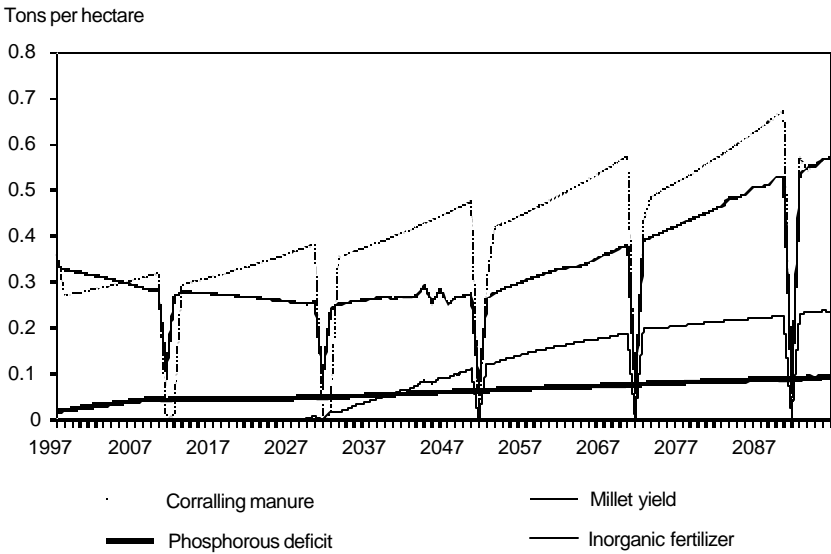


Figure 14.4 Evolution of millet production and millet use

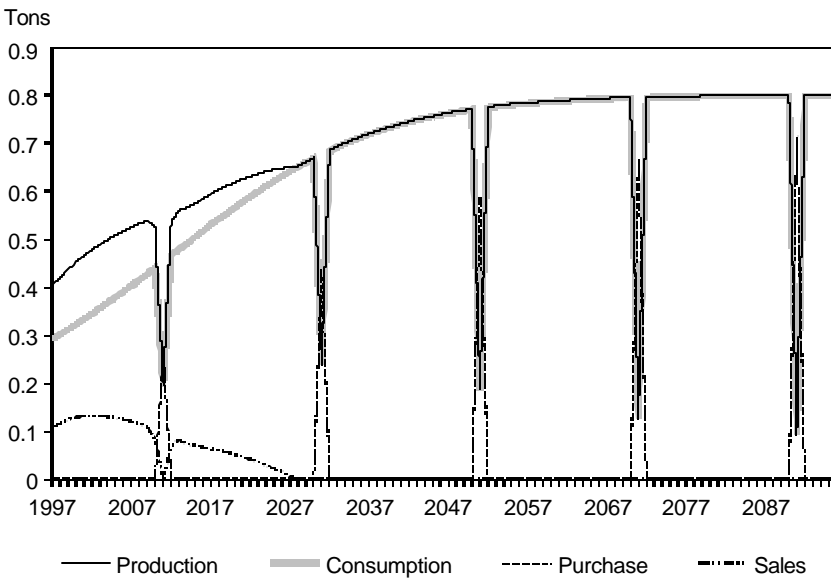


Figure 14.5 tracks the baseline evolution of livestock numbers. Livestock numbers initially trend upwards because livestock production is competitive and because some forage is still left in the community and in the transhumant areas, at least during normal years. However, as the availability of forage in the transhumance areas declines (at an assumed rate of 3 percent per year), livestock numbers eventually trend downwards.

Figure 14.6 shows forage consumption by the livestock from the community. Transhumance is always an important source of forage during the rainy season (season 1), but not during the hot and dry season (season 3), except in drought years.

Figure 14.7 shows the evolution of total income and its composition in the village. Crop income, which accounts for about a quarter of total income, initially increases but then begins a long-term decline after about the 35th year, as production costs increase with the adoption of inorganic fertilizer. Livestock income accounts for only a small part of total income and shows little change over time. The men from the villages have to resort to greater seasonal migration to survive, although migration from the village is not permanent because temporal migration is more profitable. However, the increase in migration income is insufficient to maintain total income, hence total income begins to fall after about the 35th year (Figure 14.7). This means that per capita income also declines (Figure 14.8 baseline case with transhumance but no feed). Even the adoption of inorganic fertilizers is insufficient to reverse this trend; apparently the system is too constrained to intensify in accordance with Boserup's induced innovation model (Boserup 1965).

Millet yields are strongly affected by droughts (Figure 14.4), because no recourse decisions are available for reducing losses. The model chooses to buy millet during droughts instead of carrying stocks from the previous harvest (Figure 14.3). This result conforms to reality. With low productivity, a need for cash and the possibility of migration, farmers are reducing the size of the grain stocks they carry.

Millet yields do not recover immediately after droughts (Figure 14.4) because the loss of part of the livestock herd reduces the quantity of manure that is available. The model compensates for these lower yields in the immediate post-drought period by increasing the cropped area. This is possible because the lower yields obtained during the drought means that less phosphorus is removed from the soil, hence need for fallow after the drought decreases. As a result of the compensation of area for yield, crop income (which includes millet consumption) is much less affected by droughts (Figure 14.7).

The Effect of Droughts

The droughts significantly shock livestock numbers and production (Figure 14.5). The droughts worsen the existing energy deficit. By allowing transhumance, the model allows the livestock to obtain sufficient dry matter, but the ingested energy intake is low and productivity declines.

Figure 14.5 Evolution of livestock numbers

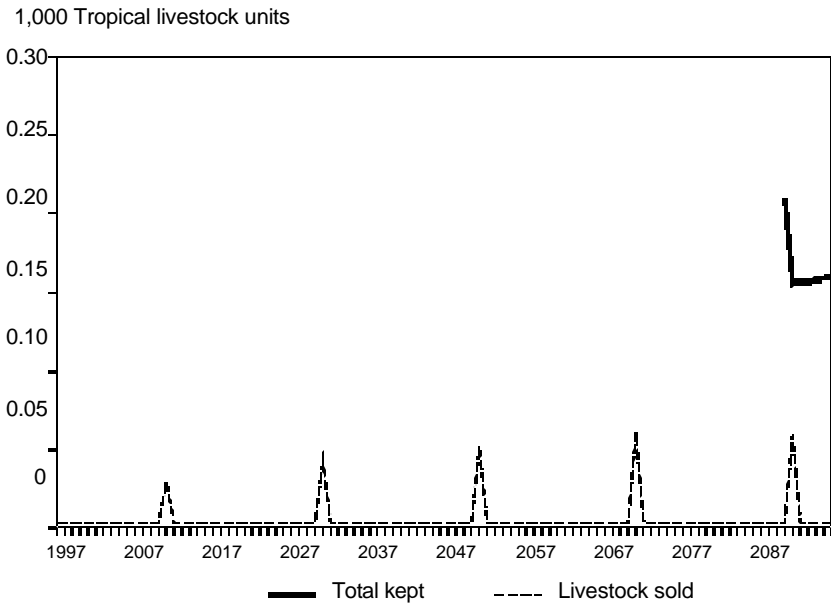


Figure 14.6 Forage consumption from different sources, by period

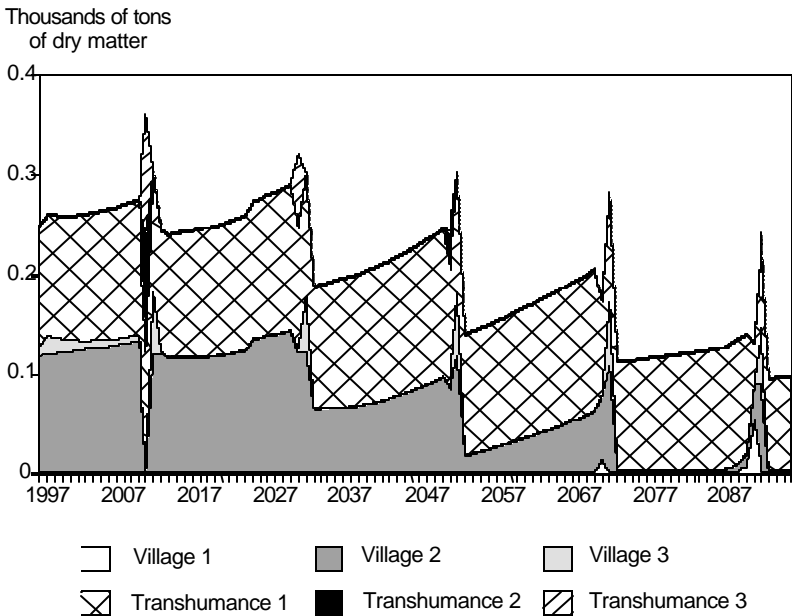


Figure 14.7 Evolution of village income, baseline scenario

Millions of CFAF (Community of Francophone Africa, Francs)

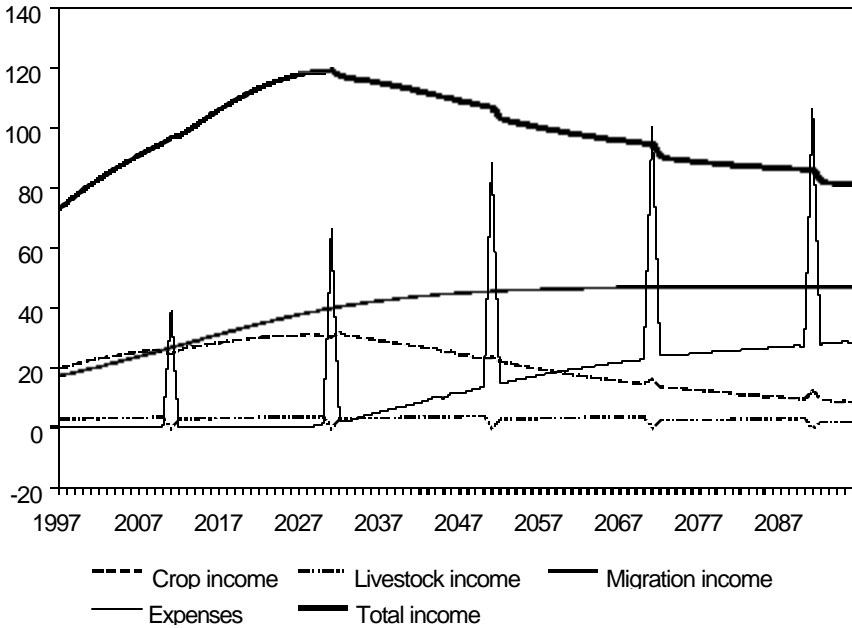
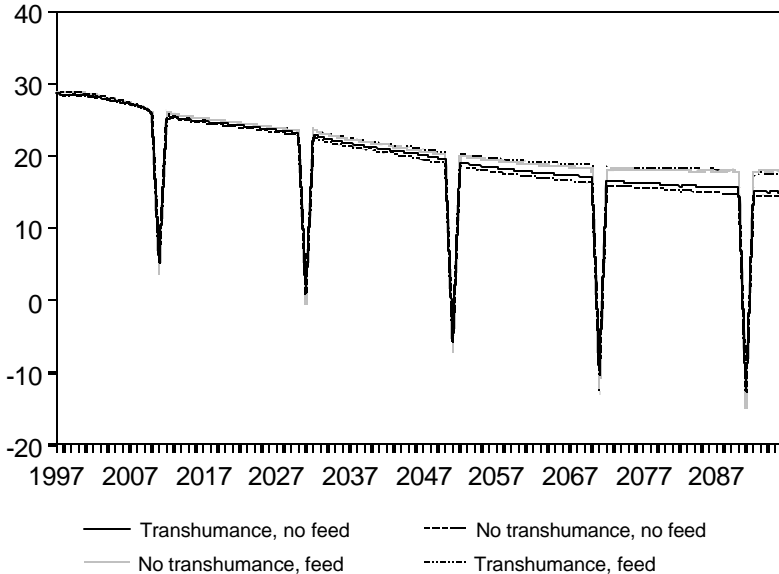


Figure 14.8 Evolution of income per capita under four scenarios

Thousands of CFAF



The baseline simulation challenges the idea that rainfall variability affects crops more than livestock production in drought years. After a severe drought, recovery of livestock numbers and production takes several years. The problem is less severe for farmers because the effect of a severe drought can be mitigated by migration. In this sense, millet production is perhaps better adapted to rainfall variability than livestock production, and thus farmers can recuperate faster than agropastoralists. Agropastoralists usually revert to millet production in the years immediately following a drought, suggesting that livestock production is not that well adapted to droughts.

Income from seasonal migration does not increase in drought years. This is because the adult males in the village already migrate as much as they can during normal years.

Alternative Scenarios for Transhumance and Purchased Feed

As we have seen, transhumance plays an important part in the feeding and drought-management strategies of farmers and pastoralists in the Sahel. Continued access to these grazing areas is increasingly threatened by expansion of the cropped area throughout the region, and by greater privatization of land by communities and individuals (Ngaido [Chapter 11]). A key question is how villages like Banizoumbou will cope as their access to grazing areas diminishes. We considered two components to the adjustment strategy. The first is the use of supplementary feeds purchased from outside the village, particularly in drought years. We assumed that this feed would be provided at market cost. The second component is the exclusion of outsiders from using the village's own grazing resources, that is, reciprocal privatization of the village's own land. Excluding outside livestock would increase the availability of fodder and grazing resources available for use by the villagers' own livestock, and it might also be expected to lead to greater intensification of the farming system within the village through increased investments in inorganic fertilizers and manure.

To examine these options, we conducted three additional model simulations. While the baseline scenario allows transhumance but not the purchase of feeds, one new scenario allows both transhumance and the purchase of feed. Two other scenarios then remove the transhumance option (and also exclude transhumant livestock from entering the village), and one of these scenarios has an option of purchasing feed while the other does not.

The bottom pair of graphs in Figure 14.9 show that a ban on transhumance in the absence of purchased feeds leads to a significant reduction in the size of the livestock herd after about 10 years. This is a clear demonstration of the value of transhumance practices for maintaining herd sizes under existing feeding practices. The graphs also show that transhumance does not smooth out the size of the downside shocks to herd size in drought years, but this is because more animals are carried into the droughts, when transhumance is allowed. Access to transhumance areas is particularly important in the harvest, and dry and hot, seasons during drought years for protecting the herd size.

Figure 14.9 also shows that access to purchased feed has a much more beneficial effect on livestock growth than transhumance and leads to very significant gains in livestock numbers in the longer term (compare the top and bottom pairs of graphs). It also leads to more stable herd sizes with greatly reduced losses in drought years. However, although a feed distribution program would have a beneficial effect on livestock numbers, its impact on per capita incomes is quite modest (Figure 14.9), and almost nonexistent in the short and medium term. This is because livestock income continues to account for but a small share of total village income.

The effect of the different scenarios on land use and yields is small because livestock numbers are too low in this village to have a significant impact on soil fertility at the village level. Even when the herd size expands sharply given a purchased feed option, the effect of manuring is low.

Conclusions

Our modeling results show that transhumance contributes importantly to maintaining the size of the livestock herd in the village, and it is particularly important in drought years for reducing herd losses. If the village were to lose all its traditional access-rights to grazing areas, the impact on livestock production would be severe. However, transhumance does not have a big impact on per capita incomes. This is partly because livestock income is only a small part of total income. (Most income comes from seasonal migration for nonfarm employment during the dry season.) However, this is also true because the village would in turn exclude others from using its own grazing resources, and this would increase the availability of local pastures and crop byproducts for the villager's own animals.

If the villagers were to start purchasing supplementary feeds for their livestock, this could lead to a dramatic increase in the herd size. It would be a very effective way of reducing the loss and sale of animals in drought years. Use of purchased feeds would significantly reduce the need for transhumance. However, again, the impact on per capita incomes would be modest because livestock income is only a small part of total income, and little justification may exist for subsidizing the feeding program.

These results confirm that transhumance is an important risk-management strategy for villages such as Banizoumbou, but that the reciprocal cost of allowing outsiders to bring their animals into the village is also high. Given an alternative drought-management strategy, such as the use of feed supplements, the village would likely soon abandon transhumance arrangements and exclude outsiders from using its own grazing resources.

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15 Ethiopian Case Study

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The importance of livestock for the subsistence and economic development of Sub-Saharan countries has long been recognized (Jahnke 1982; Winrock International 1992; McIntire, Bourzat, and Pingali 1992; Birner 1996). Agriculture, which dominates most of the economies in the region, relies heavily on the livestock subsector for its contribution to the gross domestic product (GDP), estimated at 32 percent in the last decades for the region as a whole (Winrock International 1992). The region's growing population relies heavily on livestock products for their daily dietary requirement. The provision of draught power and manure also contributes a great deal toward improving the stability and sustainability of cultivation in agropastoral systems. Because discussions on the multifarious role of livestock in the region is already abundant in the literature (Jahnke 1982; McIntire, Bourzat, and Pingali 1992; Birner 1996; Ellis 1991; Winrock International 1992), this topic is not be emphasized in this chapter.

Livestock production in Sub-Saharan Africa is dominated by pastoralism and agropastoralism. These are traditional systems that evolved in response to the region's diverse agricultural environment—arid, semi-arid, subhumid, and highland zones with varying temperatures, altitudes, soil types, and natural vegetation (Jahnke 1982). These diverse agroclimates—coupled with disease constraints, divergence in cultural preferences and economic incentives—influence the distribution of animals throughout Sub-Saharan Africa. Pastoralism is practiced in areas not suitable for cultivation; and agropastoralism, in areas where the agroclimatic conditions favor crop production. Pastoralism in the region, in general, is characterized by the daily, seasonal, or yearly movement of animals—in response to the region's fluctuating weather conditions—to reduce risks associated with the use of variable rangelands. An estimated 25 million people in Sub-Saharan Africa derive their livelihood directly from pastoralism, while the number of agropastoralists is estimated at 240 million (Swallow 1994).

Pastoralism has survived through many centuries as a production system in Sub-Saharan Africa. In recent decades, however, it has been observed that pastoralism is in continuous decline because of threats posed by human population growth, by increasing crop cultivation, and by other human activities that shift extensive livestock-production to areas of primary productivity that are increasingly marginal. Government policies—especially land-use policies—over the past decades have hardly been in favor of pastoralists.

Land-tenure policies in most parts of Africa were designed to support sedentarization; indeed privatization, which by implication was supportive of crop production, limits pastoralism to marginalized areas (Ault and Rutman 1979;

Kirk 1996). Pastoralism was to be “modernized” through the introduction of state ranches, fattening centers, and forced organization of pastoralists into strictly supervised pastoral associations. Most of these policies and interventions have, over the decades, only proved to be inappropriate,¹ as they underestimated the production potential of traditional systems and misconstrued the production rationale of the traditional pastoralists. Relics of such interventions in the form of defunct ranches, among others, are still evident in Tanzania and southern Ethiopia today.

As a consequence, pastoralism, which was once capable of maintaining the sensitive balance between grazing land, water, livestock numbers, and the environment, is gradually breaking down in most parts of the region. This has created a need for reorientation in planning and implementing development projects and research priorities for pastoral systems. Realization is growing that pastoralists are also experts, at least in their own way, in living and surviving in their marginal and risky environments; and that priority should first be given to understanding pastoral systems from the perspective of management institutions and property rights under which resources are managed (Hogg 1997; Kituyi and Kipuri 1991; Helland 1997).

Ethiopia: Economic and Policy Issues

AGRICULTURE, LIVESTOCK, AND THE ECONOMY. Ethiopia is situated in northeastern Africa and has an area of 1,223 square kilometers and a population of about 60 million people, with an estimated mean density of 49 people per square kilometer. It is the second most populous country in Sub-Saharan Africa, with a population growth rate of more than 3 percent per year, which is higher than the growth rate in the agricultural sector. It is estimated that the population will have exceeded 67 million by the turn of the century (FAO 1996).

More than 80 percent of the population live in rural areas and derive their livelihood directly or indirectly from agriculture. Ethiopia’s economy is agrarian, with agriculture’s accounting for 85 percent of total employment and 75 percent of exports. In 1996, agriculture alone accounted for about 40 percent of the GDP. The main cash crops include coffee, oilseeds, sisal, tobacco, fruits, pepper, and sugarcane. In general, crops account for about 80 percent of the output value of the agricultural sector, while livestock and livestock products account for the rest (FAO 1996). Despite its relatively low contribution to the agricultural sector, livestock production plays a paramount role in generating rural employment: less than 10 percent of the total land area of Ethiopia is actually under crops, and extensive land use in the form of pastoral and agropastoral production dominates the agricultural production systems. The country is the first in Africa and tenth in the world in terms of livestock resources. These

¹ For further reading, see for example Ellis 1991; Winrock International 1992.

amount to about 70 million head of cattle, sheep, and goats, and about 8 million equines and camels (FAO 1996).

Ethiopia has a diverse agricultural environment: the central massive highlands rise up to an altitude of 4,000 meters, while the lowland altitudes may be as low as 1,000 meters. The delineation of highlands and lowlands here is based on the crude threshold elevation of 1,500 meters or more of above sea level for the highlands (Jahnke 1982). The highlands compose about 40 percent of the entire land area and support about 90 percent of the rural population, forming the main seat of Ethiopia's agricultural activities. Smallholder agropastoral farmers, whose production is largely subsistence, dominate agricultural production in the highlands. Although currently experiencing a declining per capita output because of decreasing soil fertility, the highlands are ecologically more suited to crop production: rainfall, temperatures, and soil types are more favorable to crop production than in the lowlands.

Unlike the highlands, the lowlands are characterized by relatively low human population densities and highly variable and uncertain rainfall. The semi-arid nature of the lowlands makes pastoralism the most well-adapted production practice in the area. To a lesser extent, agropastoralism is also well adapted: cultivation is practiced in areas around villages where population densities are relatively high, and areas around valleys where the agroecological conditions permit this activity. Crop production is generally favored by the central administration, so that the adoption of crops cannot only be attributed to high population densities and suitable microclimates, but is also a response to policy incentives.

In general, development policies in the country are currently based on a five-year, agriculture-based development plan that is intended to create self-sufficiency in food throughout the country. This plan is, however, highly concentrated in the agricultural and agropastoral highlands. Except for programs and projects implemented through the activities of the rangelands development units, pastoral areas have little to expect from such development plans; they form only a small proportion of the country's population and fall into the category of "neglected areas," which, despite decentralization efforts, continue to be marginalized (Hogg 1997).

LAND-USE POLICY. Ethiopia has never really had any comprehensive national land-use policy that clearly spells out different legislation regarding different aspects of land-use and resource-management practices. Frequently, separate legislation governing minor aspects of land use are issued and implemented as deemed necessary. Over the past decades, land administration was mainly in the hands of authorized sectoral ministries, often with different interests, so that the legislation of one sectoral ministry conflicted with that of the other. This lack of a consistent and comprehensive land policy has been noted as a setback in Ethiopia's land-tenure history. The trend is said to have continued unabated throughout the transitional periods (Zegeye Asfaw 1995).

Several changes in land-use policy have been recorded in Ethiopia over the past decades (Teka 1983; Ghose 1985; Zegeye Asfaw 1995). These changes are

believed to have had different impacts in diverse parts of the country, based on the prevailing type of production systems. The changes are attributed to the divergence of policy priorities by the different regimes that prevailed—namely, the monarchy before 1974 (pre-Derg), the Ethiopian Socialist Government (Derg), and the Transitional Government of Ethiopia (post-Derg). Each of these regimes introduced and implemented different land policies that have very important implications for different production systems in the country.

Before the fall of the Monarchy, land tenure in Ethiopia was characterized by an intricate and hierarchical system that varied greatly across different parts of the country (Teka 1983; Ghose 1985; Bruce, Hoben, and Rahmato 1994; Zegeye Asfaw 1995). In the northern region, access to land was based on hereditary rights and community membership—with the imposition of tithe, tributes, and other services imposed on the peasants. In the south, much of the land was held in large estates by landlords and farmed by tenants who were often the original inhabitants of the area. Rents and other services were imposed, or sharecropping arrangements were made. Tenure insecurity was high and eviction was easy, since most of the agreements were merely verbal. Land holdings of peasant households hardly were larger than 5 hectares, and this often consisted of parcels in more than one community. The area was thus characterized by an unequal distribution of land and tenure insecurity. By the 1960s it had become obvious that land tenure was a major constraint to development in the country (Bruce, Hoben, and Rahmato 1994). Pastoral areas were considered “marginal” and therefore experienced little, if any, of the impacts of land-policy changes at that time.

The emergence of the Derg regime in 1974 was greeted by a series of land-reform programs (Zegeye Asfaw 1995). The regime was quick to recognize the need for land reform and on March 5, 1974, it nationalized all rural land and declared it “the collective property of the Ethiopian people.” The program was implemented almost everywhere; land was expropriated from the landlords, state farms were established, wage labor was abolished, and villagization programs were immediately initiated. All other existing land rights were extinguished, and all land became public property with the aim of “liberating the masses from oppression and exploitation” by the land-owning classes.

The implementation of this land-redistribution program began with the formation of peasant associations (*Kebelles*), whose primary responsibility was the allocation of land to peasant households. The redistribution was based on a set of criteria that differed from one region to another—family size, availability of land, and productive potential of the land—and guaranteed a maximum of 10 hectares per household held under usufructuary rights. Households could make claims only at residential *Kebelles*. Under this system, all individual transfer of land, regardless of the method involved, was prohibited. Before its eventual fall in 1991, the Derg regime had already relaxed some of its rigid policies—lifting the ban on hired labor and slowing down the resettlement program.

The post-Derg regime has not reformed land-tenure policy very drastically. Despite its declaration that land continues to be nationally owned, certain inheritance rights were once again ensured and the resettlement programs stopped. This was followed by a call for the establishment of commercial farms by private individuals, with reassuring statements of guaranteeing property rights, credit facilities, construction of feeder roads, and tax concession to facilitate marketing activities (Bruce, Hoben, and Rahmato 1994). Since the fall of the Derg, a general improvement in marketing conditions—both in terms of better selling opportunities and in terms of more consumer goods' becoming available in local markets—have been observed in the country.

Although the target groups for most of the changes in land-use policies were sedentarized crop producers and agropastoralists, the pastoralists also experienced indirect impacts from these changes. Before these policy changes, pastoral-land ownership and administration rested in the hands of the pastoralists, whose enterprise was entirely based on mobility and communal-resource use that was managed traditionally. In other words, the management of all grazing resources was entirely in the hands of community. Communities that once independently and commonly managed their pastures started to become accountable to the central administration through the chairmen of the peasant associations, whose duties and responsibilities sometimes conflicted with those of the traditional elders in these pastoral settings. This situation, coupled with the sedentarization programs, constrained the mobility on which traditional pastoralism greatly depends, creating a negative impact on pastoral development.

LIVESTOCK-PRODUCTION SYSTEMS AND PASTORALISM. Livestock are produced in Ethiopia in an extensive system that is largely agropastoral in the highlands, and pastoral in the lowlands. The natural and agroecological conditions in the highlands are suited to the integration of crops and livestock in a single production system (Jahnke 1982). In the highlands, livestock husbandry is combined with crop production in a sedentarized system with open grazing and relatively high cropping intensities and livestock densities. About 60 percent of the total livestock in Ethiopia is produced in the highlands, the most predominant one being cattle. With this increasing intensification, human population in the highlands is high and was estimated in the 1980s to have an average density of 72 people per square kilometer—almost nine times that of the lowlands (Coppock 1994). The use of draught power and animal manure on crop fields is widespread and is equally as important as postharvest grazing. This mutual contribution of crops and livestock to the farming system, coupled with a relative reliability of rainfall, makes production in the highlands more stable compared with the lowlands. Although production is to a large extent subsistence, market orientation is gradually gaining ground: live animals and dairy products from pastoral areas are penetrating the urban markets, while grains are traded with pastoralists in the lowlands.

The main pastoral areas are the vast stretch of lowlands to the south, southeast, and northeast of the country, surrounding the central massive highlands and

constituting more than 50 percent of the total land area. The area is home to a diverse array of pastoral groups, the most important being the Afar in the north-east, the Somali in the southeast, and the Boran in the south. Although the lowlands have much lower livestock densities than the highlands, they play an important role in meeting the livestock demand in both the domestic and international markets. Lowland breeds are robust and generally regarded as superior to indigenous highland breeds, not only in terms of size, endurance, and productivity but also in terms of performance in cross-breeding programs and in satisfying consumer preferences in the international market. It is also estimated that about 20 percent of the draught animals used in the highlands come from the lowlands (Coppock 1994).

Development efforts targeted at improving pastoral livestock-production date far back to the inception of the first and second livestock-development programs in the late 1950s and early 1960s (Coppock 1994). The objective of these programs was to facilitate the integration of lowland and highland production-systems by establishing a commercial link between the former and the latter. The outcome of this initiative was for a long time minimal and only became significant after the launching of the third livestock-development program in the mid-1970s, which later became the dominant force in the development of the pastoral subsector. The program's pastoral development efforts were concentrated on infrastructural improvements, such as the construction and maintenance of roads, creation of market facilities, water management, and animal-health improvement through the provision of veterinary services. These projects were operational in all the pastoral areas in the country—the northeastern, southeastern, and southern rangelands. With the advent of the regionalization program, the projects were later handed over to the respective regional governments and eventually transformed into rangeland-development units within the federal ministry of agriculture, with a great reduction in the former staff. This move is presumed to be attributed to budget constraints on the central government (Hogg 1997).

The rangeland-development units include the Southern Rangelands Development Unit (SORDU), with headquarters in Yabello; the North-East Rangeland Development Unit (NERDU), with headquarters in Wedia; and Jijiga Rangeland Development Unit (JIRDU) in the east, with headquarters in Jijiga. These targeted areas exhibited good linkages to marketing centers: the NERDU area has good proximity to the Assab port; the JIRDU area has a good rail link to Djibouti; and the SORDU area is bisected by a tarmac road that links the area to Addis and Nairobi, forming part of the African transcontinental highway system (Coppock 1994).

The rangeland-development units are assigned with the execution of a vast array of development activities for facilitating trade linkages and market off-take in the respective regions. On the southern rangelands, for example, the activities of SORDU are largely concentrated on the Borana Plateau, a portion of the southern rangelands that is largely occupied by the Boran pastoral ethnic group.

The activities of SORDU include improvement of access to pasture and water (digging and maintenance of ponds, and renovation of traditional deep wells), construction, and maintenance of access roads to health and marketing centers and to animal-health services. SORDU also manages the few state ranches in the Borana Plateau, which now face pressure for privatization. The field sites of this study are selected from pastoral communities on the Borana Plateau that consist mainly of Boran pastoralists.

Background and Objectives

The study is intended to provide information that will help to smooth the development process of the livestock subsector in semi-arid areas of Sub-Saharan Africa, using the Borana Plateau in the southern rangelands of Ethiopia as a case study. The plateau has received considerable research and development attention over the past decades. While most of these studies acknowledge the enormous work done in the areas of rangeland improvement, animal health, livestock productivity, and marketing, there is a general consensus that the outcomes of these research and development efforts remain far below expectation (Coppock 1994; Cousins and Upton 1988; Hogg 1980; Helland 1982; Kerven and Cox 1996). The International Livestock Centre for Africa's 11-year system study (from 1980 to 1991), summarized in Coppock (1994), concludes that the Borana Plateau, once frequently cited as a model of pastoralism in Africa, is currently in a deteriorating situation that needs attention. This failure is occurring for two main reasons.

First, Coppock attributes this failure to assumptions by planners that were erroneously based on western values and commercialization, largely ignoring the traditional social and economic values of the Boran people. Market off-take of immature cattle, for example, to supply smallholder fattening schemes in the highlands and to generate cash income for the Boran pastoralists, were the expected outcomes. These outcomes could not be realized partly because the Boran people traditionally regard "cattle as wealth" rather than as a source of cash income.

Second, population has been reported to be growing at a rate that is putting significant pressure on a finite resource base, while market opportunities have been increasing since the fall of the Derg. Coppock (1994) concedes that, despite the bulk of research done on the Borana Plateau, little is known about human population dynamics, including changes in social values and how the traditional management institution is able to cope with these changes. He refers to the *gada* system as the traditional institution for managing rangeland resources in the Borana Plateau and cites cultivation as an observable change in property rights. Hogg (1997), using privatization of rangelands on the Borana Plateau as an example, points out that privatization of rangelands upsets the longstanding common-property relationships that are based on the exigencies of

pastoralism or common livestock interests, and emphasizes the need for examining the causes and consequences of these changes.

In their reconnaissance survey in 1996, Kerven and Cox hypothesized changes in land use and property rights on the Borana Plateau to be the outcome of political upheavals, new economic policies, and long-term demographic shifts. The study recommends testing these hypotheses, focusing on various factors underlying shifts in common-property management. It is against this background that the Borana Plateau is believed to offer a good opportunity for a case study on property rights, risk, and livestock development. The natural and agroecological characteristics of the area, which give an idea of the riskiness of production activities in the area, are examined in the next section.

The objectives of the study were to

- identify and characterize important property-rights systems that govern grazing resources in the Borana Plateau, so as to provide a better understanding of the reasons for the existence of common property;
- determine how environmental risk affects resource use and property rights, particularly stocking rates, allocation of land to crop cultivation, and privatization of property rights;
- identify different pathways of property-rights and land-use change in the Borana Plateau; and
- determine the factors that cause a community to follow one pathway rather than another.

Meeting these objectives will provide a basis for the recommendation of policy and other interventions that can assist the Boran community to achieve pathways to intensification that are socially preferred, efficient, equitable, and environmentally sustainable. The study is intended not only to improve understanding of the natural and socioeconomic factors influencing land-use and institutional change, but also seeks in particular to identify ways in which government policies affect community resource-management decisions and their outcomes.

Conceptual Issues and Hypotheses

Two models (the demand led and the supply led) have been put forward to explain changes in property rights, land use, and institutional change (Demsetz 1967; Posner 1977; Anderson and Hill 1975). The demand-led model is consistent with the postulates of the theories of agricultural intensification, and emphasizes that the redefinition of property rights by communities follows a need to internalize externalities that are inevitable concomitants of population growth and increased market opportunities, and thus property rights will evolve if the benefits for establishing and maintaining private rights exceed the costs (Plateau 1995). Although sometimes criticized, the demand-led model is largely accepted on the grounds that factor scarcities and market opportunities do change

people's preferences for different property rights. Many authors have expanded differently upon this model by incorporating the following concepts:

- Marginal benefit and marginal costs associated with the definition and enforcement of property rights (Anderson and Hill 1975)
- Discrete jumps in changing property rights and the irreversible nature of property rights change (Howitt 1995)
- Induced institutional innovation, with special attention to factors affecting the supply of institutional innovation (Ruttan and Hayami 1984)
- Interest-group and rent-seeking theories of property-rights change.

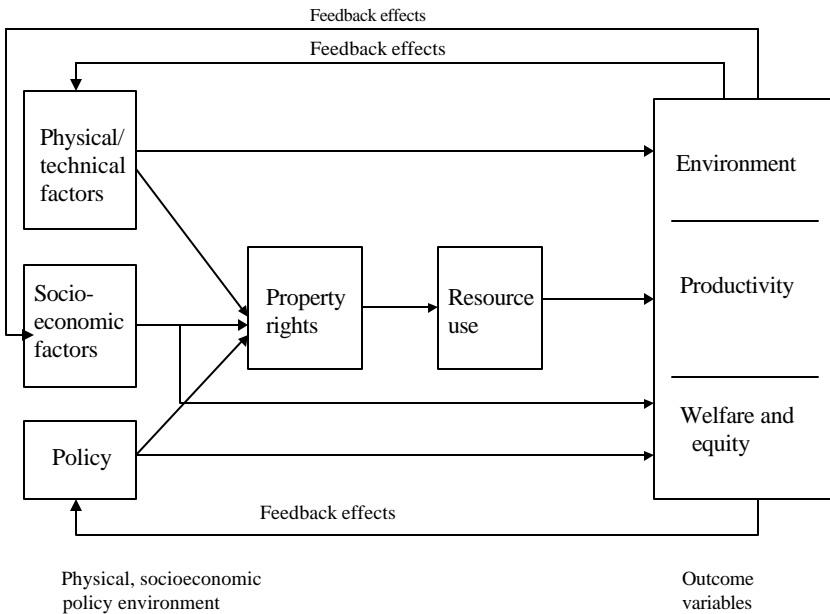
North (1995) focuses on the path dependency of institutional change, citing the importance of individual and shared "mental models."

While the above models lay the basic foundations for this empirical work, the conceptual framework is specifically based on the theories of agricultural intensification, induced innovation, investment in agriculture, property rights, collective action, and institutional change (Boserup 1981; Ruttan 1980; Ostrom 1990; Binswanger and McIntire 1987). Boserup (1965, 1981) and Binswanger and McIntire (1987) postulate in their theories of intensification and induced innovation that factors such as population, market, and technology will induce changes in resource management at the local level as a result of changing factor scarcities and prices. Lele and Stone (1989), among others, expanded upon these theories by incorporating the important role played by government policies in depicting the nature and impact of agricultural change, particularly on natural-resource management and institutions.

The impact of these changes in particular sets of communities will depend on the available institutions facilitating or endorsing the change, and on community characteristics, such as natural-resource endowments (land quality, natural vegetation, topography, climate, and water resources), human capital, and social capital—as captured by the presence of local institutions, rules, and regulations for resource use and of enforcement agents. Pender and Scherr (1996) referred to these characteristics as "conditioning factors" that constrain resource-use decisions at both the household and community levels, leading to different incentives that give rise to divergent preferences for property regimes. Different pathways to intensification may result. The outcomes accompanying these pathways are measurable in terms of changes in productivity, in human welfare, and in the condition of natural resources. It is important to note that policies and decisions that may improve on one of these variables may or may not improve the others. Figure 15.1 summarizes the conceptual framework.

Against this background, the study is designed to test the following hypotheses:

- The main motivations for individualization in the Boran rangelands are related to individual incentives for appropriation of pasture for private grazing.

FIGURE 15.1 Conceptual framework

- Improvement in market access and market condition leads to livestock-development pathways that are led by demand, and improved marketing facilities in Borana increases the demand for privatization.
- State policies and interventions are crucial in facilitating changes in property rights in the Borana Plateau.

The Borana Plateau

LOCATION, CLIMATE, AND AGROECOLOGICAL CONDITION. The Borana Plateau is in the southern-most part of the Ethiopian lowlands and occupies a total land area of about 95,000 square kilometers. It is located between latitudes 4 and 6 degrees north and longitudes 36 and 42 degrees east, sloping gently from 1,600 meters in the northeast to about 1,000 meters in the extreme south, bordering northern Kenya. The area is still predominantly in pastures consisting of flat plains forming the main parts of the range. There is an occasional occurrence of mountains of granitic formation and massive valleys and depressions. Cultivation is mostly done in the valleys and depressions, where good soils occur, and where the average annual rainfall permits the activity. Soils vary widely across the plateau—from the very rocky terrain of lithosols around Yabello, colluvial red soils around Mega, yellowish red soils around Medacho, to loose sandy soils

around Dillo. The differences in characteristics and fertility of these soils and the average annual rainfall are, among other factors, major determinants of the level of cultivation observed in the different communities during the 1998 field surveys and by other researchers (Assefa, Bille, and Corra 1986).

The Borana Plateau exhibits a bimodal pattern of precipitation, with the long rains falling between March and May; and the short rains, between September and November. Spatial and temporal variability in both the quantity and distribution of rainfall renders the plateau as semi-arid, with an average annual rainfall varying from 300 millimeters to 900 millimeters per year (based on unpublished SORDU rainfall data from 1986–97). The long rainy season is usually followed by an extended dry period that offers little opportunity for the growth of annual herbaceous species (Assefa 1990).

The Joint Ethiopian Pastoral Systems Study divided the plateau into four ecological zones based on soil types, natural vegetation, primary productivity, and duration of growing seasons (Cousins and Upton 1988; Assefa, Bille, and Corra 1986). These divisions include the savanna in the north, which has a high potential for carrying high numbers of livestock or being agriculturally productive; the bush land with high shrub cover in the central zone; the medium-potential grassland in the east; and the volcanic areas in the west. Primary productivity varies greatly from year to year and across zones, the highest being 2.7 tons per hectare per year in the savanna grasslands and the lowest being 1.5 tons per hectare per year in the volcanic areas. The west-central part of the plateau is considered to be the heartland of the Borana pastoral system, where the population density in 1982 was estimated to be 7.3 persons per square kilometer (Coppock 1994). The dominant ethnic group, particularly in the west-central part of the plateau, is the Boran, with smaller numbers of Burji, Amhara, Somali, Konso, and Oromo living around towns and in the eastern part of the region.

Social Dimensions

The social organization of the Borana pastoral system is generally based on the *gada*² system, which is a complex organizational framework based on a grade system that divides the Borana community into a number of general classes created each eight years. This grade system is important for the distribution of duties, responsibilities, social rights, and the regulation of the human population growth. Each *gada* (eight-year period) is administered by an *aba gada* or father of the *gada*, who is traditionally elected to preside, together with his council of ministers, over all issues affecting pastoral life in Borana. A consensus on important community issues—such as redefinition and enforcement of rules, regulations, and norms—is reached through open, participatory assemblies (although

² For a more comprehensive review of the *gada* system, refer to Legesse 1973, and Coppock 1994.

for men only). An assembly of all Borana people and/or their representatives (*gumi gayu*) is held every eight years to discuss issues such as resource conflicts and cardinal rules, including those that have been violated because of declining adherence to traditions and culture intertribal issues, and to divine the future of the Borana society (Coppock 1994). The system is believed to have evolved in the 1600s.

The Borana communal-grazing system allows access to pasture and water to every member of the Borana society, contingent upon compliance with the prevailing rules and regulations, and the performance of duties and responsibilities. The *gada* system is primarily concerned with regulating the use of the Borana resource base, maintaining peace among the multitudes of users, and protecting them and their cattle from external invasion. Cattle dominate the Borana pastoral systems and are the focal point of the Borana way of life. The organization of land use, settlement, and traditional administrative systems (which are examined in the next section) has frequently been cited as a model of pastoralism in Africa (Coppock 1994; Hogg 1997; Helland 1997; Swallow 1994).

Institutional Structure, Resource Use, and Property Regimes

INSTITUTIONAL STRUCTURE. The entire Borana Plateau is divided into traditional administrative units called *maddas*. The geographical configuration of a *madda* is constructed around a permanent water source (traditional deep well or permanent pond), administered by a “father of the well.” The wells are of vital importance in Borana social life and all economic and religious life is centered around them. Nine groups of such wells are concentrated in 35 locations on the central part of the plateau (Helland 1982). The father of a well regulates its use, organizes its maintenance, and coordinates with *madda* elders for the implementation of rules, regulations, and sanctions regarding the water source. Each *madda* is subdivided into *ardas* that can best be described as a collection of encampments (*ollas*). Each *arda* has jurisdiction over some form of grazing area, cultivation land, and, to a lesser extent, water resources. The *ollas* comprise about 10 households and are the smallest units of communal resource-management in Borana. At each of these three levels there are officials (usually elders) who manage, in an overall way, the affairs of the community at the respective levels.

PROPERTY RIGHTS OVER GRAZING RESOURCES. Transhumant pastoralism is the customary form of land use in the Borana Plateau. Grazing resources in Borana (pasture and water) are to a large extent owned communally and administered by traditional elders who formulate rules about resource use, administer their enforcement, and ensure that sanctions and penalties are implemented. Pastures can either be *warra*, *forra*, or calf enclosures. *Forra* grazing areas are areas designated for grazing bulls and nonlactating cows (dry herds), and are customarily open to all Borana people. Transit areas around permanent water points are also *forra*. Permanent settlement in *forra* areas is prohibited by *madda* elders;

such areas are regarded as fall-back areas for all Borana people during periods of forage scarcity. *Warra* areas are grazing areas for lactating cows, and for sick and weak animals that return to the encampment everyday so that they can be milked and monitored. Areas designated as *warra* are normally only open to members of the same *arda* but can be used by members of different *ardas* under special arrangements, usually on a reciprocal basis.

Grazing is unrestricted in terms of time, except during periods of forage scarcity, when herd-splitting³ agreements force dry herds to migrate. The most individualized pastures in the Borana Plateau are calf enclosures. Calf enclosures are thorn-fenced pastures that are reserved for use by calves and to a lesser extent by milking cows; they are not stocked at all in the rainy season and are used only in the dry season. The use of calf enclosures is restricted to members of the community that erected the fences, usually one or more *ollas*, although some calf enclosures are now being constructed for use by individual Borana households, as noted below. Access to an enclosure is restricted only to periods of absolute forage scarcity and for specific types of animals. The rules and regulations here are more strictly implemented; collective investment in fencing and, to a lesser extent, bush clearing, is a common practice.

Crop production has recently become important in the Borana Plateau. Using aerial photographs, Assefa, Bille, and Corra (1986) estimated that 0.3 percent of the area of the west-central part of the plateau was cultivated in 1982, compared with 1.4 percent of the area in 1986. Most of the cultivation was around towns and villages (Coppock 1994). Individual households farm cropped fields, with thorn fences erected to protect the standing crops from damage by grazing livestock. Coppock (1994) associates this increase in cultivated area with the drought of 1984.

WATER MANAGEMENT. Like pastoralists elsewhere, the Borana employ a variety of strategies for survival in their marginal and risky environments. The traditional organization of the grazing system, water management, and use of different livestock species are basic elements of resource-exploitation strategies used by the Borana people. The organization of the grazing system into *warra*, *forra*, and calf enclosures has already been elucidated in the preceding section. This system has developed in response to seasonal feed shortages and nutritional stress during periods of forage scarcity, especially the dry period between the long and short rainy seasons. This period is frequently characterized by seasonal water shortages that more or less effectively determine access to pastures. The communal *warra* and *forra* grazing systems impose virtually no limits to grazing, except those imposed by labor requirements and water restrictions (Helland 1982).

³ "Herd splitting" refers to the separation of dry herds from the rest of the animals so that they can be moved over long distances in search of better forage. The duration of stay may vary from a few days to a whole season, depending on the availability of forage and water.

Helland (1982) distinguishes three main forms of water in the Borana Plateau: occasional water, such as natural pools and puddles of rain water lasting only a few days; temporal water, such as ponds and basins that can be both natural and artificial; and the permanent, traditional deep wells that form the pivot of pastoral life in Borana. The pools and puddles are more or less regarded as pasture and are accessible to all Borana pastoralists; in any case, they occur only at the peak of the rains; hence their use need not be restricted. The ponds and wells are subject to a complex set of restrictions, rules, and regulations that are administered and enforced by special agents (ponds or well managers), under the supervision and guidance of the traditional elders. During periods of acute water shortage, the frequency of watering cattle can be reduced to three days so as to increase the number of herds that can be supported by the wells. The effects of this infrequent watering has hitherto not been made very clear, apart from minimal losses of weight and body condition. Details regarding the social organization and administration of the traditional wells, and the importance of this institution to the overall management of grazing resources in Borana, are elucidated in Helland (1982) and Coppock (1994).

Research methods

Site Selection

To test the hypotheses and address the research questions in the preceding sections, a field survey was conducted in 40 rural communities or *ardas* in the Borana Plateau. As stated above, the *arda* is the lowest level of social organization that governs resource use and allocation. *Ardas* were selected in all six districts in Borana: Yabello, Dirre (Mega), Arero, Negelle, Teltele, and Moyale. The selection focused on the Borana pastoral ethnic group in SORDU operational areas that had access roads or paths and some secondary information, at least on rainfall. The field activity was divided into a participatory appraisal phase and an in-depth survey phase. The field research covered an 11-month period from September 1997 through July 1998.

The communities were selected to represent different rainfall patterns (level and variation) and access to markets. Monthly rainfall data from 1986 to 1997 for 12 weather stations located across the Borana Plateau were used to classify areas around the stations into four different rainfall categories: high mean, high variation; high mean, low variation; low mean, high variation; and low mean, low variation. The weather stations varied in terms of their access to markets. Three to five *ardas* were randomly selected from around each of the weather stations to cover the four rainfall categories and different degrees of market access. The selection of *ardas* was also contingent upon physical accessibility (roads or footpaths) and the prevalence of pastoralism. Inaccessible *ardas* and heavily cultivated *ardas* (mostly around major towns) were excluded from the sampling. The focus was on pastoral communities and not on sedenta-

rized, crop-producing communities where the privatization path is already fully established. Table 15.1 shows the distribution of communities around weather stations.

TABLE 15.1 Distribution of rainfall across sites

Station	Characteristics ^a	Mean ^b	Standard deviation	Coefficient of variation	Number of <i>ardas</i>
Sarite	LR, LCV	469	103	0.24	3
<i>Sum</i>					3
Wachile	LR, HCV	473	222	0.49	5
Web	LR, HCV	399	199	0.48	4
Dembelawachu	LR, HCV	353	130	0.39	2
Dillo	LR, HCV	499	170	0.39	3
<i>Sum</i>					14
Yabello	HR, HCV	519	230	0.46	5
Arero	HR, HCV	873	374	0.45	4
Negelle	HR, HCV	739	241	0.32	3
Moyale	HR, HCV	869	588	0.67	2
<i>Sum</i>					14
Hidilil	HR, LCV	717	203	0.28	4
Did Yabello	HR, LCV	496	141	0.28	1
Teltele	HR, LCV	634	135	135	4
<i>Sum</i>	...	...	...	...	9
<i>Grand total</i>	...	...	...	...	40

NOTE: An ellipsis (...) indicates not applicable.

^a LR indicates low mean, HR indicates high mean, LCV indicates low coefficient of variation, and HCV indicates high coefficient of variation.

^b Millimeters per year.

Data collection

The first phase, the community survey, employed a combination of both open- and closed-ended survey questions, and participatory appraisal methods. Social mapping was used to assess the proportion of land under different types of land use, the different types of common-property grazing-areas, transhumance routes, and private enclosures. This was followed by a wealth-ranking exercise, identification of border points, and an intensive interview to gain information on demographics, appraisal of livestock holdings, livestock diseases, marketing, and rules and regulations regarding pasture and water management. Physical

measurements of land area under different land uses were not possible because of environmental and geomorphological constraints. The total land area of a community was appraised using a Global Positioning System instrument to obtain as many coordinates of community border points as possible. Using these coordinates, two geographic-information-system packages were employed as follows: the data were first entered into ArcInfo, where boundaries for each community were digitized and areas for each community calculated; ArcView was then used to prepare community maps. Market surveys were also conducted to generate cross-sectional data on prices, body condition, and other physical attributes that determine prices of livestock across the seven major markets in the plateau. These surveys are further supplemented with information generated by a rapid appraisal of the range condition of the 40 communities by a range expert.

The second phase was an in-depth survey of two pairs of *ardas*—a subsample of the first 40, whose selection was based on information generated by the first rounds of surveys. In each set, common range is largely maintained in one while the conversion into private land is greater in the other, despite both being exposed to similar policies, interventions, and climatic conditions. The object here is the assessment of the long-term impacts of policies and external interventions on property rights, institutional change, and the way in which different pathways are followed. This survey consisted of semistructured interviews guided by a chronological chart of events (for example, droughts and policy changes) and reference dates compiled by the researchers together with the *arda* elders. The in-depth survey relied very much on recall information as narrated by community elders.

Preliminary findings

Descriptive Statistics

COMMUNITY CHARACTERISTICS. Table 15.2 summarizes the characteristics of the 40 *ardas* covered in the study. The communities consist of a total of 200 settlements (pastoral encampments), with an average of 5 settlements per community. This constitutes a total of 3,141 households, with an average of 79 households per community and 7 people per household. The total human population of all the *ardas* is 21,637 people, with a mean of 541 people per community and a population density of 46 people per square kilometer. This mean density ranges between 4 and 218 people per square kilometer, excluding one community in the sedentarized areas of Moyale that has a unusually high population density of about 408 persons per square kilometer. About 26 percent of the households are headed by females. The overwhelming majority of the households are classified as poor (60 percent), 24 percent as middle class, and the remaining 17 percent as wealthy. This is based on the wealth classification criteria used by the respective communities.

TABLE 15.2 Community characteristics

Variable	Mini- mum	Maxi- mum	Mean	Standard deviation	Sum per <i>arda</i>	Per- cent
Settlements per <i>arda</i> ^a	1.00	21.00	4.97	4.25	199	100.00
<i>Arda</i> population: persons	48.00	3,160.00	540.93	610.00	21,637	100.00
Population den- sity—persons per square kilometer	4.35	218.00 ^b	46.14	46.72	...	...
Number of people per household	4.00	8.00	6.50	0.90	...	...
Total households in <i>arda</i>	8.00	395.00	78.50	82.55	3,141	100.00
Number of female headed households	1.00	85.00	20.68	19.58	827	26.32
Number of male headed households	5.00	331.00	58.35	64.29	2,314	73.68
Total	...	...	78.55	82.59	3,141	100.00
Number of wealthy households	4.00	58.00	9.62	14.82	385	16.73
Number of middle class households	6.80	59.60	16.50	12.75	660	23.55
Number of poor households	13.00	90.00	52.45	21.96	2,096	59.75
<i>Total</i>	...	...	78.55	82.59	3,141	100.00

NOTE: An ellipsis (...) indicates not applicable.

^a Pastoral community consisting of two or more settlements—the unit of study.

^b Excluding one community in the highly sedentarized areas of Moyale that has a population density of 407.51 persons per square kilometer.

LIVESTOCK HOLDINGS. Cattle is by far the most important livestock species kept by the Borana pastoralists. All 40 of the communities raise cattle as the dominant component of their stock. This consists of about 64,470 heads of cattle (45,130 tropical livestock units, or TLUs) that account for about 90 percent of the total livestock population of the sample communities in terms of TLUs (Tables 15.3 and 15.4). The conversion of livestock heads into TLUs follows the Food and Agriculture Organization of the United Nations' conversion factors as applied by Jahnke (1982). The minimum number of cattle per community is 66 (46 TLUs), the maximum is 13,350 (9,345 TLUs), and the mean is 1,600 (1,128 TLUs).

TABLE 15.3 Livestock holdings per community (head of livestock)

Species	Number ^a	Minimum	Maximum	Mean ^b	Standard deviation	Sum
Cattle	40	66	13,350	1,612.00	2,972	64,469
Goats	39	0(10)	6,320	391.00	1,047	15,747
Sheep	36	0(2)	1,640	125.00	347	5,005
Horses	5	0(2)	10	0.57	2	23
Donkeys	35	0(1)	153	23.50	35	942
Camels	36	0(2)	606	52.60	99	2,105

NOTE: Numbers in parentheses are the minimum holdings per community besides the zeros.

^a Number of communities with the species.

^b Mean for the 40 communities.

TABLE 15.4 Livestock holdings per community in tropical livestock units

Species	Minimum	Maximum	Mean ^a	Standard deviation	Sum	Percent
Cattle	46	9,345	1,128.20	2,080.80	45,128.3	90.34
Goats	0(1)	632	38.48	1,04.40	1,539.2	3.08
Sheep	0(1)	164	12.73	34.90	509.3	1.01
Horses	0(2)	8	0.46	1.56	18.4	0.04
Donkeys	0(1)	107	16.48	24.44	659.4	1.32
Camels	0(2)	606	52.62	98.83	2,105.0	4.21
<i>Sum of TLUs</i>	58	9,780	1,248.69	2,229.80	4,9948.0	100.00

NOTE: Numbers in parentheses are the minimum holdings per community besides the zeros.

^a Mean for the 40 communities.

The second-most important species, in terms of adoption, are goats, which are raised by 97 percent of the communities under investigation. This totals about 15,750 head of goats (1,540 TLUs). In terms of the total number of TLUs, camels are more important than goats and constitute about 2,105 of the total TLUs of the 40 communities under investigation. Sheep, donkeys, and, to a lesser extent, horses are also raised to some extent by the Borana pastoralists. These three together constitute only 2.4 percent of the total livestock (in terms of TLUs) of the Borana pastoralists. Sheep and donkeys are present in 90 percent of the communities under investigation, while horses are present in only 13 per-

cent of these communities. The total number of livestock in all the 40 communities is about 50,000 TLUs, with a mean density of 107 TLUs per square kilometer.

CURRENT LAND ALLOCATION AND PROPERTY RIGHTS. Table 15.5 shows the current pattern of land allocation on the Borana Plateau. The total land area of the communities under investigation is about 46,741 hectares. Approximately 16.3 percent of this land is allocated to cropping activities (in agricultural year 1997/98), while the remaining 84 percent is used for different livestock-production activities—communal and private grazing. These include the following:

- Communal-grazing areas for milking cows, calves, sick, and weak animals (*warra*)
- Communal and private enclosures for calves

TABLE 15.5 Land use (hectares)

Use type	Number ^a	Minimum	Maximum	Mean ^b	Standard deviation	Sum	Percent
Communal grazing: <i>warra</i> ^c	33	0(84)	1,845	570	438	22,767	48.70
Calf enclosures ^d	33	0(21)	530	150	137	6,008	12.85
Communal grazing: <i>forra</i> ^e	1	0(570)	570	14	90	570	1.22
Cultivation area	33	0(32)	1,050	191	230	7,629	16.32
Area for draught animals	19	0(8)	338	46	74	1,850	3.95
Others ^f	29	0(53)	1,972	198	341	7,915	16.93
<i>Total</i>	...	249	3,074	1,168	639	46,741	100.00

NOTE: An ellipsis (...) indicates not applicable. Numbers in parentheses are the minimum number of hectares per community besides the zeros.

^a Number of communities with the land use type.

^b Mean for the 40 communities.

^c Communal-grazing areas for milking cows and calves. Sick and weak animals may also graze here.

^d Enclosures for calves during forage scarcity—most enclosures are communal, but some are private.

^e Communal-grazing areas for dry herds (unrestricted) for all Borans; usually unsettled.

^f An aggregate of settlement areas; grazing areas for small ruminants, camels, and equines; and transit areas for transhumant herders around deep wells and ponds.

- Communal-grazing areas for dry herds (*forra*)
- Settlement areas and communal-grazing areas for small ruminants, camels, and equines
- Enclosed areas for draught-animal grazing around cultivated fields
- Buffer areas, such as transit areas reserved for transhumant herders around permanent water-sources that are usually accessible to all Borana pastoralists.

Warra areas are present in 83 percent of the communities and constitute about 49 percent of the total land area (about 23,000 hectares). Calf enclosures are also present in about 83 percent of the communities but account only for about 13 percent of the total land area. In each of the communities, the encampments are surrounded by an area reserved for grazing by small ruminants for all members of the encampments. Grazing areas for draught animals within the enclosures surround enclosed areas for cultivation. In total area, cultivation areas account for 16 percent and the adjacent areas for draught animals account for 4 percent of the total land area.

Currently, 32 out of the 40 communities under investigation (80 percent) are cultivating. About 30 percent of the communities took up cultivation in the last 10 years; and 50 percent, in the last 20 years (Table 15.6). Thirty years ago only four communities (10 percent) were cultivating. The mean area cultivated by a single household is appraised to be 2.4 hectares. This fluctuates between a maximum of 12 hectares and a minimum of 0.4 hectares. These figures are not based on physical measurements but appraisals of proportions that were later converted into actual areas.

TABLE 15.6 Adoption of cultivation

Practice duration	Number of communities	Percentage	Cultivated area (hectares) ^a
No cultivation at all	8	20.0	...
1 to 10 years of cultivation	12	30.0	...
11 to 20 years of cultivation	20	50.0	...
Number of communities cultivating	32	80.0	...
Average per community	...	...	191.0
Largest per household	...	...	12.0
Least per household	...	...	0(0.4)
Average per household	...	...	2.4

NOTE: An ellipsis (...) indicates not applicable. Numbers in parentheses are the least number of hectares besides the zeros.

^a Average for all households or communities, whether cultivating or not. These appraisals are not based on physical measurement.

Table 15.7 shows the proportion of land area held under different regimes. Property rights are determined here not by the property institutions themselves, but rather by their realization at particular points in time as measured by the amount of land area or other resources held under different categories of property regimes. Private-property rights are thus given by the land area held under private usufruct and apply to private enclosures for calves, cultivated areas, and areas for draught animals, constituting a total of about 24 percent (11,200 hectares) of the total land area. As to the land held under private usufruct per community, the minimum is 32 hectares, the maximum is 1,050 hectares, and the mean is 280 hectares. Common property constitutes 76 percent of the total land area, and about 49 percent of this is the *warra* area. Common calf-enclosures account for about 9 percent and are present in 65 percent of the communities. *Forra* grazing areas, settlement and small-ruminant grazing areas, and transit areas around permanent water sources all constitute common property. Details of their proportional contribution to the land area under common property are shown in Table 15.7.

Econometric Analysis

The econometric analysis is intended to quantitatively assess the relative importance of the various factors affecting stocking rates, land use, and property rights in the Borana Plateau. Population growth, increasing market opportunities, and climatic conditions, among other factors, have been asserted by previous studies to be the main determinants of stocking-rate and land-use change in the Borana Plateau. However, specific attention has hitherto not been paid to the assessment of the relative importance of these factors to the observed changes in Borana (for example, Coppock 1994; Hogg 1997; Kerven and Cox 1996). This assessment could be of relevance to policymakers in setting policy priorities for related questions. To address these issues, two models are currently being developed: the stocking-rate model and the land-use model.

THE STOCKING-RATE MODEL. This model is a single-equation model expressing stocking rates as a dependent variable expressed as a function of many explanatory variables. The model is intended to give an idea of the current stocking rates, the extent of community-level cooperation in managing stock levels, and the significant variables that explain the observed outcomes. Stocking rates are important for making decisions about which land should be put into private or common use. The reduced-form equation is as follows:

$$A_i = f(S_{Ai}^2, Pi, c, het, SC, mem, \mathbf{a}, \beta),$$

where the following is true:

$$A_i = \text{the actual stocking rates in the } i\text{th community—the number of livestock in TLU per hectare.}$$

TABLE 15.7 Property rights (area under different regimes, hectares)

Property rights	Number ^a	Minimum	Maximum	Mean ^b	Standard deviation	Sum	Percent
Communal grazing: <i>warra</i> ^c	33	0(84)	1,845	570	438	22,767	48.70
Communal calf enclosure ^d	26	0(21)	505	107	121	4,288	9.17
Communal grazing: <i>forra</i> ^e	1	0(570)	570	14	90	570	1.22
Others ^f	29	0(53)	1,972	198	341	7,915	16.93
Sum: common property	...	174	2,459	889	569	35,541	76.02
Private calf enclosure	7	0(47)	530	43	116	1,719	3.67
Cultivation area	32	0(32)	1,050	191	230	7,629	16.32
Area for draught animals	19	0(8)	338	46	74	1,850	3.95
Sum: private property	...	32	1,050	280	281	11,200	23.94

NOTE: An ellipsis (...) indicates not applicable. Numbers in parentheses are the minimum number of hectares per community besides the zeros.

^a Number of communities with the type of land use.

^b Mean for the 40 communities.

^c Communal-grazing areas for milking cows and calves. Sick and weak animals may also graze here.

^d Enclosures for calves during forage scarcity—most enclosures are communal, but some are private.

^e Communal-grazing areas for dry herds (unrestricted) for all Borans; usually unsettled.

^f An aggregate of settlement areas; grazing areas for small ruminants, camels, and equines; and transit areas for transhumant herders around deep wells and ponds.

- s^2 = the output variance. Rainfall variability will be an indicator, and forage productivity is associated with rainfall variance, which in turn affects livestock productivity.
- P_i = the output price—prices for crop and livestock products at the market centers where the transactions take place.
- C = costs. Input used on crops are still relatively low, and those used on livestock are obtained almost free from SORDU. Distance to the service center will be used in this preliminary analysis as proxy for costs.
- Mem = number of users that have access to the resource. In this preliminary analysis, this equivalent the number of households in the community.
- Het = heterogeneity in terms of cultivation or wealth as defined by the communities.
- SC = social capital—a dummy variable indicating, for example, the presence or absence of absence of rules and regulations regarding resource use and mechanisms of enforcement. For this preliminary analysis, the sum of resource use rules in the community will be the proxy.
- α, β : = productivity parameters of the rangelands—biomass and dry matter production; aggregate of the crude protein content of the different species comprising the forage. These constitute a score attributed to each community on a scale of 1 to 5. Mathematically, the range-quality index (R) is given as

$$R = \sum_{i=1}^n (i H_i).$$

- i = the pasture score.
- H_i = the proportion of area ascribed to score i .
- n = upper limit of score ($n = 5$).

THE LAND USE MODEL. This model is developed in terms of land allocation to different activities. This model is intended to give an idea of the current utilization pattern of the rangeland resources among different activities—how these compare with optimal use and the significant variables that explain the observed trends. The relative importance of population, market access, relative prices, and other factors in determining land area allocated to different activities and under different regimes will be assessed. The land-use equation is as follows:

$$LU = f(d, \mathbf{f}R, ma, a, p_c, p_l, t, A_i),$$

where

- LU = land area allocated to crop- and livestock-production activities, in hectares, which will be the dependent variable in each of the equations;
- d = population density, expressed in people per square kilometer;
- \mathbf{f} = production risk for crop and livestock again, with the level and variability of rainfall used here as a proxy;
- R = range quality index, determined as above;
- a = agroecological conditions;
- ma = market access in terms of physical distances (kilometers) from the markets where livestock (and products), input, and grains are bought and sold;
- t = technology—a dummy variable expressing the presence or absence of cost- or labor-efficient technology that favors one activity; and
- p_c, p_l = prices of crops and livestock, respectively.

The models are yet to be fully developed. The results of these models are therefore not included in this chapter.

Discussion

Land Use and Property Rights

The preliminary analysis presented in this chapter provides an overall picture of land-use and property rights in the Borana Plateau. The results indicate a large increase in the area cultivated since 1986. Slightly more than 16 percent of the area in the 40 *ardas* was reported to be within cultivated fields in 1997. This includes pasture land adjacent to cultivated fields within the thorn fences used to protect and demarcate the fields. This study was not able to distinguish between land actually cropped and pasture land within crop enclosures. The figures could be slightly understated for the whole of Borana, since very heavily cultivated areas around major settlements were excluded from the sampling because of the absence of pastoralism. Coppock (1994) estimates that 70 percent of cultivation in Borana takes place around towns and villages. The community survey also indicates a phenomenon that is apparently new in the Borana Plateau: private

enclosures of pasture for grazing calves (3.6 percent of total area) and draught animals (4 percent of total area). This trend of private enclosure is observed in seven communities around Wachile and Arero.

Among the 40 communities, several distinct patterns of land use and property rights existed. It is useful to distinguish five types of communities:

- Those in which most of the land is enclosed in private fields, some of which is used for cultivation and the remainder used for private grazing
- Those in which a smaller proportion of the land is enclosed in private fields, with much of the pasture land contained in restricted-use enclosures used by individual households or small groups of households
- Those in which a smaller proportion of the land is enclosed in private fields, with much of the pasture land used by all members of the *arda*
- Those in which none of the land is cultivated, with some of the pasture land contained in restricted-use enclosures
- Those in which none of the land is cultivated, with most of the pasture land available to all members of the *arda*.

Changes in Property Rights and Land Use

Expansion of cultivation and enclosure of land around cultivated fields are two of the most noticeable and important changes in land use in the Borana Plateau. Up to 16.3 percent of the land area in the 40 communities is now cultivated, compared with 1.4 percent in 1986 (Coppock 1994). Approximately 80 percent of the communities in the sample now include some households that cultivate: 30 percent of the 40 communities took up cultivation within the last 10 years, and 53 percent took up cultivation in the last 20 years. Thirty years ago only 4 communities (10 percent) were cultivating. The average plot size of the cultivated fields has also increased from 0.15 hectares (Coppock 1994) to 2.4 hectares per household in agricultural year 1997/98.

Individualization—at the levels of the *arda*, *olla*, and individual—is also increasing rapidly in the Borana Plateau. All of the cultivated land is reserved for individual use. *Warra* grazing is the most significant of all the communal-grazing systems in Borana. It is present in 83 percent of the communities under investigation. The expansion of cultivation areas and the privatization of rangelands encroach a great deal on the *warra* areas. Despite this encroachment, *warra* areas still account for about 50 percent of the total land area of the sample communities, suggesting that it is the most important form of common-property regime that still prevails in Borana. The communal calf-enclosures are more regulated, with more restricted conditions of access and rules that are more strictly implemented than those of the *warra*. Calf enclosures have increased a great deal in the recent past with the advent of cultivation and sedentarization. Enclosure by private individuals is also evident in about 17.5 percent of the communities but composes only 4 percent of the available land area. Community-level enclosures are relatively more important and compose about 10 per-

cent of the available land area, with about 65 percent of communities involved in the practice.

Communal-grazing areas for dry herds (*forra*) is present only in about 2.5 percent of the communities and compose only about 1 percent of the study area. This observation does not imply an insignificantly small *forra* area all across the plateau, but rather, it points to the fact that *forra* areas are generally unsettled areas that are open to all Borans during periods of forage scarcity. Since *forra* areas fall outside the borders of the communities under investigation, their proportional representation in terms of community land area is therefore almost nil. The rest are areas around settlements that are communally grazed by small ruminants, camels, and equines. The pathway analysis that will use data from the follow-up in-depth surveys is currently in progress and could not be presented in this report.

Determinants of Property-Rights and Land-Use Change

The observed privatization of rangelands can be attributed to a number of exogenous and endogenous factors. Among important factors, population growth appears to have played a key role. Evidence compiled by Coppock (1994) suggests that the human population has been growing at a rate of between 2.5 percent and 5 percent per year. While the average population density in the west-central part of the Borana Plateau was 7.3 persons per square kilometer in the mid-1980s, average population density in the 40 communities in 1997/98 was 46 persons per square kilometer, with a range of 4 to 218 persons per square kilometer. This is a relatively high population density relative to other pastoral areas in East Africa. However, while it is a ubiquitous force, overall natural population growth cannot explain the rapid changes that have occurred in the last 20 to 30 years, and particularly in the last 10 years. Also important has been the recent influx of nonpastoralists into the area, particularly around the towns.

The main cultivation areas continue to be within 10 kilometers of the main towns. The cultivators around such settlements are mainly highlanders coming from the neighboring Guji, Gabbra, and Konso groups, or Boran who lost all of their cattle.

Preliminary estimations of the stocking-rate equation also show a positive relationship between population density and stocking rates. This is possibly explained by the fact that the larger the number of members with access to the resource, the more difficult it becomes to cooperate and to make and enforce rules on stocking rates and access to resources.

Climatic conditions are also important. First, some parts of the Borana Plateau are actually well suited for crop cultivation. Coppock (1994) estimates that 12 percent of the land, particularly valley bottoms and water swills, may be cultivated sustainably. As of the mid-1980s, most of that land was still used as pasture land. However, the drought of the mid-1980s resulted in a reduction of about 70 percent of the cattle kept by Boran pastoralists. Crop cultivation may

have become a fall-back for many households. Again, however, this does not explain the virtual absence of cultivation 30 years ago.

The timing of the rapid change in property rights and land use is likely more related to the interplay of the external and local political systems. Until 1975, the rulemakers and rule enforcers in the Borana Plateau were the traditional elders who were generally reluctant to grant individual rights to either cultivated land or to enclosed pasture land. The advent of peasant associations in 1975 created an alternative form of government, a form of government that favored the sedentarization of pastoralists. Peasant associations were rulemakers and rule enforcers that were strong enough compared with the Borana elders to facilitate the registration of individual use-rights to crop land. Many *ardas* saw crop cultivation for the first time after 1975. The Derg regime also supported the development of agriculture in the Borana Plateau through its external support to crop cultivation.

Another change in the external environment occurred after the change in government in 1991. Since that time, regional governments have become much stronger and some changes have been made to the structure of peasant associations. In some cases, the forced merger of two areas into one new peasant association has resulted in something of a land rush, with the members of resource-rich communities' claiming private usufruct to cropland and rangeland, rather than letting it be exploited by a much larger supra-*arda* population.

Thus the policies of the Ethiopian government since 1975 have been biased toward cultivation and, through the government's system of individual land-use rights for cultivated land, toward individualization. The reach of those policies has been extended by the development of transportation infrastructure in the area by the SORDU. Cultivation and individualization thus go hand-in-hand in Borana. It can therefore be hypothesized here that the main motivations for both cultivation and individualization are related to appropriation of pasture land, and desired investments in pasture land. The demand for appropriation may have also increased because of changes in market conditions that have linked the Borana Plateau directly to the urban market in Nairobi, Kenya. At the same time, changes in the national government have made private appropriation more feasible. Demand for investment in pasture land has also increased as an indirect result of policies of the Derg government. Prohibitions on fire resulted in bush encroachment in the common pastures; individuals have more incentive to invest labor in bush removal on private cropland.

Private appropriation of pasture land without the pretext of cultivation is occurring in some communities. Detailed case studies indicate it is allowed to happen because of an implicit partnership between the wealthy households that want to appropriate land and the poorer households that seek to align themselves with those wealthy households. Poorer ones who cannot afford to erect their own fences assist wealthier neighbors so that they can be granted grazing rights in the dry season. First, they "forum shop" between two options of social groupings: either to align with the group of poorer pastoralists who cannot afford the

investment in establishing the private claims and hence are opposed to the activity, or join the elite group of investors by occasionally assisting in fencing and other related activities in return for some form of grazing rights in the dry seasons. The current trend seems to favor the latter option, since social grouping by opposers is still not well organized enough to create a reasonable impact.

There is also evidence of the elites securing their interests through affiliation with the heads of the peasant associations. This trend is commonly observed especially in communities around Wachile and Arero. In communities where this trend was not observed, the claim was that the community is not interested because no attempt has been made so far to be followed by others—no beginner to spearhead the others' conforming to the innovator line of argument.

The activities of nongovernmental organizations and other development agencies in Borana also should not be neglected here. The construction of large ponds by SORDU and to a lesser extent CARE–Ethiopia contributes positively to sedentarization and its associated cultivation. Results of these interventions have not been very consistent with expectation; the reasons for this are numerous (see Coppock 1994). The bush-clearing programs of the German Agency for Technical Cooperation and Norwegian Church Aid contribute a great deal to the management of communal *warra* grazing areas. One of the hypotheses behind the private appropriation of rangelands is that forage scarcity is due largely to the loss of grazing areas to bush encroachment following a policy that banned burning in the 1970s. The bush-clearing programs facilitate the reclamation of grazing areas that can once again be used by the community.

Conclusions

The changes in property rights and management institutions in Borana are explained by an interaction of internal and external factors. Adoption of cultivation and privatization of rangelands in Borana is partially demographic and partially market driven, as explained above. Evidences of endogenous individualization is found in traces as demonstrated by the “interest groupings” and “forum shopping” in a few communities. The current demand for the individualization of rangelands (for private grazing) is facilitated by the state through the formal institution of the peasant associations. National policies that support cultivation and sedentarization also play a paramount role in facilitating the privatization process.

The bush-clearing and “pasture reclamation” programs are desirable for supporting the local commons in Borana. As an alternative to privation, common management is consistent with traditional pastoralism in Borana, especially under equity considerations. The privatization path constrains mobility on which traditional pastoralism is based; and if the trend continues unabated, movements may become restricted in the future, perhaps to the extent of full sedentarization. The semi-arid nature of the Borana rangelands, with their recurrent droughts, will hardly be the basis for a stable production system if sedentarization results.

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Conference Agenda

Saturday, September 26, 1998

Arrival in Feldafing
Registration
Introductions

Sunday, September 27, 1998

Opening Session *Chair: P. Hazell*

- 8:30–9:10 Welcome and discussion of symposium agenda and format
- Representative of the German Foundation for International Development
 - S. Ehui (International Livestock Research Institute, Ethiopia)
 - M. Kirk (Marburg University, Germany)
 - Peter Hazell (International Food Policy Research Institute, U.S.A.)

Session 1: The Context for Livestock and Crop-Livestock Development in Africa

- 9:10–9:40 Property Rights, Risk and Livestock Development—Overview of Issues
- B. Swallow (International Livestock Research Institute, Kenya)

- 9:40–10:40 The Evolving Role of the State in Influencing Property Rights over Grazing Resources in Sub-Saharan Africa
- M. Kirk
- Discussant:
- W. Kisamba-Mugerwa (Makerere University, Uganda)

- 10:40–11:00 Coffee Break

- 11:00–12:00 Public Policy and Drought Management in Agro-Pastoral Systems
- P. Hazell
- Discussant:
- S. Ehui

- 12:00–1:00 The Role of Donors in Influencing Property Rights over Pastoral Resources in Sub-Saharan Africa
- M. Kirk/H. Grell (German Agency for Technical Cooperation, Burkina Faso)
- Discussant:
- N. Chisholm (Irish Aid)
- 1:00–2:00 Lunch Break
- 2:00–3:00 Managing Mobility in African Drylands
- M. Niamir-Fuller (United Nations Sudano-Sahelian Office, Brazil)
- Discussant:
- P. Hiernaux (International Livestock Research Institute, Niger)
- 3:00–4:00 Crop-Livestock Systems in Sub-Saharan Africa: Determinants and Intensification Pathways
- T. Williams (International Livestock Research Institute, Niger)
- Discussant:
- S. Sandford (Farm Africa, UK)
- 4:00–4:20 Coffee Break
- 4:20–5:20 Roundtable to Identify Key Issues Emerging from the Day's Presentations
- Chair:
- W. Kisamba-Mugerwa
- Rapporteur:
- N. McCarthy (International Livestock Research Institute, Kenya)

Monday, September 28, 1998

***Session 2: Modeling the Effects of Risk
on Rangeland Management***

- 8:30–9:30 An Economic Analysis of the Effects of Production Risk on the Use and Management of Common-Pool Rangelands
- N. McCarthy
- Discussant:
- J.-P. Chavas (University of Wisconsin, USA)

- 9:30–10:30 Fuzzy Access: Modeling Grazing Rights in Sub-Saharan Africa
 ▪ R. Goodhue (University of California—Davis, USA) and N. McCarthy
 Discussant:
 ▪ J.-P. Chavas
- 10:30–10:50 Coffee Break
- 10:50–11:50 Ownership, Appropriation and Risk
 ▪ P. Scandizzo (Universitat di Roma)
 Discussant
 ▪ K. Otsuka (Tokyo Metropolitan University)
- Session 3: Policies and Institutions
 for Risky Environments***
- 11:50–12:50 Induced Changes in Property Rights and Land Use in Semi-Arid East Africa
 ▪ B. Swallow
 Discussant:
 ▪ R. Birner (Göttingen University, Germany)
- 12:50–2:00 Lunch Break
- 2:00–3:00 Conflicts and Co-operation over the Commons: A Conceptual and Methodological Framework to Assess the Role of Local Institutions
 ▪ J.-P. Vanderlinden (York University/International Livestock Research Institute)
 Discussant
 ▪ R. Meinzen-Dick (International Food Policy Research Institute, USA)
- Session 4: Empirical Studies***
- 3:00–4:00 Can Pastoral Institutions Perform without Access Options?
 ▪ T. Ngaïdo (International Center for Agricultural Research in the Dry Areas /International Food Policy Research Institute, Syria)
 Discussant:
 ▪ S. Lawry (Ford Foundation, Egypt)
- 4:00–4:20 Coffee Break

- 4:20–5:20 Roundtable to Identify Key Issues
Chair:
▪ T. O. Williams
Rapporteur:
▪ B. Swallow

Tuesday, September 29, 1998

- 8:30–9:30 Southern African Case Study
▪ Rhode, R., Hoffman, T. and B. Cousins (University of Western Cape, South Africa)
Discussant:
▪ I. Scoones (Sussex University, UK)
- 9:30–10:30 Niger Case Study
▪ J.-P. Vanderlinden and colleagues (International Livestock Research Institute, Niger)
Discussant
▪ B. Hassan (President, National Federation of Livestock Producers in Niger and Consultant to the World Bank on Livestock Development Projects in West and Central Africa)
- 10:30–10:50 Coffee break
- 10:50–11:50 Implications of Population Growth and Declining Access to Transhumant Grazing Areas for the Sustainability of Agropastoral Systems in the Semi-Arid Areas of Niger: A Bio-Economic Modeling Approach
▪ B. Barbier and P. Hazell (International Food Policy Research Institute, USA)
Discussant:
▪ Kuyvenhoven (Wageningen Agricultural University, Netherlands)
- 11:50–12:50 Ethiopia Case Study
▪ A. Kamara and colleagues (Goettingen University/ International Livestock Research Institute, Ethiopia)
Discussant:
▪ J. Dembella (CARE, Ethiopia)
- 12:50–2:00 Lunch Break

***Session 5: Issues for Policy, Research
and Methodology Arising***

- 2:00–2:30 Outstanding Issues: Policy and Programme
 ▪ M. Kirk, A. Kamara, and B. Cousins
- 2:30–3:00 Outstanding Issues: Research Priorities
 ▪ B. Swallow, T. Williams, and R. Meinzen-Dick
- 3:30–4:00 Outstanding Issues: Methodology
 ▪ P. Hazell, N. McCarthy, and M. Niamir-Fuller
- 4:00–4:20 Coffee Break

Session 6: Working Groups

- 4:20–5:20 Working Groups (Session 1)
- Working Group 1 to Discuss Policy and Program
 Facilitator:
 ▪ B. Cousins
- Working Group 2 to Discuss Methodology Priorities
 Facilitator:
 ▪ R. Meinzen-Dick
- Working Group 3 to Discuss Research Priorities
 Facilitator:
 ▪ M. Niamir-Fuller

Wednesday, September 30, 1998

- 8:30–10:30 Working Group G (Session 2)
- Working Group 4 to Discuss Devolution/Decentralization
 Facilitator:
 ▪ M. Niamir-Fuller
- Working Group 5 to Discuss the Process of Reforming
 Property Rights
 Facilitator:
 ▪ B. Cousins
- Working Group 6 to Discuss Drought Management for Food
 Security
 Facilitator:
 ▪ R. Meinzen-Dick

10:30–10:50 Coffee Break

Session 7: Wrap-Up of Symposium

10:50–12:20 Reports from Working Groups

12:20–12:40 Closing Comments
▪ W. Kisamba-Mugerwa

12:40 Closing of Symposium

1:00 Evening Excursion and Oktoberfest in Munich

