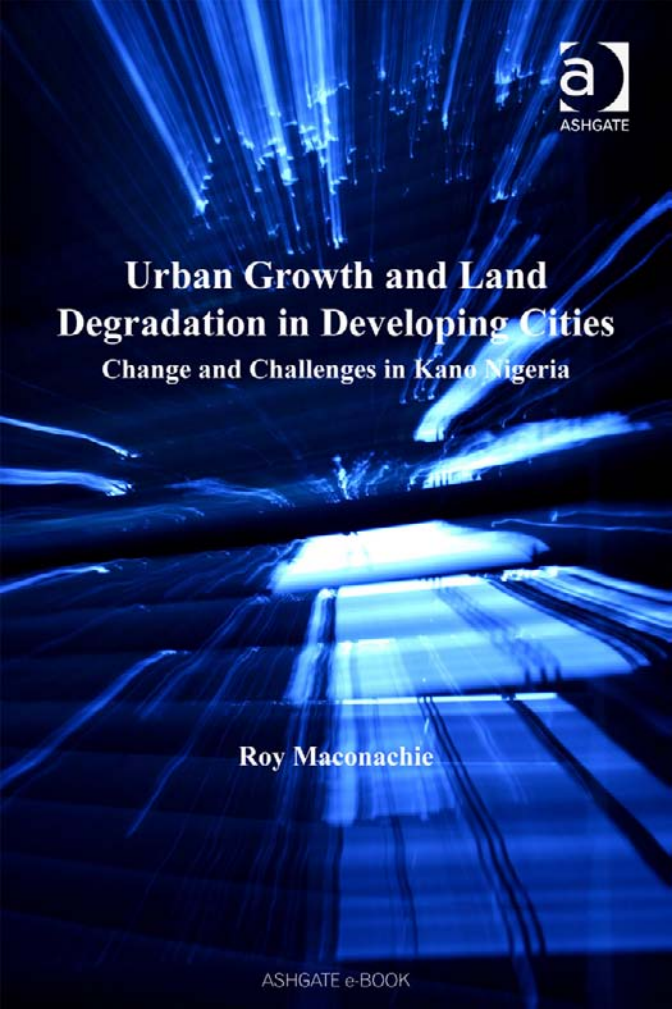
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Change and Challenges in Kano Nigeria
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Urban Growth and Land Degradation in Developing Cities

Change and Challenges in Kano, Nigeria

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Preface

The peri-urban interface in poor countries is often an area of great dynamism but it is also a focus of competition for basic resources. In Nigeria, Africa's most populous country, peri-urban livelihood strategies have become increasingly important as survival mechanisms for a wide range of actors in the context of rapid urban population growth. Yet remarkably little attention has been paid to the sustainability of these strategies. In attempting to move beyond the dichotomous Malthusian vs. Boserupian people–environment debate, this book examines the social, economic and cultural contexts of land degradation in peri-urban areas, with specific reference to recent developments in and around the burgeoning city of Kano in northern Nigeria.

Based on field research which illuminates local actors' knowledge and perceptions of land degradation, this book identifies some of the most significant forces that are currently shaping the process of peri-urban change. While many previous studies maintain that Kano and its hinterland will continue to support sustainable intensification for many years to come, the evidence in this book highlights how more than ever before, Kano's 'ecological footprint' is having an extensive impact on both environment and society in its 'close-settled zone'. Although peri-urban land managers often adopt creative and ingenious strategies for coping in increasingly difficult situations, recent increases in competition for resource use between local actors point to mounting evidence that the sustainability of a once apparently resilient system may be starting to break down.

In revisiting much of the earlier (but perhaps now dated) research conducted in the Kano region, the point of departure that makes the research in this book unique is its engagement with human–environment interaction in its wider context. The dynamism and intricacy of people–environment relationships are often misunderstood or ignored, and more literature is needed to highlight the nexus between decision-makers and environmental change in different contexts. This book attempts to fill this gap by exploring Kano's land–society debate in a new context and by looking at an entirely new set of socio-economic pressures that have not adequately come into the discussion in the past. Although the study is one of locality and focuses on one specific region in the West African drylands, it is hoped that this book will contribute wider lessons for peri-urban areas under pressure elsewhere in sub-Saharan Africa and beyond. In a broader sense, the findings are transferable to other growing Third World cities where increased pressures on urban hinterlands have intensified contests amongst various actors, made access to resources much more difficult and made traditional smallholder mechanisms of adaptation and resilience increasingly challenging. As such, this book has relevance for a wide range of individuals beyond the academy, including the many planners and policy makers in the Third World who

must grapple with the issues of sustainable urbanization and land degradation much more directly, and in a more 'hands on' manner. Indeed it would appear that many of the themes and issues described in this book are becoming increasingly timely and relevant and are of growing interest to a wide audience.

The foundations of the research on which this book is based were instigated in 1999, when I initially carried out a study into soil erosion in the Kano region for my Masters dissertation. At the outcome of the project, however, there appeared to be more new questions than answers and this led to further Doctoral work in the Kano Close-Settled Zone, involving the more conceptually expansive concept of land degradation. This research was predominantly made possible by a Teaching Assistantship award from the Department of Geography at the University of Sussex. Additional financial support was provided by the Overseas Research Awards Scheme (British Council), the 20th International Geographical Congress Fund (Royal Society) and an Edward J. Boyle Scholarship. I would also like to thank the Leverhulme Trust who awarded me a post-doctoral Early Career Fellowship, which ultimately made it possible for me to write this book.

Many individuals contributed to this research and I would like to express my gratitude to all my colleagues and friends who have provided encouragement and support along the way. At the University of Sussex, I am particularly grateful to Professor Tony Binns and Dr. David Robinson for their role in shaping the direction of this project from the very beginning. Additional thanks go to Sue Rowland and Hazel Lintott in the Cartography Department, who spent many hours transforming my rough field sketches into maps. Colleagues at other universities and institutes in the UK provided further guidance and advice and I would especially like to thank Reg Cline-Cole and Ken Swindell (Centre of West African Studies, University of Birmingham), Gina Porter (Durham University), Frances Harris (Kingston University) and Adrian Wood (University of Huddersfield). In Canada, special thanks go to Bob Stock (University of Saskatchewan) for sharing his passion and expansive knowledge of Hausaland, and to Tony Weis (University of Western Ontario) for his inspiration.

In Nigeria, my year spent as a Research Associate in the Department of Geography at Bayero University, Kano was an extremely rewarding experience. I am greatly indebted to Professor Essiet U. Essiet, Dr. Adamu Tanko and Dr. Maharazu Yusuf for all of their help in the field. I also received considerable assistance from Mr. Garba Kofar Naisa Adamu in the Soils Laboratory, and the staff of the Central Laboratories, who provided guidance in the analysis of soil and water samples. In the field, the research could not have taken place without the help of my research assistant and interpreter, Alhaji Ibrahim Abdu Lawan. I am especially indebted to Alhaji Ibrahim for his kindness and understanding and overall commitment to the project.

The British Council team in Kano was instrumental in facilitating the research, and I would like to thank Peter and Sabina Morison for their help. The success of the fieldwork was also due in no small measure to the warmth and kindness of Mustapha Zakariya, who welcomed me into his house and provided me with a 'home away from home' while I was in Kano. At the end of each day in the field, I always looked forward to returning to the compound, where Mustapha was waiting with the *fura da nono*. Endless evenings were spent chatting under a sky of fabulous stars. I

learned so much from Mustapha and his family and I shall always remember their tremendous generosity.

A final word of thanks goes to my close friends and family who have supported me from the inception of this project to its completion. I would particularly like to single out my great friend Loch Brown, who journeyed with me to West Africa by motorcycle through sand and mud, and to Erin, Ross, Max, Ruth, Beth and Benny who have shown great encouragement. My partner, Elizabeth, provided love and support throughout the writing of the manuscript and revived my enthusiasm on numerous occasions. Ultimately, however, my greatest debt goes to the six communities in the Kano Close-Settled Zone who shared their knowledge and understanding with me. Without their acceptance and willingness to participate in the research, this study would never have happened in the first place.

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List of Abbreviations

CEC	Cation exchange capacity
CSZ	Close-Settled Zone
DfID	Department for International Development (UK)
FAO	United Nations Food and Agriculture Organization
FEPA	Federal Environmental Protection Agency (Nigeria)
GIS	Geographical Information systems
HYV	High Yielding Variety
IDS	Institute of Development Studies, Sussex (UK)
IK	Indigenous knowledge
ITCZ	Inter-Tropical Convergence Zone
ITD	Inter-Tropical Discontinuity
ITF	Inter-Tropical Front
IMF	International Monetary Fund
KASEPPA	Kano State Environmental Planning and Protection Agency
Km	Kilometer
KNARDA	Kano State Agricultural and Rural Development Authority
NDVI	Normalized Difference Vegetation Index
NEST	Nigerian Environmental Study/Action Team
NGO	Non-governmental organization
NRSP	Natural Resource Systems Programme
OECD	Organization for Economic Cooperation and Development
pH	Potential of hydrogen
ppm	Parts per million
PRA	Participatory Rural Appraisal
RRA	Rapid Rural Appraisal
SAP	Structural Adjustment Programme
SAR	Sodium-Adsorption Ratio
UN-Habitat	United Nations Human Settlements Programme (*formerly* UNCHS (Habitat))
UPA	urban and peri-urban agriculture
USDA	United States Department of Agriculture
WALTPS	West Africa Long Term Perspective Study
WCED	World Commission on Environment and Development

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Glossary of Hausa Words

Bakarkasa	Black, fertile soil.
Bature	European.
Bazara	Hot season just before the rains.
Birni	Walled town or city.
Burtali	Hedged road between farms, used as a cattle track.
Cin rani	Dry season migration (of people) in search of work or better pasture lands.
Damina	The rainy season.
Fadama	Seasonally waterlogged or flooded low-lying land.
Fara	White soil that is sandy in nature and considered to be infertile (sometimes referred to as *Rairayi*).
Fura da nono	Gruel made by mixing balls of cooked millet with sour milk.
Gayya	Communal work.
Ganaka	The process by which local manure or chemical fertilizer is applied to crops during the rainy season. Small amounts of these substances are applied directly around the base of crops after they have germinated.
Gandu	Household labour unit.
Garuruwa (sing. *Gari*)	Town.
Gyaro	'Volunteer' crops or plants that germinate on their own (often from the seeds in *taki*).
Harawa	Leaves or stalks of cowpeas, groundnuts, etc. used for animal fodder.
Harmattan	Cool and desiccating north easterly wind that blows seasonally off the Sahara.
Jangargari	Red soil that is heavy in nature and has good water retention properties (sometimes referred to as *Kitsendamo*).
Jihad	Holy war (to spread Islam).
Kaka	Harvest season (dry and cool).
Kitsendamo	Red soil that is heavy in nature and has good water retention properties (sometimes referred to as *Jangargari*).
KeKuwa	A type of hardpan ground that is not conducive to agriculture.
Kuka	Baobab tree.
Kulesheshe	Very soft soil that is infertile.
Kwari	Steep-sided and flat floored inter-dune depressions.
Makiyaya	Pasture or grazing land. Rangeland that Fulani herders use to graze their animals.
Mai Gari	Village head.

Mangala	Twin bags for carrying loads on a donkey.
Mudu	A standard size measuring-bowl used for selling grains, rice or produce.
Naira	The Nigerian unit of currency.
Rairayi	White sand (sometimes referred to as *Fara*).
Rani	Dry season.
Sana'a	Trade, occupation, profession.
Sassabe	The process whereby farm trees that germinate naturally are not removed during weeding, and are protected and encouraged to grow.
Sassaka	A traditional practice where women strip the bark off certain trees for medicinal purposes.
Shara	Urban waste, refuse or sweepings.
Taki	Local manure, sometimes mixed with household waste or ashes.
Tuwo	Staple food made from rice or flour of millet, sorghum, etc., which is cooked in boiling water and stirred until thick.
Udawa	Nomadic Fulani from Niger Republic
Wankan jego	A Hausa cultural practice where newly delivered mothers bathe twice daily for 40 days in scalding hot water.
Yanyawa	Fennec (African Fox).
Yasa	The process of digging a well deeper during the dry season, to increase the amount of water available.
Zaman makoki	A three-day mourning ritual undertaken by the relatives and neighbours of a deceased person.
Zamani	Period or epoch. *Zaman*i can also signify 'former times' or 'the old days'.

Chapter 1

Introduction

Introduction

Since the 1960s, a dramatic acceleration in rapid urban growth, combined with rising levels of chronic poverty, have heightened concern for the 'urban crisis' that has unfolded in many countries in sub-Saharan Africa. Although most Africans still live and work in rural areas, the estimated average annual urban growth rate of 4.8 per cent between 1980 and 1993 was more rapid than in any other part of the world and has been cause for great alarm (World Bank, 1995a). Over the last decade, urban populations have continued to escalate in numbers, and in the year 2000 Africa's urban population was estimated to be 34 per cent, or about 210 million people (UN-HABITAT, 2002). Although there is evidence to suggest that the exceptionally rapid urban population growth rates of the early years following independence have somewhat abated in recent years, it is soon likely that half of Africa's people will be living in cities (UN-HABITAT, 1996).[1] There continues to be growing concern about providing for rapidly growing cities in sub-Saharan Africa, where urban growth rates are still among the fastest in the world.

While there is no disputing that African cities have undergone rapid growth in the past four decades, there is, however, much debate over the causes and effects of the urban transformation, and the ensuing social and ecological deterioration of the urban landscape. During the early 1990s, concerns for urban sustainability played a role in focusing attention on the impacts that cities have beyond their boundaries, which led to the introduction of the now well-known concept of the 'urban ecological footprint' (Rees, 1992). This concept has been important in exploring the relationship that cities have with their hinterlands – the area required to support urban production, consumption and waste generation. As sub-Saharan cities continue to expand and leave their growing 'ecological footprints' on their surrounding environments, urban fringes are being rapidly transformed, with intensifying competition for scarce resources often resulting in the progressive degradation of the peri-urban environment. Although there appears to be a lack of consensus on the best way to ameliorate many of the desperate conditions that have ensued in and around African cities, in recent years a great deal of attention has been given to what the Brundtland Commission referred to as the great 'urban challenge' (World Commission on Environment and Development, 1987). Perhaps more than ever before, there is a pressing need for further research that addresses the many

1 Rakodi (2005) estimates that Africa's urban population will reach 46 per cent of the total by 2020.

serious issues confronting the sustainability of urban and peri-urban livelihoods in the shadow of Africa's burgeoning cities.

In West Africa, a region of exceptional urban growth, the influential *West Africa Long Term Perspective Study* (WALTPS) carried out by Club du Sahel (1994) reported that the number of settlements exceeding 100,000 people rose from 17 in 1960 to 90 by 1990. Moreover, the study projected that if urbanization continued at predicted levels, there would be 300 West African cities of over 100,000 by the year 2020, with a network of cities with populations exceeding one million spread evenly across West Africa. Among the many consequences that rapid urbanization has had on West African society, the WALTPS report notes that in recent years the dryland food production systems of West Africa, particularly those on the outskirts of growing cities, have had to respond to a series of dramatic new shocks. Smallholder livelihood systems have increasingly had to cope with intensified exposure to a rapidly changing world economy, in concert with the very significant levels of rapid urban growth which have occurred over the last four decades. Although it is true that this transformation has had positive knock-on effects for some individuals, the negative consequences for others have been profound. Indeed, as will be highlighted in this book, the forces associated with urbanization in West Africa have had a major impact on the rural hinterlands of growing cities on all fronts – politically, economically, socially, culturally and ecologically. Consequently, as has been suggested by the WALTPS report, it is envisaged that major changes will continue to take place with vigour over the next thirty years.

In Nigeria, Africa's most populous country, there are presently more cities with over a million people than any other nation on the continent. The rate of growth of some Nigerian cities has indeed been spectacular, with the largest city, Lagos, for example, growing at an estimated annual rate of 6 per cent during the 1980s and early 1990s (Binns, 1994). Although such rapid rates of urban population expansion may have slowed down in recent years, the physical size of Nigerian cities continues to expand in all parts of the country, and there remains a great deal of concern about the exploitation of key natural resources in urban hinterlands (Main, 1995). As rural areas surrounding growing cities become increasingly integrated into the urban system, Nigeria will need to incorporate these urbanization trends into its future environmental and development strategies. The WALTPS report (Club du Sahel, 1995, ix) is quick to point out that 'Nigeria …represents the likely pattern of urbanization for its neighbours twenty or thirty years hence: a majority of town dwellers living in a tough world, having to mobilize all their energies to ensure their daily survival…'.

This book is concerned with the changing nature of people–environment relationships in drylands Africa, and more specifically focuses on the densely settled region around the city of Kano, northern Nigeria's largest urban centre. As early as the mid-nineteenth century, in his travels through Sahelian Africa, the German explorer Heinrich Barth noted the unusually high concentration of people that the landscape around Kano appeared to support. Although population statistics in Nigeria are notoriously problematic and must be viewed with caution, in the late 1990s, Kano and its region were believed to support over 5 million people (based on predictions from the National Population Bureau, 1991), with densities of between 250 and 500

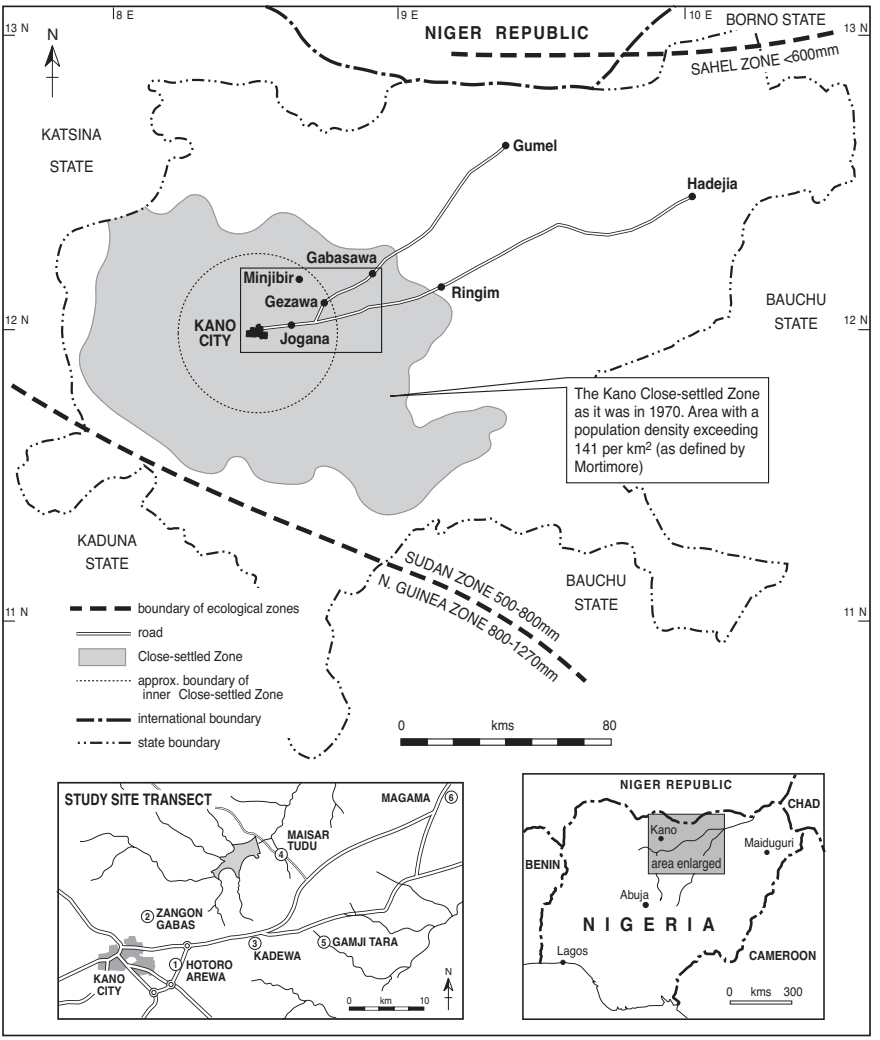

Figure 1.1 The Kano Close-Settled Zone

people per square kilometre (Mortimore, 1993a). The so-called Kano 'Close-Settled Zone' (CSZ), as originally defined by Mortimore (1967), was demarcated by the area which, on the basis of 1962 census statistics, included rural population densities in excess of 141 people per square kilometre. Since these early days, the Kano CSZ has received considerable academic attention, and today the region stretches up to 100 km from metropolitan Kano (Figure 1.1).

Despite being one of the most heavily populated regions in semi-arid West Africa, past observers have marvelled at the apparent sustainability of farming systems in the area. There is a rich body of existing research on the historically dynamic CSZ, and many studies maintain that Kano and its hinterland will continue to support

sustainable intensification for many years to come, even in times of increasing competition. Building on this considerable literature, the research activities outlined in this book are particularly concerned with the social, cultural and economic contexts of land degradation in the region. The investigation explores how urban growth and subsequent increases in the competition for resources are impacting upon the sustainability of a system which in the past has largely been portrayed as being resilient to increasing pressure. In doing so, the study makes a significant contribution to a growing body of literature that reveals the complexity of people–environment interactions and the systems within which they operate. These systems are far from being simple or static, and in the past it has been this very flexibility of livelihood strategies that has helped local actors negotiate risk. The findings of this book, however, highlight the importance of wider forces and structures in shaping, and at times constraining people–environment interaction, as actors are faced with increasingly challenging situations in the rural-urban interface. Future development planning in Kano and its hinterland must be based upon a detailed understanding of the rapid pace of change that is presently taking place, particularly in the peri-urban regions. Development interventions must fully appreciate the intricacies, strengths and weaknesses of a wide variety of peri-urban livelihood systems, as well as the needs and aspirations of the people involved.

In this introductory chapter, the main objective is to provide a context for the book as a whole. After introducing the research on which the book is based, the next section of the introduction begins with a discussion of the dichotomous Malthusian vs. Boserupian debate that concerns people–environment relationships. Within this context, some of the key research previously carried out on environment and development in Kano's CSZ is reviewed. Locating the present study within the context of this literature, it is argued that there is a pressing need to move beyond these stale polarities that concern human–environment relationships. Some of the problems with previous studies of environmental change are highlighted. It is suggested that there is a great need for alternative analyses of environmental change that place the land manager at the centre of the enquiry, but that adequately take into account a host of new pressures associated with rapid urbanization that have begun to challenge the sustainability of the system in the peri-urban region and beyond. Following a discussion of the interdisciplinary research approach adopted in this study, the final section of the chapter then outlines the remaining chapter-by-chapter structure of the book.

Exploring the broader debate: Kano research past and present

The Kano CSZ has been heralded as the most intensive farming system in semi-arid West Africa (Snrech *et al.*, 1995), and its apparent ability to support extremely high population densities sustainably has attracted a great deal of attention from a wide range of academic backgrounds. However, interest in land–society relationships in Africa has been evident for many centuries. As Mortimore (1998) points out, the nexus between population growth and the state of the environment has existed since

the origins of technology and social organization in Africa, possibly going back four millennia.

In the Kano CSZ, and in dryland Africa more broadly, the vast majority of research into land–society issues has focused on the impact of population growth on resource use, and has most often been framed by an overarching theoretical perspective, or 'meta-narrative'. As Roe (1991) explains, these 'narratives' or development 'stories' tell us not so much about what *should* happen as they do about what *will* happen, and they have had tremendous power in 'standardizing' and 'stabilizing' environmental problems into a 'one size fits all' scenario (Leach and Mearns, 1996). In this light, most land–society studies in the Kano CSZ have inevitably been highly influenced by either the so-called 'optimistic' or 'pessimistic' school. On the pessimistic side, many people–environment studies have adhered to the received wisdom of neo-Malthusian and neo-Hardinian thought, and population pressure has frequently been perceived as a fundamental cause of environmental degradation. However, on the other side of the debate, following the logic of the optimistic or 'cornucopian' school, other research has suggested that increasing population densities can lead to environmental recovery (Tiffen *et al*., 1994) and conditions for 'agricultural growth' (Boserup, 1965). Although both arguments consider population growth to be one of the principal driving forces in the transformation of the African biosphere (Milas, 1984; Myers, 1989), the relationship between population and environment remains far from clear and continues to be regarded as a highly polarized area of debate (Lockwood, 1995).

The Malthusian position

Having had a profound influence on the construction of 'crisis' narratives, the work of Thomas Malthus (1798) has had great bearing in both academic and policy circles, arguing that population growth, which increases at a geometric rate, ultimately outstrips food production which only increases linearly. Malthus' argument has been widely critiqued, and an extended discussion of his work will not be developed here.[2] However, it is important to note that his reasoning has been applied more broadly to include the impact of population on all environmental resources, which has frequently contributed to inaccurate and inappropriate predictions of a 'downward spiral' for dryland Africa (Mortimore, 1998). According to Malthusian logic, if population growth is allowed to increase unabated, the resulting resource mismanagement will exacerbate environmental degradation, reducing the supporting capacity of the land. Ultimately, so the story goes, the finite environment will not be able to keep pace with the demand for resources, and rising mortality and environmental disaster will ensue.

Of relevance to the present discussion, Malthusian and neo-Malthusian interpretations of the relationship between land and society have been instrumental in perpetuating 'degradation narratives' and may exaggerate the role that human agency has assumed in the process of environmental change (Hoben, 1996). The controversial

2 For further discussion, see, for example, Harvey (1996; 1974).

concept of 'carrying capacity', a fixed external variable that determines the number of people that an area can support, has further complicated a clear understanding of the situation (Scoones, 1995), and undoubtedly, such an oversimplification of land–society relationships can be problematic. By and large, carrying capacity is almost always viewed as a fixed external variable that determines the number of people an area can support. As Jones (1996) contends, mention is seldom ever made of the capability of human agency to raise the carrying capacity of the land through innovations or increased labour inputs (following Boserup, 1965).

In Kano and its environs, interpretations of dryland degradation and the severity of its consequences have also been dramatically influenced by the concept of 'desertification', a term which has frequently been associated with increased population pressure. As early as the 1930s, when a great deal of concern was being generated by the North America 'Dust Bowl' experience (Swift, 1996; Scoones *et al*., 1996), the notion of a 'creeping desert', coupled with the European desire to protect the African natural environment as a special kind of 'Eden' (Anderson and Grove, 1987), led to the implementation of a host of soil conservation measures. In the Kano region, early colonial interpretations of land degradation played a key role in firmly establishing environmental discourses which still have great influence today. During the 1930s, E.P. Stebbing, a West African colonial forester, wrote prolifically of the encroaching Sahara in northern Nigeria, proposing that a forest belt be planted to stop the southward progress of the sand. Upon returning from a tour from Kano to Geidam in 1935, Stebbing (1935: 510) noted:

> …the chief question in this region is the 'Threat of the Sahara.'…And the desert is advancing! How, or how fast, I have yet to learn when I cross the frontier. It is impossible to travel to Geidam from Kano, followed by us, or back from Geidam via Nguru to Kano, without realizing the serious threat….The people are living on the edge, not of a volcano, but of a desert whose power is incalculable and whose silent and most invisible approach must be difficult to estimate. But the end is obvious: total annihilation of vegetation and the disappearance of man and beast from the overwhelmed locality.

Stebbing's views on the state of the environment in Kano, and more generally in the Savanna and Sahel regions of West Africa, were taken seriously by the scientific community at the time. The Anglo–French Forestry Commission was established in 1936–37, and further fieldwork was carried out in the Kano region in an attempt to substantiate Stebbing's claims. One member of the Commission, geographer L.D. Stamp, published two influential scientific papers in 1938 and 1940, the latter of which pointed out a number of problems with Stebbing's research. Stamp believed that the intensive permanent agriculture that he had observed around Kano was a more satisfactory response to land degradation than the forest belt that Stebbing had proposed. However, like Stebbing, many of the 'crisis' ideas mentioned in Stamp's observations can be found in much contemporary writing about desertification today. Stamp described nearly all of the northern belt of Nigeria as a 'danger zone', and he (1938: 43) wrote that:

> [a]ll the evils of uncontrolled grazing by cattle and goats are present, and the increase in numbers…is capable of converting the whole northern belt into a desert within a very short

period. The change that is undoubtedly taking place is often referred to as the invasion of the Sahara, as if the desert were an invader from without.

The term desertification was not officially introduced into the international development lexicon until 1949. Aubréville (1949: 341), a French colonial forester, was the first to adopt the term *désertification*, perpetuating a gloomy picture of the drylands by describing 'slabs of sterile truncated soil, bearing tufts of grass around uprooted bushes [that] recall a kind of leprosy that is spreading over the face of Africa.' Since these early colonial days, there has been growing concern for environmental degradation in the Kano CSZ and other regions in the African drylands, perhaps reaching its apogee at the 1977 United Nations Conference on Desertification in Nairobi. Although desertification was not given as high a profile at the Rio Earth Summit in 1992, the concept was once again enshrined in the 1996 United Nations Convention to Combat Desertification. Today, it is widely recognised that the concept of desertification has many attendant problems (Binns, 1990), but its advancement as a manifestation of anthropogenic causes still appears to have as much appeal as ever. As Milas (1984: 11) argues, it is commonly believed by many that 'intensifying population pressures are exacerbating the problems of land mismanagement and desertification, and destroying the very resources on which any sustainable development must be based.'

Building on Malthus' foundational work and early colonial interpretations of the environment, various other scholars have offered similar explanations for the emergence of population driven catastrophe in drylands Africa. Hardin's (1968) 'tragedy of the commons' thesis suggests that as populations increase in number, they will be unable to utilize natural resources in a sustainable manner because individual interest will hinder group co-operation. However, although highly influential, Hardin's approach has frequently come under severe attack on the grounds that it lacks adequate empirical testing and suffers from a gross misinterpretation of 'common property systems.'[3] Other neo-Malthusian accounts, such as Ehrlich's (1968) apocalyptic work, *The Population Bomb*, have also done little to help foster a better understanding of environmental change in the drylands. The drastic solutions to many problems which have accompanied neo-Malthusian academic theory, such as Hardin's (1974) call for the implementation of 'lifeboat ethics', have largely been both inappropriate and futile.

The Boserupian argument

In recent research carried out in the Kano CSZ, many scholars have postulated more optimistic hypotheses concerning the relationship between population and physical resources. Specifically, the Boserupian hypothesis has received support from numerous studies at the village and district level, and has greatly influenced much of the research done in the region (Mortimore and Adams, 1999). Many recent studies which support the sustainability of Kano's intensively cultivated CSZ, derive their foundations from the widely cited work of the Danish economist Ester

3 For further elaboration, see Berkes et al. (1989) or Feeny et al. (1990).

Boserup (1965), who documented how in response to the growth of rural population densities, farmers shorten their fallow periods, increase the use of technological innovations such as the plough, and adopt multiple cropping cycles to make the land more productive and raise its carrying capacity (Jolly and Torrey, 1993). In short, as Boserup suggests, rather than being a limiting factor, population growth can actually be a prerequisite for agricultural development. Her work has been instrumental in recognizing that increased pressure on the land can in some cases lead to a reduction in degradation and erosion through various innovations, rather than an increase.

Whilst a number of anthropogenic-focused studies carried out around Kano have tended to see human activity as being essentially destructive, the detailed work of Michael Mortimore, conducted in the Kano CSZ over a long period (1967, 1989, 1993a, 1993b, 1993c, 1995, 1996, 1998), suggests that in a high population density area, small-scale farmers may invest considerably more in land improvement than in low-density areas in order to meet growing demands for food. Increasingly, Mortimore reminds us that the 'diversity, flexibility and adaptability' of dryland households are perhaps their greatest resource. According to Mortimore, identifying the role that indigenous knowledge can play in risk management by responding to opportunities and threats, will play a major part in ensuring the sustainability of livelihoods and natural resources in the Kano CSZ (Mortimore and Adams, 1999). His alternative thesis dismisses much of the received wisdom which views degradation as being driven by population growth and inappropriate land-use, and he concludes that 'population growth, and high population density, are compatible with sustainable resource management under smallholder conditions' (1993b: 65).

Mortimore's work on the Kano CSZ has been crucial in laying the foundations for knowledge and understanding in the region, particularly because it recognises that the authority and legitimacy of neo-Malthusian environmental orthodoxies must be challenged on the grounds that they frequently distort and misrepresent the issues. However, it could also be argued that his research paints an overly optimistic picture of the present-day situation in Kano's CSZ, in light of the fact that life has become much more challenging in recent years as a result of deteriorating economic conditions in Nigeria. It is true that for centuries, many poor actors have relied on strong networks to cope in difficult times. However, it is also true that such adaptation has often become increasingly difficult or sometimes no longer possible, as radically new pressures have undermined the so-called 'moral economy' (or traditional coping mechanisms) which has played a central role in the survival of communities. Indeed, the detailed evidence presented in this book suggests that all is certainly not 'rosy in the garden', and there are some very significant challenges which must be faced in the immediate future, as urban growth is having a considerable effect on the livelihood resilience of individuals, households and communities in the CSZ.

In a similar vein to Mortimore, Frances Harris' research into soil nutrient management by smallholders in the Kano CSZ (1996, 1999, 2000) appears to reinforce the evidence supporting the sustainability of the region, and her work celebrates the role that indigenous management strategies can play in low output farming systems. Her investigations illustrate that despite being one of the most densely populated areas in semi-arid West Africa, the intensive farming systems of Kano's CSZ can be both productive and sustainable. In a two year case study

carried out in Gamji Tara, a hamlet near the village of Tumbau approximately 35 km northeast of Kano, Harris suggests that the key to successful soil nutrient cycling lies in the area's high population density. In short, soil fertility is maintained through the integration of livestock and crops, and high labour inputs have increased agricultural innovation and enhanced the soil fertility of the region (Yusuf, 1996).[4]

Like the extensive studies carried out by Mortimore, Harris' research has made a great contribution to understanding how Kano's rural production systems operate. However, recent discussions with land managers in the region, including those in Gamji Tara, reveal that present-day constraints associated with the growth of the city have made access to traditional farm inputs increasingly challenging. As a consequence, many farmers reported that declining yields were becoming more and more common. In a more recent study where Harris and Yusuf (2001) report on farmers' indigenous knowledge regarding the quality and production of manure supply, some of the constraints of the existing manure management regime which Harris does not mention in her earlier studies are acknowledged and considered. It is concluded that for the sustainability of the system to continue, better manure management practices are urgently required, since soil fertility can no longer be maintained by fallowing due to land hunger. As will be explored at length in Chapter 5, great concern for soil fertility decline is presently shared by a wide range of actors in Kano's peri-urban zone and throughout the CSZ. Reports of 'nutrient mining', or the depletion of soil nutrients at a rate which is greater than re-supply, are becoming increasingly common local explanations for perceptions of soil infertility in the region.

Although intensive cultivation has placed great pressure on the land over the years, in the past, as Harris' research reveals, many farmers have successfully been able to integrate crop production with livestock raising. As such, soil fertility has been maintained by the constant application of manure, compost, or urban refuse to croplands (Binns and Mortimore, 1989; Yusuf, 1996). A number of important studies concerning herder–farmer relations have described a long-established symbiotic relationship between pastoralists and sedentary farmers in the Kano CSZ, whereby Fulani cattle herders have been permitted to graze their animals on field stubble during the dry season in exchange for animal manure to fertilize farm plots (Binns, 1994). Today, however, such an understanding may be somewhat simplistic as these relationships have become challenged in the wake of new pressures. In a recent exploration of pastoralist–farmer relations in northern Nigeria, Milligan (2002) suggests that not only has this supposed state of symbiosis never truly existed, but present conflict cannot merely be explained by tensions resulting from stress placed on the resource base. At any rate, in the Kano CSZ land hunger and increasing resource pressures have radically changed the way land is managed, and Harris and Yusuf (2001) note that due to exceedingly high population densities, the region now has relatively few cattle in comparison to other parts of West Africa. Of particular concern in the peri-urban localities, virtually all traditional rangeland and

4 For example, areas of high population density have more available labour to transport manure from compounds to fields.

cattle paths have disappeared, often due to pressures associated with urbanization, and Fulani cattle herders have consequently had to diversify their livelihoods.

Although Fulani do still traverse the Kano CSZ during the dry season as they migrate to greener pastures in the south, in reality, most manure used on farms now comes from draught animals, donkeys, and small ruminants that are actually kept by farmers themselves. The significance of animal manure in the nutrient management strategies of farmers in the CSZ is well documented (Powell *et al.,* 1995; Harris, 1996, 1999; Harris and Yusuf, 2001), but it is not clear whether current demands for manure in the Kano region will be able to keep pace in the years to come. As Stocking and Murnaghan (2001) point out, by increasing amounts of manure inputs, the effects of land degradation can be 'hidden', but production will continue at a cost. Unfortunately, as Harris and Yusuf (2001) reveal, although farmers appreciate the role that manure plays in maintaining soil fertility, resource pressures may not permit them to use manure optimally, and the high cost and erratic availability of chemical fertilizer excludes it as a viable option.[5]

Further evidence based on the Boserupian hypothesis that is frequently used in support of the sustainability of the Kano CSZ is provided by the widely cited studies by Cline-Cole *et al*. (1990a, 1990b), who conducted detailed research into fuelwood consumption in urban Kano, rural-urban firewood trade, and the management of trees in the urban hinterland. Challenging deforestation orthodoxies, the studies suggest that in the Kano CSZ, the maturity and density of trees actually increase in localities which are closer to urban centres and where population densities are greater. Their research, which compares aerial photographs in both the inner and outer CSZ, concludes that tree age-distribution and the density of trees in the CSZ were maintained from the early 1960s until the late 1980s, and 'ground truthing' exercises suggest that regeneration has taken place through protection and planting.[6]

The resistance of Kano's indigenous system of agroforestry to urban fuelwood pressures appears to contradict much of the popular neo-Malthusian literature on deforestation and desertification. The long-established fuelwood interaction between Kano and its hinterland has been well documented by Mortimore (1975), who provides a detailed account of the donkey-load exchange involving manure and urban waste taken out of the old city, and fuelwood brought into the city from the rural areas. Mortimore (1998) adds that until the 1960s, almost all of Kano's fuelwood demand could be satisfied by trees harvested within the inner CSZ (the area within a radius of 25–30 km of the city which is now generally considered to be peri-urban in nature), but by the early 1990s, growing urban populations drove

5 Further studies into soil management and agricultural sustainability in the Kano CSZ by Essiet (1990, 1995), suggest that although smallholder farming systems may currently be sustainable, there are some farm practices within the production system that are not sustainable. Essiet (1990) concludes that sustainability could be enhanced by carrying out soil modification measures, especially the conservation of the soil against erosion.

6 Further challenging the population–deforestation nexus, also see the pioneering research of Fairhead and Leach (1996), which re-examines the way historical human–environment relations and forest patterns are understood in West Africa. In their study, they conclude that in certain situations, inhabitants' activities can shape and enrich the forest, as occurred in the creation of Kissidougou's anthropogenic peri-village forest islands.

fuelwood traders to distances of more than 300 km away in search of wood (Cline-Cole *et al*., 1990a). In the research carried out for this book, discussions with a diverse range of actors in the CSZ reveal that there is currently widespread concern for changes in tree cover in the region. In particular, residents in peri-urban localities lamented a perceived decline in many valuable indigenous species, such as *Dorawa* (*Parkia biglobosa*), *Rimi* (*Ceiba pentandra*) and *Kuka* (*Adansonia digitata*). Bearing this in mind, it is worth considering that the studies carried out by Cline-Cole *et al*. (1990a, 1990b) were based on field research undertaken in the late 1980s. According to many local voices, it would now seem that there is a pressing need to re-visit some of this important work concerning trees in the Kano CSZ that has been conducted in the past.

In contrast with the rhetoric of Malthusian apocalypse, researchers such as Mortimore, Harris, and Cline-Cole have usefully challenged received wisdom on dryland livelihood systems. In place of the pessimistic orthodoxies that have shaped African environmental policy over the past decades, these more optimistic models of sustainable land-use reframe the issues and suggest that many of the standard prescriptions for environmental problems have often been highly inappropriate and draconian in nature. At the same time, however, as the evidence in this book will show, it would be erroneous to suggest that serious environmental problems do not exist in Kano's CSZ. Although it is imperative to be more critical about many environmental diagnoses and the data on which they are based, there is no doubt that those living in Kano's urban periphery are indeed facing a series of serious new challenges. As Rakodi (2005) points out, the fortunes of Africa's urban centres are invariably tied up with the fortunes of the countries where they are located. In the case of Nigeria, as the economy has continued to decline over the last three decades, indigenous land management systems have been challenged and urban and peri-urban environments have increasingly come under pressure. Consequently, it has become all too apparent that many Nigerian cities have economies that cannot support their growing populations sustainably.

In Kano and its hinterlands, as the cost of living and unemployment have mounted, and most social services have been dramatically reduced, underdevelopment and a reduction in the quality of life have become much more commonplace. At the same time, as Ayodele Ariyo *et al*. (2001) point out, the 'bitter medicine' of International Monetary Fund (IMF) austerity programmes has had drastic impacts on smallholder food production and marketing in the Kano region, forcing the retreat of the Nigerian state and ensuring that government development extension agencies remain under-resourced and unable to effect meaningful change. Evidence also suggests that these same structural adjustment policies, which were partially designed to reduce the so-called 'urban bias' phenomenon, were responsible for deepening urban poverty during the 1980s and 1990s (Rakodi, 2005). Ironically, although the effects of a neo-liberal order have created an intense need for the empowerment of grassroots actors to fill the void left by massive state cutbacks, these same forces of global capitalism have also eroded grassroots coping mechanisms and constrained local development alternatives. Although it remains imperative to consider grassroots voices when formulating meaningful environmental policies in Kano's CSZ, at the same time however, we must also recognise that it may be equally dangerous to over-

romanticize the role that indigenous knowledge can play in conservation, in light of the many constraints faced by local actors. Ultimately, while research approaching the causality of land degradation and the articulation of alternatives must indeed be rooted in the outlook and aspirations of local people, so too must it consider how such local solutions are embedded in regional, national, and global systems.

Although many of the challenges posed to traditional coping mechanisms and relationships of reciprocity in Kano's hinterlands may have intensified in recent years, these pressures are not necessarily new processes. Over twenty years ago, Watts (1983a) demonstrated how in northern Nigeria, the nature of household adaptation had increasingly become challenged by declining commodity prices, the burden of taxation, and the erosion of communal labour structures, which had forced a 'peasant reproduction squeeze' and caused grave ecological implications for smallholders. Today, it can perhaps still be argued quite strongly that as traditional safety nets have continued to be eroded by the forces of global capitalism, both rural and urban households have felt the consequences in dramatic ways. For communities in northern Nigeria, population mobility has long played a vital role in their adaptation to changing conditions, and as urban migration continues to be a key element in livelihood portfolios, increased pressure on Kano and its peri-urban environment has resulted.

As will be further explored in Chapters 5, 6 and 7 where the field research data are presented and analysed, it has become apparent that so-called 'closed systems', which once formed the basis of many early pioneering studies in the Kano area, are becoming increasingly difficult to find as new external forces take their toll on the landscape.[7] This being the case, in undertaking present-day explorations of the sustainability of the Kano CSZ, it remains vital to move beyond the well rehearsed land–society debate which has dominated the focus of so many previous studies. In particular, there is a need to focus more fully on the environmental and social implications of recent developments in and around the burgeoning city of Kano.[8] Reflecting Watts' (1983a) contentions of twenty years ago, the combined effects of social, political and economic factors, in conjunction with the resource pressures in Kano's growing peri-urban zone, have most certainly intensified contests among various actors at the micro-level, and have made traditional smallholder mechanisms of adaptation and resilience increasingly difficult. Although it is acknowledged that many rural-urban linkages can and do have positive implications for many actors, at the same time, physical evidence of land degradation, together with 'insider'

7 Mortimore himself concedes, 'It should be noted …that the drylands are not, and in general never have been, closed economic systems. Trading networks and diasporas were a feature of their pre-colonial histories [and] Political linkages between arid and sub-humid regions gave expression to fundamental complementarities. Mining and urbanisation have intensified these linkages through offering new employment opportunities to migrants.' See Mortimore (2002: 137) for further discussion.

8 In essence, as Lockwood (1991a) points out, population growth may best be regarded as an 'intermediate level cause' of environmental change, in the sense that while it may exacerbate environmental problems such as soil erosion, it is itself often the result of more deep-rooted social and economic factors, such as poverty.

perceptions of some of the key environmental issues, provide the first warning signs that a number of key studies must now be re-visited.

Why another degradation study in the Kano Close-Settled Zone?

In the past, there have been numerous studies which have attempted to uncover the human causes of environmental degradation, but many remain somewhat simplistic and deterministic in their analysis. As Jones (1999) suggests, the dynamism and intricacy of people-environment relationships are often misunderstood or ignored, and more research is needed to highlight the nexus between decision-makers and environmental change in different contexts. With this in mind, the research upon which this book is based calls for a greater appreciation of these relationships, and argues that such insight is essential to improve understandings of how and why people transform their environment in increasingly difficult situations. Such an awareness would seem to be especially timely and relevant, as Kano's urban fringe has become an even greater zone of contested terrain.

The main focus of this book is to explore land degradation and the dynamics of environmental change in relation to a wide variety of actors in Kano's CSZ, with particular interest being given to the 'peri-urban' zone. Preceding any discussion of recent change, however, it must be pointed out that Kano's peri-urban area has, to some extent, always been an arena for competition, and for many years the landscape has been shaped by a variety of anthropogenic forces. For example, an early undated paper by Mortimore (c. 1960s) noted that the zone has long been subjected to pressures associated with competition for land, markets, and off-farm employment. However, increasingly, it would seem that as the region of spatial transition between the urban tract and rural environs has grown substantially and has consumed greater expanses of Kano's hinterlands, levels of competition have also intensified considerably. More recently, Mortimore (1993a) noted that by the early 1990s, the size of the peri-urban area had extended to the limits of the inner CSZ, and the entire region had become a zone of mixed land use:

> The inner or peri-urban zone has a radius of about 30 km, the effective limit of a day trip to the city by donkey or on foot. Intensive rural-urban interaction long preceded the colonial era…The peri-urban zone is now a mosaic of rural and urban residential and land-use patterns (1993a: 359).

While many previous studies of environmental change have been founded on the premise that there is a clear distinction between the urban and the rural, the field research on which this study is based challenges this assumption, exploring the widespread occurrences of rural-urban interaction between Kano and its hinterland. In the process, it is shown how links between urban areas and the countryside play an important role in the process of rural, urban and peri-urban change. In doing so, the book presents a comparative study of how access to resources and corresponding livelihood strategies change on a distance-decay transect, and vary spatially with distance from urban Kano. In this light, land-society relationships are located on a wider intellectual canvas, and a number of new questions emerge vis-à-vis land

degradation in a peri-urban context. For example, we might ask: what role do rural-urban linkages play in peri-urban livelihood strategies, who benefits from such arrangements, and who is being marginalized? How is the juxtaposition of rural and urban livelihoods affecting the physical state of the landscape? What impact does the competition for 'key resources' have on the incidence of land degradation, and what implications does this have for poverty, the sustainability of food production systems, and the livelihood strategies of various stakeholders? If a more robust understanding of the relationship between people and environment is to emerge in Kano's peri-urban zone and beyond, a new line of questioning is demanded, and indeed an entirely new approach is needed to the way that environmental problems are framed and their solutions formulated.

In pursuing such alternative analyses of environmental change and the role that people assume in the process, there remains a pressing need for degradation studies that frame actors and their decision-making environments in 'situated contexts' (Long and Long, 1992). More specifically, as Jones (1999) contends, land–society studies must address the great ontological divide between approaches which view land degradation from either the 'active' view of human agency implicit in humanism, or the 'passive' view adopted in structural analyses. Siddle and Swindell (1990: 1) add that, '[T]he difficulty in coming to grips with African rural society is one of reconciling individual actions and perceptions with larger structural forces of society and the state.' It thus remains crucial to consider both the role that wider linkages play in environmental change, as well as how individual actors mediate and transform these structural factors in their specific decision-making environments.

This being the case, it is also important to bear in mind that the forces driving change in Kano's urban hinterlands interact on varying scales. Following Blaikie and Brookfield (1987), questions concerning land degradation are perhaps best posed on a variety of scales, and can be regarded as fitting inside each other like a set of 'Chinese boxes.' For example, just as Hoben's (1996) alternative analysis of degradation in highland Ethiopia reveals, it would appear that many contemporary environmental problems that affect local actors in Kano's CSZ at the micro-level, may in fact be a product of wider political and economic conditions that are unfavourable to conservation. In this light, the relationship between land degradation and human activity in the CSZ can be most effectively understood by employing an approach that is guided by a 'nested set of scales' (Blaikie and Brookfield, 1987). It is, however, acknowledged that carrying out a study which is capable of integrating different scales is, of course, often easier said than done**.** As Marcussen and Reenberg (1999) contend, much of the research on environmental change carried out to date has been conducted on a macro-scale, remains purely descriptive, and fails to link to micro-level understandings of physical, biological, and socio-economic processes. Although this study is one of locality, and is carried out purely on a micro-scale, an attempt is made to link the findings to the wider processes that play a role in defining them. In short, although decision-making may often be local in nature, many of the parameters of choice that local people face may, in actuality, be determined by others who operate on greater scales.

Indeed, as much of the discussion in the upcoming chapters will highlight, perceptions of both the environment and land degradation will differ, depending

on an individual's relationship with the land. Stocking and Murnaghan (2001: 10) suggest that definitions of degradation must 'incorporate the relationship of change in biophysical quality of the land to the effect it has on society, economy, politics and humanity.' The differentiation in lifestyles and livelihoods between various actors in Kano and its hinterlands is vast, and thus local people see degradation in entirely different ways. These many different perspectives are grounded within local contexts, and must be reflected in any field-based study into land degradation, if a full and accurate picture of the situation is to be obtained. To date, there has not been an in depth actor-oriented study which explores perceptions of urban and peri-urban influences on land degradation in the Kano CSZ, nor has there been a meaningful critical evaluation of how the knowledge, understanding and perceptions of local actors affect their land-use decisions in the rural-urban interface. This study calls for a more dynamic approach to understanding these relationships – one that is historically and politically situated, and capable of exploring the 'multiple realities' of land degradation. Such an understanding, it is argued, will not only play a role in reflecting a more comprehensive picture of population–resource relationships in the CSZ, but will be important in critically informing both policy making, and the way in which 'outsiders' think about many of the problems.

Exploring the 'multiple realities' of degradation: a note on research design and approach

A recognition of the multiple perceptions and aspirations of local actors is central to this investigation. Indeed within the Kano CSZ, there is considerable variability in the interests, characteristics and actions of different types of actors in understanding political–ecological conflicts. Long and van der Ploeg (1994) contend that one advantage of an actor-oriented approach, such as the one adopted in this study, is that it begins with an interest in explaining differential responses to similar structural circumstances. In this respect, rather than determining outcomes, structural forces may be better appreciated as conditioning agents that maintain 'analytical space for social agency and local diversity' (Marsden *et al*., 1996: 367). Most importantly, Long (1992: 5) notes that at the heart of an actor-oriented approach is the notion that concepts are grounded in 'the everyday life of men and women, be they poor peasant entrepreneurs, government bureaucrats or researchers.' Such an approach provides a valuable methodology to explore the reasons why there are so many differential responses to the environmental and social problems that local actors face.

By grounding this investigation in the perceptions of local actors and placing the land manager at the centre of the 'chains of explanation' (Blaikie and Brookfield, 1987), an attempt has been made to avoid the determinism that has often been ascribed to political–economic interpretations of environmental change in the past. Likewise, it is also anticipated that by focusing on the relationship between the land manager and the wider forces that shape management practices, the pairing of oversimplified binaries may be avoided – such as the tendency for many scholars to see indigenous management techniques as inherently beneficial and desired, and modern techniques

as destructive and resisted.[9] Indeed, it is important to recognize that perceptions of land degradation are socially constructed, and thus an analysis that allows for an exploration of the 'multiple realities' and constructions of knowledge between various actors remains essential (Scoones and Thompson, 1994). In this study, following the principle of triangulation,[10] a number of different methods – from both the natural and the social sciences – are adopted in the analysis in the hope of exposing these multiple and varying perceptions of land and society.

In addition to appreciating that land degradation is a socially constructed concept that will have a wide range of associations to different actors, research must also seek to explore the spatial and temporal differences in degradation, both at real and perceived levels, with respect to topographic location and changing land-use patterns. This book provides an investigation into the contention that urban pressures have challenged the 'sustainability' of land management strategies in Kano's CSZ, and have had notable impacts (for better or for worse) on land degradation. In light of these considerations, the methodology for the field research focused on an 'actor-oriented' approach established within a spatial sampling frame.

Chambers (1983) has written extensively on the notion of 'rural development tourism' and the accompanying research biases that impede an 'outsider's' contact with the community of study. Of specific relevance to this study, Chambers (1983: 13–16) has been extremely critical of spatial biases which often occur in research practice, particularly those to do with urban, tarmac and roadside biases. Probably quite correctly, he suggests that most research visits are concentrated in the more accessible and favoured areas near towns. Moreover, since much of the fieldwork of development professionals is carried out with the aid of vehicles, field visits usually follow networks of tarmac roads, which facilitates research carried out where there is a shortage of time and fuel, and allows for the maximum comfort of the researcher. Chambers (1983) argues that these spatial biases direct attention away from the poor, since most visible 'development' follows main tarmac roads and is concentrated near

9 As was previously mentioned, there is a great danger in assuming that grassroots actors will automatically be able to operationalize the indigenous environmental conservation knowledge they possess, in light of the fact that coping mechanisms have been greatly eroded by deteriorating economic conditions in recent years. However, at the same time, it is also important to remember that the accessibility of Green Revolution technology is frequently governed by highly uneven power relations. In the case of the Kano CSZ, constraints dictated by the entrenchment of liberalization in the Nigerian economy have made much modern technological and scientific innovation (such as HYV seeds, pesticides and chemical fertilizer) inaccessible to the poor. The elimination of subsidies and the forced retreat of Nigerian state extension agencies (associated with SAPs) has meant that most smallholders in the Kano CSZ must rely on low input 'traditional' land management technologies not necessarily out of choice, but rather due to lack of available alternatives.

10 Triangulation is a term originally derived from land surveying practices to describe the use of different bearings to give the correct position. In the social sciences, the term refers to the process whereby researchers draw on a combination of research methods to cover overlapping issues and present a more accurate picture of a situation. Arguably, the findings of a study will be much more reliable if there is a consensus between the various methods adopted. For further discussion see Valentine (1997).

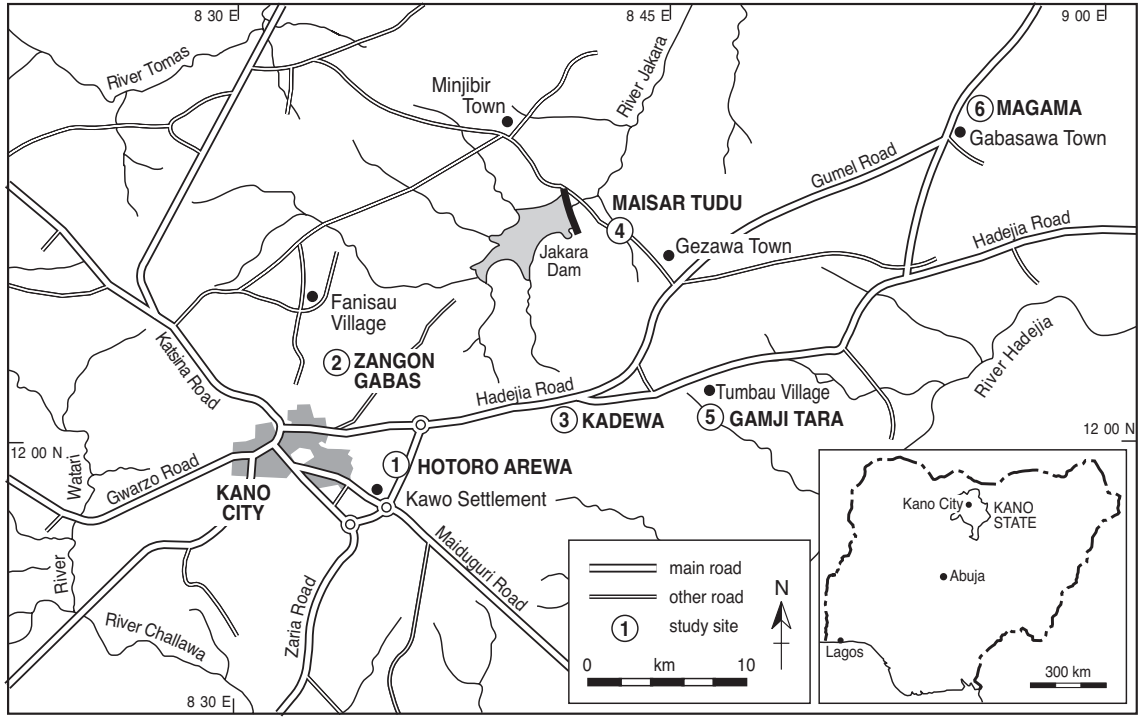

Figure 1.2 Six study sites in the Kano Close-Settled Zone

cities or towns. When roads are constructed, he adds, property values escalate, and an 'elite roadside ecology' develops where the wealthy and influential buy up roadside land (also see Ssennyonga, 1976). The primary aim of the investigation in this book is to examine land degradation, and explore how the presence of Kano is affecting land-use patterns, and influencing local actors' ability to manage the landscape. If, as Chambers (1983) suggests, land is used differently and more intensively near the roadside, the question of how this is having an impact on the incidence of land degradation becomes relevant. The WALTPS report (Club du Sahel, 1995) further suggests that over the last two decades, the growth of cities and their markets, together with improvements in transport infrastructures and the cost of travel, have widened the economic opportunities and 'geographic horizons' available for exploitation by rural individuals. This being the case, research is needed to determine how positive links between the city and countryside can be strengthened, and how detrimental links can be inhibited. A number of questions emerge concerning the relationship between urban areas, their rural hinterlands, and the transportation networks which provide the 'connectivity' between the two. In short, in opposition to Chambers' (1983) criticism of roadside research, the presence of a tarmac road is crucial to the sampling frame of this study, and played a key role in determining the selection of research sites.

In the field research on which this book is based, six study sites were sampled on a distance decay transect along a major tarmac road extending north-east from Kano to Hadejia, in order to test for the attenuation of peri-urban influences with increased distance from central Kano (Figure 1.2). Distance decay models have, of course, been widely used by scholars over the years when exploring the effects of urban expansion on the peri-urban zone, and have led to different theoretical attempts to explain the relationship between land use and distance from the city's edge. For example, as early as 1826, Von Thunen's model of rural land-use hypothesized that with increasing distance from the edge of the city, the resulting land-use pattern would be one of a declining intensity of agricultural production (see Hall, 1966). Alternatively, Sinclair (1967) posits a model of land-use which suggests that the confusion regarding the pace of urban expansion creates additional uncertainty that limits medium and long-term investment, and results in less intensive utilization of land by those farmers located nearest to cities than by those farmers located at greater distances.

In this study, the main logic for sampling sites on a road-side distance decay transect is that rural-urban linkages are likely to be facilitated by the presence of a major transportation route, and may diminish with distance from an urban centre. It should also be acknowledged that spatial distance may not be the regulating factor here, but rather, rural-urban linkages may be a function of temporal distance, or how long it takes to travel from an urban setting to its hinterland. With this in mind, two sites were sampled away from the main tarmac road, one in relatively close proximity to Kano and the other at a greater distance from the city centre. In addition to the two main selection criteria – access to the tarmac road and proximity to Kano – each site was chosen subject to several other conditions. All six sites shared similar characteristics physically, socially and ethnically. Ultimately, as can be seen in Table 1.1, six sites of similar population size were selected, although the two most peri-

urban sites – Hotoro Arewa and Zangon Gabas – exhibit greater population sizes due to their relatively close proximity to the urban centre.

Table 1.1 Characteristics of the six study sites

Site	Location	Approx. from Kano	Altitude (m)	Road access	Population 1991†	Population 1996††	Ethnic groups
Hotoro Arewa	N11 59' 38.1" E008 35' 11.2"	2.2	480	Good tarmac, site has direct access to ring road	2,020	2,391	Hausa/ Fulani
Zangan Gabas	N12 03' 07.1" E008 34'26.2"	5	471	Good tarmac.	3,235	3,829	Hausa/ Fulani
Kadewa	N12 00' 27.8" E008 43' 11.0"	15	466	Dirt road (2.5 kms) leads to Hadejia Road	1,211	1,433	Hausa/ Fulani/ Kanuri
Maisar Tudu	N12 07' 25.9" E008 43' 24.4"	28	442	Good tarmac road (5.2 kms) leads to Hadejia Road	850	1,006	Hausa/ Fulani
Gamji Tara	N11 59' 14" E008 49' 27.9"	35	444	Dirt road (10 kms) and broken tarmac (7 kms) separate site from Hadejia Road	555	657	Hausa/ Fulani
Magama	N12 12' 05.6" E008 55' 23.3"	46	429	Good tarmac. Site has direct access to Hadejia Road	937	1,109	Hausa/ Fulani

Structure of the book

The second chapter begins by exploring and defining some of the key terms and ideas that are used throughout the course of the book. The notions of 'sustainability', 'land degradation', 'livelihoods' and the 'peri-urban zone' are discussed, and various interpretations of each are examined. The central idea that perceptions of both the environment and the processes that constitute land degradation are subject to many interpretations is introduced and it is consequently argued that these concepts may best be regarded as social constructions.

Chapter 3 provides a historical backdrop to agrarian development in the Kano CSZ. The discussion argues that contemporary land–society relationships in urban and

peri-urban Kano are, to a great extent, shaped by historical factors, especially those linked to the political economy of the colonial and post-colonial state. It is suggested that not only have state agrarian policies played a role in marginalizing small-scale agriculture in the CSZ, but the resilience of grassroots coping mechanisms has also been challenged in the process. The chapter traces the history of a long pattern of capital accumulation in the CSZ, which has played a defining role in shaping life in and around Kano. The chapter shows how regional, national and now global forces are placing increasing amounts of stress on food production systems, which has had severe consequences for smallholder livelihoods over the years.

Chapter 4 first offers a brief presentation of the physical background of the area of study, highlighting the climatic unpredictability and ecological uncertainty of the environment in the CSZ. The variability and complexity of the research area are particularly significant for local actors, who must cope with and adapt to an ecosystem that many researchers have described as being in a state of disequilibrium.[11] Following this general description, some of the new pressures which may currently be challenging the sustainability of Kano and its region are highlighted. Of key relevance to the arguments put forward in the empirical chapters to follow, is how the growth of urban Kano is currently affecting livelihoods and subsequently being 'played out' on the landscape.

Chapters 5, 6 and 7 form the core of the book, and the empirical data of the study are presented, analysed and discussed. Each of the chapters explores a different representation of land degradation and is framed around a different environmental theme. Chapter 5 focuses on the issue of soil degradation and highlights some of the methodological complexities involved in conducting actor-based studies of environmental change. Chapter 6 is concerned with perceptions of tree cover change in the Kano CSZ, and the discussion exposes a number of key forces that shape vegetation management decisions and are a function of proximity to the city. According to in-depth discussions with a wide range of actors, it becomes evident that there is much interlinkage between perceptions of the soil and their relationship to tree cover. Finally, in Chapter 7, critical issues that surround irrigated agriculture and water quality in peri-urban Kano are explored, and some of the immediate environmental consequences of food production on the urban periphery are brought to the fore.

Chapter 8, the concluding chapter of the book, begins by summarizing the key points that have emerged from the preceding chapters. Of key significance to the study, and a common thread that is found in all of the empirical chapters, is the notion that perceptions of the environment and land degradation vary both spatially and temporally, and urban pressures play a defining role in how people imagine and construct their landscapes. An understanding of these perceptions, it is argued, remains paramount, since they determine how and why local actors behave in the way they do. Thus, policies that attempt to regulate land management in the CSZ need to flexible, and must accommodate a wide range of actors and their diverse

11 Ellis (1995: 38) defines non-equilibrium systems as being 'those where populations or components are not in long-term balance with other elements of the system; thus they are unpredictable and sometimes undergo complex dynamic behaviour.'

livelihood strategies. In discussing the wider relevance of the study and its findings, several key areas of new research are identified, and recommendations are laid out for the creation of a more enabling environment that addresses the sustainability of changing livelihoods patterns in the Kano CSZ over the years to come.

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Chapter 2

Sustainability, Land Degradation and Peri-Urban Expansion

Introduction

The next two chapters will provide the contextual background and necessary definitions for the empirical chapters of the book which will follow later. In this chapter, an attempt is made to clarify the meanings of terms and key concepts that are referred to throughout the study, and to briefly sketch out the links between them. Specific attention is focused on three core conceptual areas that continuously surface throughout the book and require further elaboration. The discussion begins by exploring the crucial variable of 'sustainability', as it relates specifically to the dynamics of environmental change and livelihoods in the Kano CSZ. The contribution of the 'capitals' school to the sustainability debate is reviewed, and is considered in relation to discussions of environmental change. Although the capitals framework is not specifically operationalized to analyse the sustainability of livelihoods in the research conducted for this book, an appreciation of the main tenets of the approach provides a useful background for the discussion which will follow in subsequent chapters.

The chapter continues by exploring the notion of land degradation, a concept that is central to the study, but one that remains contextual and notoriously difficult to define precisely. Different interpretations of the meaning of degradation are presented, but ultimately, it is suggested that the concept largely remains a perceptual term that is inevitably open to multiple interpretations (Blaikie and Brookfield, 1987). In the section to follow, the relationship between the divisions of 'rural', 'urban' and 'peri-urban' are drawn out, but clear-cut definitions of these terms remain problematic since the differentiation between the city and countryside has presently become much less clearly geographically defined. The link between urban growth and many of the environmental burdens associated with degradation is then made, and attention is focused on how urban pressures, particularly those being played out in peri-urban localities, are having significant impacts on land and society. Finally, in the concluding section of the chapter, the ability of actors to respond to environmental shocks and stresses is discussed. The sustainability of newly evolving livelihood patterns in the rural-urban interface is considered, as well as how they have been increasingly shaped by significant environmental changes in recent years. It is suggested that the notion of 'resilience' remains a key concept in understanding how households respond to environmental change in the peri-urban zone and beyond, and is the prime mechanism for ensuring the sustainability of livelihoods over time.

Defining the concept of 'sustainability'

Over the past decade, the notion of 'sustainability' has become enshrined in the international development lexicon, and in both academic and political arenas worldwide it is now recognized that there are significant links between many of the problems associated with environment and development. However, despite a widespread acceptance of the notion of 'sustainable development', the concept itself has been subject to extensive criticism on numerous grounds. Most often, it is argued that the notion of sustainability has acquired so many different definitions that the term has in effect become meaningless. As Adams (2001: *xvi*) points out in his foray into the 'greening' of development, 'the path to sustainable development is paved with good intentions, but the rhetorical vagueness of that master-phrase 'sustainable development' has made it too easy for hard questions to be ignored, stifled in a quilt of smoothly crafted well-meaning platitudes.'

Undoubtedly, the most well-known and frequently cited definition of 'sustainable development' is that published by the Brundtland Report, in *Our Common Future*, which suggests that it is 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED, 1987: 43). However, as numerous critics have pointed out, this well-worn phrase may better be considered a slogan than a meaningful definition (Wilbanks, 1994; Adams, 2001). While sustainable development generally refers to the maintenance of development over time (Elliott, 2006), Holmberg and Sandbrook (1992) point out that by the early 1990s there were more than seventy different definitions of the term in existence. In fact, there are so many definitions of sustainable development that the term has been criticized as being conceptually elusive, and Pretty (1994) even suggests that the concept has become so value-laden that it is now probably incapable of being defined precisely. While an extended debate about the meaning of sustainability is beyond the scope of this chapter and will be left for consideration elsewhere, the concept is used frequently throughout this book, and thus a basic understanding of the term, or how it is used here, is necessary for the discussion which follows in subsequent chapters.

For the purpose of this book, the concept of sustainability is fundamentally about reconciling livelihoods and the environmental resources on which local actors depend. In this light, one of the most well-known models of sustainability, the 'capitals school', remains useful for the discussion to follow. The capitals framework, as outlined by Serageldin (1996), is premised on the idea that communities derive their livelihoods from a number of different types of 'capital'. According to Serageldin, these capital assets can be categorized as being natural, social, human, or human-made. In this context, 'sustainability' is defined as the maintenance of stocks or capital over time, and a sustainable society is one that is able to nurture and enhance these stocks (Warren *et al*., 2001). Other adaptations of the capitals school model, such as the 'sustainable livelihoods' framework, as developed by the Institute of Development Studies (IDS) team at the University of Sussex, or the model of 'sustainable livelihoods' used by the UK Department for International Development (DfID), have slightly different categories of capital assets, but the main concept remains the same. For example, the approach adopted by IDS and DfID uses the concept of 'economic or financial' capital,

in place of 'human-made' capital, and 'physical' capital is also included on the list. Broadly speaking, following the definitions provided by Scoones (1998: 7–8), the five main types of capital most commonly identified are as follows:

- Natural capital – the natural resource stocks (soil, water, air, vegetation) and environmental services (hydrological cycle, pollution sinks) from which resource flows and services useful for livelihoods are derived;
- Economic or financial capital – the capital base (cash, credit, savings, remittances and economic assets), which allows a land-user to make livelihood decisions about investments in natural, human or other forms of assets;
- Human capital – the skills, knowledge, ability to provide labour and good health, and physical capability which allow land-users to successfully pursue different livelihood strategies;
- Physical capital – the basic infrastructure, manufactured goods and tools which are required to produce or pursue livelihood strategies; and
- Social capital – the social resources and relations (networks, social claims, relationships of trust, affiliations, associations) upon which people draw when pursuing different livelihood strategies that demand coordinated actions.

At any specific moment in time, individuals or households may possess different combinations of capital in their livelihood 'portfolios.' Indeed, if a household is lacking in one category of assets, capital can be converted from one form into another (Stocking and Murnaghan, 2001), but ultimately, changes in the level of assets available may affect both land degradation and a land manager's ability to engage in sustainable practices. Livelihood portfolios therefore are dynamic, and livelihood strategies are susceptible to change over time and space, as local and external conditions change. As such, the sustainability of a livelihood pathway may largely be determined by its ability to adapt to unpredictable disturbances that are introduced to a system. Thus, according to Chambers and Conway (1992: 7):

> A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation…

Being equally significant, it remains important to acknowledge that access to the various categories of capital assets is to some extent determined by society, by way of socio-cultural norms or rules. For example, as Stocking and Murnaghan (2001) suggest, factors such as gender relations, marital status, education and age, may all play a role in mediating access to assets and environmental services. Central to the sustainable livelihoods framework, and of direct relevance to the investigation in this book, is the notion that there is a range of formal and informal institutional factors that have significant bearing on sustainable livelihood outcomes (Scoones, 1998).[1]

1 In this context, following Leach *et al*. (1997: 5), the concept of 'institutions' is used in a broader sociological sense to refer to 'regularized patterns of behaviour between individuals and groups in society', rather than merely referring to community-level organizations.

Thus, as Davies (1997: 24) points out, 'institutions are the social cement which link stakeholders to access to capital of different kinds, to the means of exercising power and so define the gateways through which they pass on the route to positive or negative [livelihood] adaptation.'

Although the capitals school has gained widespread currency in recent years, there are, undoubtedly, a number of problems with this framework when considering issues of environment and development. For example, Warren *et al.* (2001) express concern that the ideas that underlie the model remain 'dangerously abstract', and they suggest that a major shortcoming of the framework is that there remains little recognition of the fact that appraisals of the environment are socially conditioned. To illustrate, they point out that 'natural' capital does not have a fixed value in time or space. Accordingly, they argue that without a value by which to judge the conversion of one type of capital into another, the capital framework remains a weak analytical tool. However, in terms of its contribution to the sustainability debate, one of the great strengths of this approach is that sustainability is viewed as being more than just a condition operating within the biophysical environment. As will be discussed in further detail in the last section of this chapter, the notion of 'resilience', of both livelihoods and the natural resource base on which they depend, remains of key significance in achieving sustainability. Indeed, in the Kano CSZ, the ability of local actors to cope with and adapt to stress has for many years remained a central component of livelihood strategies. The sustainable livelihoods approach remains useful to the enquiry at hand because it acknowledges that there must be social sustainability as well as environmental sustainability, and this social dimension is perhaps the most vital contribution from the sustainability literature to understanding the concept of land degradation (Warren, 2002).

Land degradation: some conceptual clarification

At the heart of the debate concerning the 'sustainability' of people–environment relationships, is the complex concept of land degradation. For many years, there has been a marked dichotomy of opinion concerning the relationship between land degradation and human activity in drylands Africa. Over the past 15 years, however, a shift in 'degradation thinking' has been steadily gaining momentum, and many environmental scientists have now become much more critical of the 'received wisdoms' that have largely gone unchallenged in the past. Most detrimentally, the previous misinterpretation or misuse of data obtained from a number of influential studies has been responsible for perpetuating numerous degradation 'myths' and eliciting their accompanying orthodox 'knee-jerk' responses (Stocking, 1996). While it would, of course, be both inaccurate and naïve to suggest that land degradation is not a serious problem in many parts of the Kano CSZ or indeed drylands Africa more broadly, most observers now recognize that the interconnections between cause–effect linkages are far from simple (Stocking, 1996). In recent years, as new socio-economic pressures have impacted upon the West African landscape in dramatically different ways, people–environment relations continue to change, and perhaps more

than ever before, a radical re-thinking of land degradation and society is urgently sought.

In Nigeria, land degradation has long been identified as a major environmental problem, and the nexus between degradation, poverty and the long-term sustainability of rural, urban and peri-urban livelihoods has been targeted as an area of great academic concern (Odemerho, 1992; Gundu, 1999; Okolo, 1999). In dryland environments, such as the Kano CSZ, most research into land degradation has largely focused on soil degradation, concerning itself with either a change in nutrient level, or erosion (Warren, 2002). However, as Stocking and Murnaghan (2001) contend, the term 'land degradation' encompasses much more than merely soil analysis, and is perhaps best thought of as a 'composite' term, which also considers natural resources such as climate, water, landforms and vegetation. It can thus be argued that by placing degradation under a more expansive conceptual umbrella, researchers may gain insight into the multiple dimensions of degradation in wider systems and landscapes. Such a broader view of degradation, Batterbury and Bebbington (1999) concur, has the ability to deal with complex interactions between people, cultures and institutions, and a wide range of biotic resources, including trees, soil, water and animals.

Related to this issue of definitional scope is that of scale. As was alluded to in the introductory chapter, in any meaningful discussion of land degradation, the issue of scale comes into play. Warren (2002: 21) points out that degradation is rarely considered to be a problem in situations where a single crop or a single herd is lost, but rather it is a process that is perceived as much 'larger in scale and longer-term'. Many previous land–society studies have been based on this assumption, and broad-scale examinations of the environment have often led to the conclusion that widespread land degradation is taking place. However, more recently, several researchers have effectively demonstrated that studies carried out at different scales can generate contrasting findings that lead to very different conclusions. Gray's (1999) multi-scale investigation of land degradation in southwestern Burkina Faso is a case in point. Her analysis demonstrates that interpretations of degradation are subject to change, depending on the scale of analysis. Ultimately, she suggests, the question of whether or not land is being degraded depends not only on how the concept of land degradation is defined, but also on the scale and scope of the enquiry.

The fieldwork on which this book is based is derived at the local scale. However, it is recognized that the capability of local actors to engage in sustainable land management practices in a given location is shaped by decision-making forces which are often situated at great distances away (Elliott, 2006). In this respect, Blaikie and Brookfield (1987: 83) point out that the issue of scale remains important, 'because it helps to identify the many different levels from which relevant inputs into decision-making derive, and it helps too to focus upon the distribution of costs and benefits in land management amongst those who are involved.' The ability to link micro-scale analysis to wider perspectives remains imperative, and degradation studies that demonstrate the ability to explore the relationships between these different 'nested' scales of analysis would seem essential if meaningful theory and policy is to be devised in the future.

Owing to the many complexities associated with land degradation, coming to terms with an all-encompassing definition of the concept remains a difficult task and as Warren (2002) suggests, it is a term that cannot be simply defined. Most frequently, definitions describe a temporary or permanent decline in the productive capacity of the land (Stocking and Murnaghan, 2001), and common to many explanations is the idea that degradation is attributed to anthropogenic causes (Gray, 1999). While some observers have noted that degradation involves a decline in the land's 'usefulness' (Johnson and Lewis, 1995), other researchers have argued that a degraded environment is one where the 'capability' (Blaikie and Brookfield, 1987), 'potential' (Hellden, 1991), or 'productivity' (Nelson, 1988) of the land is reduced. Of the numerous and varying interpretations of the concept, most definitions view degradation as a biophysical process but many fail to recognize that any assessment of land degradation is 'deeply embedded within cultures and economies', and is above all, a value judgement (Warren, 2002: 20). Of vital importance in deriving any meaningful interpretation from the concept, Johnson *et al.* (1997: 583) add that land degradation is a term, 'whose meaning reflects our perceptions, viewpoints, time-frames, and value attachments.'

Related to this observation, Gray (1999) emphasizes the 'relativity' of degradation, pointing out that it is a process that is judged according to societal or individually determined standards. Simply put, she suggests that what might be considered to be degradation for one social group, might not necessarily be considered so for other groups. For example, the conversion of farmland to scrubland may be a detrimental situation for cultivators, but not for those who graze animals or practice shifting cultivation. Likewise, the conversion of forest cover to agricultural land may constitute a reduced potential in capability for foresters, but not necessarily for farmers.

In Kano's urban hinterlands, one good example to illustrate this point can be seen in the increasingly common land-use activities of peri-urban 'sand collectors'. At many peri-urban localities, it is apparent that sand extraction has become a very profitable income-generating strategy as the demand for construction materials in the city has increased spectacularly in recent years. According to one sand excavator, a lorry load of good quality sand could be sold for as much as 9,000 naira (c. £47 in April 2002). Such high profit margins have led to a proliferation in the number of sand collectors, and in the absence of any proper regulation in the practice, a number of conflicts have developed between different land-users. According to one peri-urban farmer, initially the 'sand carriers' began extracting such building materials without permission and free of charge. When local farmers observed these activities and realized that they could not prevent them, many thought that it would be better to sell their land to the sand collectors in an attempt to gain some sort of compensation. In desperation, as increasing numbers of peri-urban farmers have sold their plots to be mined for urban construction, the size and incidence of gullies have grown enormously, rendering a great deal of land useless for cultivation (Plate 2.1).

To this extent, a decline in biological productivity (or an increase in degradation) for one group of actors may go hand-in-hand with an increase in economic productivity for another group. Thus, degradation may best be considered as a socially constructed concept that has very different meanings for different actors

Plate 2.1 Sand collectors in Hotoro Arewa

and, as is suggested by Osbahr (2001), local perceptions of degradation will almost undoubtedly reflect the nature of local livelihood strategies. While varying knowledge and experiences will lead to contrasting ideas about what constitutes degradation, diverse actors also have different interests to protect, which will influence their perception of the landscape. Perceptions thus vary between groups, both spatially, and temporally (Dahlberg, 2000).

In the study carried out for this book, the idea that both the environment and land degradation are subject to varying perceptions is central to the investigation. While Blaikie and Brookfield's (1987) much cited definition of degradation as, 'the reduced capability of land to fulfil a given function', provides a useful starting point when investigating environmental change, it also remains crucial to recognize that local people do not form homogenous, consensual groups, nor do they hold identical meanings of their environment. Following Blaikie (1994, cited in Jones, 1999: 213), the environment, 'is constantly in a state of being conceived of, learnt about, acted upon, created and recreated and modified.' Jackson (1994) adds that differences in meanings held may occur where there is a strong division of tasks or responsibilities in daily life, such as occurs in engendered environments, or between socially differentiated groups using the same environment. Leach *et al*. (1997: 4) further suggest that when considering land–society relationships, an approach is needed that, 'starts from the politics of resource access and control among diverse social actors, and sees patterns of environmental change as the outcomes of negotiation, or contestation, between social actors who may have very different priorities.' As such, it would appear that understanding local perceptions of both the environment and land degradation is absolutely imperative in understanding how structural factors are mediated and transformed internally. Ultimately, the way in which local

perceptions of land and society drive behaviour at the micro level not only remains a key factor in mediating responses to structural forces, but may also shed light on why many farmers do not act in predictable or determined ways (Jones, 1999). As was noted in a foundational paper by Brookfield (1969: 53) many years ago, decision-makers base their decisions on the environment as they perceive it, not as it is. The actions resulting from their decisions, however, are in effect 'played out' in the real environment.

In the case of Kano and its hinterland, as will be clearly revealed in the empirical chapters of this book, as the urban fringe has steadily become a zone of contested terrain, the competition for environmental goods and resources has become acute. In such situations, the 'environmental entitlements' approach developed by Leach *et al.* (1997) provides a helpful framework for exploring the role that people play in environmental change. In short, there are two fundamental assumptions underlying this approach which are crucial for understanding the complex relationships between land degradation and society in Kano's CSZ. First, it is suggested that 'communities' are socially differentiated and variable groupings that are often characterized by conflicting values. Second, and being equally as important, it is pointed out that the environment must be considered as a dynamic, disaggregated entity that is never universally valued. By embracing social and ecological difference, and acknowledging that conflict rather than consensus may be a defining factor in the relationship between people and their environments, Leach *et al.* (1997) demonstrate that a more robust understanding of land degradation can be developed. They draw on Sen's (1981) notion of entitlements[2] to address environmental questions, and in the process they illustrate how access to environmental goods and services are mediated by diverse institutions. Specifically, in their words, they note that, 'those with different modes of livelihood, or who carry different responsibilities within divisions of labour, may need to draw on very different environmental resources and services, and hold different views of what constitutes environmental degradation or improvement in that context' (Leach *et al*., 1997: 7).

Although an appreciation of the 'multiple realities' of land degradation remains vital to this study, relying solely on perceptions of the environment as an indicator of degradation can be problematic. As was noted in Chapter 1, an approach is needed that employs a wide range of methods in the analysis. While broadly speaking perceptions are socially constructed and politically mediated (Gray, 1999), this is especially the case in peri-urban areas where a diverse range of actors congregate, and perceptions of degradation can vary greatly. In such situations conflict may ensue, access to resources between actor groups may be contested, and each social group may blame the other for a perceived incidence of degradation. As Watts (1983b)

2 Sen's (1981) 'entitlement approach' places poverty at the centre of the analysis. He argues that famine is a social phenomenon resulting from institutional and political factors which determine an individual's ability to secure food entitlements. This being the case, he demonstrates that famines can occur even when food supply is not significantly lower than in non-famine years. Accordingly, food insecurity results primarily from what Sen refers to as 'entitlement failure', which occurs when market forces take away the ability for local people to acquire sufficient food supplies.

correctly notes, analyses of perceptions must consider the historical, societal, and political contexts which determine how people interact with their environments. With this in mind, Chapter 3 will attempt to situate Kano's changing landscape in a historical context, demonstrating that it remains very difficult to explore the process of environmental change in isolation of the historical forces that drive it. Indeed, the notion of temporal scale is fundamental in this respect, and as Batterbury and Bebbington (1999: 281) remark, 'it is difficult to understand the dynamics of land-use change at a point in time if these are not analyzed within the context of longer histories of society–environment interactions.'

While the broad focus of this book involves an exploration of the relationship between urban pressures, livelihood strategies and environmental change, the main aim of the investigation is to examine the impact of urban expansion on agricultural sustainability in Kano's urban hinterlands. In doing so, the enquiry demonstrates that not only do various land-users perceive their environments and indeed the concept of land degradation in very different ways, but both land-use decisions and an individual's capability to manage the environment sustainably are greatly impacted by the effects of the city. However, before the discussion turns more specifically to the impacts that urban areas have on the people and the environments that immediately surround them, further examination of the continuum between the poles of 'urban' and 'rural' will first be useful. Indeed as growing African cities increasingly consume their surrounding rural areas, clear-cut distinctions between these discrete typologies may not be as straightforward as previously believed.

Bridging the divide: defining 'rural', 'urban' and 'peri-urban'

Adding further confusion to the complexities associated with defining urban boundaries, in recent years, many researchers have demonstrated that increasing numbers of urban households in effect operate across the urban-rural divide, and maintain close ties with their rural kin in the countryside (for example, see Potts, 1995).[3] In such situations, it is often no longer useful or relevant to make the traditional distinction between the 'urban' and the 'rural', as rural and urban areas have become blurred and livelihoods in the two areas have become intertwined. In agreement with Rees (1992), Tacoli (1998a) adds that urban livelihoods frequently depend on a geographic zone substantially larger than the built-up city area to supply basic resources and ecological functions. This being the case, a number of studies have begun to acknowledge the increasing importance that 'peri-urban' zones play as arenas for rural-urban exchange in the strategies of households and family networks (Swindell, 1988).

Bridging the divide between the city and the countryside, the peri-urban zone can broadly be defined as an interface where there has been a blurring of the rural and urban, and is characterized by mixed land-use by a wide range of stakeholders. However, any researcher who has undertaken fieldwork in sub-Saharan Africa will

3 In the Kano context, dry season circular migration patterns from villages to urban centres, or the practice of *cin rani*, as it is referred to in Hausa, was considered by Prothero many years ago. For further articulation, see Prothero (1959, 1972).

be well aware of the difficulties presented in trying to delimit and define the spatial areas of 'urban', 'peri-urban' and 'rural' zones. Indeed, it seems that the countryside that immediately surrounds urban areas, or the peri-urban zone, does not have a simple definition that is universally accepted by all scholars (Allen, 2003).

Although the term peri-urban is usually used to convey the overlapping of rural and urban areas, Bryant *et al.* (1982) point out that the definitional problem lies mainly in the difficulty of delimiting the spatial extent of this dynamic region, and in the interpretation of the notion of transition. Allen (2003) further notes that this transitional element can be measured by a wide variety of criteria that are used to distinguish rural from urban, including population size and density, the presence or absence of built-up areas and infrastructural characteristics, administrative boundaries, and the predominant economic activities that take place. It would thus appear that some confusion exists not only with respect to a physical definition of the peri-urban zone, but also in the criteria that are used to measure and delimit this dynamic region.

Nevertheless, over the years, numerous definitions of the term peri-urban have been devised, most of which broadly agree that peri-urban zones are areas which are generally rural in character, but are under the influence of urban factors or processes (Ilbery, 1985). In one very early definition by Wehrwein (1942: 218), this zone is simply described as, 'the area of transition between recognized urban land-use and the area devoted to agriculture.' In a similar vein, emphasizing the notion of transition, Johnson (1974: 4) states that a peri-urban zone is, 'the area in which suburban growth is taking place, and where rural and urban land-uses are mixed together to form a transition zone between town and country.' Alternatively, the Organization for Economic Cooperation and Development (OECD) (1978: 9) refers to the region as, 'the periphery of urban agglomeration where economic and social activities are directly affected by the presence and expansion of the city.'

It thus appears that like the concepts of 'sustainability' and 'land degradation', there are numerous and varying interpretations of the notion of peri-urban as well. For present purposes, the region is perhaps best thought of as a transitional environment of mixed land-use between a city's continuously built-up area and its rural hinterland, where '…economic and social activities are directly affected (beneficially as well as to their detriment) by the presence and expansion of the city' (Mwamfupe, 1994: 12). In recent discussions concerning the nature of peri-urban zones, the dynamic characteristics of these regions are often stressed. Tacoli (2003: 3) notes that the linkages and interactions in the peri-urban interface have become an increasingly important component of livelihoods and production systems, 'forming not so much a bridge over a divide, as a complex web of connections in a landscape where much is neither 'urban' nor 'rural', but has features of both.'

One specific activity which is increasingly associated with the dynamism of the peri-urban region is the proliferation of small-scale agriculture that has developed in and around many African cities in recent years (Freeman, 1993; Freidberg, 1996; Lynch *et al.*, 2001). However, although peri-urban agriculture is now widely considered to be an important survival strategy for urban residents, there has been correspondingly little attention given to the future sustainability of peri-urban livelihoods. In Chapter 7, specific attention will be focused on the issues

of degradation and sustainability that concern peri-urban agriculture in the Kano region. As is the situation with other burgeoning Nigerian cities, it would appear that in the case of Kano, alarming growth rates have served to 'ratchet up' pressures on agricultural areas, particularly those in peri-urban localities where the differentiation between the city and countryside has become blurred. Past experience suggests that the political stability and economic sustainability of 'exploding' sub-Saharan cities will be vitally dependent on the accessibility of reasonably priced food supplies (Walton and Seddon, 1994; Egziabher, *et al*., 1994). It thus remains paramount to appreciate that what happens in cities has both environmental and livelihood implications far beyond the city limits.

Urban growth and the pressure of the city: are Africa's mega-cities sustainable?

As reviewed in Chapter 1, relationships between population and environment are complex and have been the focus of an ongoing debate between proponents of neo-Malthusian and neo-Hardinian views concerned with environmental limits to population growth, and neo-Boserupians, who see increasing population densities as stimuli to innovation and conservation. Focusing more specifically on urban land–society studies, there has also been a wide range of opinions concerning the relationship between degradation and human activity. While some analysts argue that overpopulated cities are essentially 'parasitic' and the cause of negative environmental impacts on people and environments (Harrison, 1979; Timberlake, 1985), others maintain that urban centres also create 'environmental economies of scale' and generate positive repercussions for both urban and rural populations and environments, through the provision of technologies, materials and increased livelihood opportunities (Main, 1995; Hardoy *et al*., 2001). A third perspective, on the other hand, maintains that the complexity of urban populations makes the link between people and environment difficult, and while it may not always be possible to quantify all negative impacts of cities, it is also often not possible to quantify the positive impacts that cities have beyond their urban boundaries (see, for example, Satterthwaite, 1997).

As rural areas surrounding Africa's growing cities continue to be integrated into the urban system, the problem of how to manage urbanization sustainably has become an issue of great significance. This is particularly the case as many of the challenges associated with growing sub-Saharan cities are not geographically defined, and extend well beyond urban limits. City residents are largely dependent on resources from their surrounding urban hinterlands to meet their livelihood needs. For example, as Potter *et al*. (2004) highlight, the food, energy, water and material inputs necessary to sustain urban living are largely drawn from sites that are great distances from a city's limits, and the environmental burdens associated with their exploitation are frequently felt in far away localities. A heightened awareness of the problems that fast-growing African cities face has led to an increased academic interest in the challenges posed to sustainable urbanization. One specific concern has to do with growing populations outstripping urban services and infrastructure

provision (Gilbert, 1992; Anton, 1993; Drakakis-Smith, 1996), and in particular, the urban exploitation of key natural resources has been flagged as a significant problem for African cities in the years to come (Main, 1995). Such concern has prompted a great deal of focus on the dynamics of population-driven environmental change in and around cities.

However, in addition to the environmental impacts that are immediately felt in a city's hinterlands, there are other indirect 'social' impacts which must be considered in any discussion of sustainable cities. According to Main (1995), who is critical of the 'environmental demonology' often associated with African cities, urbanization can have both positive and negative environmental impacts on rural people and environments. While Hardoy *et al.* (2001), suggest that cities potentially create a series of environmental advantages and opportunities for those living in their shadows, others argue that the high population densities associated with urban centres create what have been referred to as 'environmental economies of scale'[4] (Lynch, 2004) and are beneficial for resource deprived governments. However, as urban populations increase in size, the commercialization of land and agricultural markets in the surrounding urban hinterlands can lead to drastic changes in the nature of productive activities and in livelihood strategies themselves (Elliott, 2006). Rural to urban migration may have positive repercussions for the rural economy in the form of remittances, and may allow for increased agricultural investment in the countryside. Alternatively, at the same time, such linkages can be a drain on rural labour supply and skills at key periods during the agricultural cycle, and may undoubtedly play a role in increasing the stress on scarce resources and inadequate infrastructure in and around the city.

The literature on urban environmental problems in Africa is vast and covers a plethora of issues such as population, water, waste, food supply, pollution, energy, disasters, transport and housing. Of particular concern to this study is the manner in which these issues are being played out on food production systems in Kano's CSZ. Focusing on Kano's peri-urban zone, the transitional region that immediately surrounds the built-up area, there is a growing body of research concerning food production that has identified a number of constraints, and raises concerns about its impact on environment and people. Acute problems of land tenure insecurity and encroaching land development are now common on Kano's urban periphery (Lynch *et al.*, 2001), and studies have also examined some of the health and environmental concerns associated with peri-urban farming. As will be demonstrated in Chapter 7, empirical evidence from Kano's peri-urban region suggests that there is currently much reason for concern as industrial and domestic toxins are reaching dangerously high levels. As peri-urban soils and water channels become increasingly polluted, the sustainability of food production in this region is questioned. The health implications of long-term exposure to these toxins are presently unclear. It is therefore vital that

4 Most often, as Lynch (2004) notes, these 'environmental economies of scale' refer to the relatively cheaper costs (per person) of providing infrastructure and services to increasing population densities. However, at the same time, increased populations also place an excessively heavy demand on urban infrastructure, often adversely impacting the surrounding environment.

joint longitudinal research between urban planners, agricultural scientists and health specialists is carried out to obtain a clearer picture of the situation (Binns *et al*., 2003).

Resilience and diversity challenged?

Returning to the discussion at the beginning of this chapter, it was suggested that the resilience of households in dealing with changes or shocks to their livelihood systems undoubtedly played a key factor in ensuring sustainability. This, of course, is hardly a new idea. Historically, rural Hausa society was able to cope effectively with risk by strengthening community-wide resilience mechanisms for reciprocal non-market exchange (Watts, 1983b). Kinship, clientalism, reciprocity, communal work groups (referred to as *gayya* in Hausa) and the Islamic tradition of almsgiving all played an integral role in creating a strong 'coping society' that was held together by solidaristic and cliental ties (Mustapha and Meagher, 1992). Over the past three decades, a considerable amount of research has focused on understanding how poor grassroots actors struggle for food and resources in times of need, and there is now a vast literature that explores the nature of household coping mechanisms and survival strategies (see for example, Richards, 1986; Mortimore, 1989).

In an important work by Scott (1976), it is argued that the ability of smallholders to adapt to environments of risk is a characteristic that is common to all pre-capitalist peasant societies. In fact, Scott (1976) suggests that it is the task of negotiating risk and ensuring 'a margin of security', or minimum level of subsistence, that actually defines the structure and organization of peasant societies themselves. He believes that there are three dimensions to pursuing this minimum subsistence – the 'safety first' mechanism (or risk aversion practices in agriculture), the 'norm of reciprocity' (or the practice of gift giving in times of need), and the functioning of a 'moral economy'. Scott borrows the term 'moral economy' from the work of the British historian E. P. Thompson (1963), whose research focused on the British food riots in eighteenth century England. For Scott (1976), the moral economy of the peasant is summed up as a 'pre-capitalist normative order' in which elite demands took account of peasant subsistence needs. In Scott's (1976: 184) words, 'Peasants expected of elites the generosity and assistance that they imposed within the village on their better-off neighbours; social rights were, in this sense, village morals writ large.' The concept of moral economy is closely related to the notion of 'social capital' and the norms of trust that exist within communities, and it is frequently used to describe the range of redistributive mechanisms which occur in times of need (Swift, 1989).

Today, many would argue that beginning with the onset of colonialism, this traditional 'moral economy' has been greatly challenged, and the capacity of local actors to respond flexibly, particularly to environmental stress, has become much more difficult (Watts, 1983a; Mustapha and Meagher, 1992). Azarya (1994) argues that when resources become exceedingly scarce, an individual's immediate needs usually take precedence over consideration of any social contract which recognizes an obligation to others. Harvey (1997) adds that such a tendency is apparent in the literature on coping mechanisms during periods of natural disaster, when the moral

economy of exchange may break down during prolonged periods of stress or scarcity. Chambers and Conway (1992: 14) note that there are a number of livelihood stresses which may build up gradually over time and have a profound effect on individuals, households and communities. Examples of such stresses include: population pressure on resources leading to declining farm size and declining returns to labour; indebtedness; diminishing yields on soils (due to salinization, acidity or erosion); shrinking common property resources; and having to travel further and spend longer hours to secure access to fuel, fodder, grazing land or water.

As was noted earlier in this chapter in our discussion of sustainable livelihoods, a livelihood can only be considered to be sustainable when it is able to cope with such stresses and shocks. Evidence from this study suggests that many of the changes associated with rapid urbanization have put increasing pressure on households, especially those in the rural-urban interface. Nevertheless, it would appear that many households continue to find new ways to struggle on, often in ingenious and creative ways. In the present-day hinterland of Kano, peri-urban livelihood strategies have become increasingly important survival mechanisms for a wide range of actors in the context of rapid urban population growth. As is also most certainly occurring in the peripheries of other fast-growing sub-Saharan cities, the empirical chapters of the study confirm that local actors in Kano have been forced to diversify their livelihood strategies and engage in an often complex web of agricultural and non-farm activities in order to ensure household survival.

Although local actors continue to cope in increasingly difficult conditions, it appears that there is a major disagreement between researchers as to whether or not long-term sustainability can be achieved with these newly evolving livelihood strategies. While it may be the case that traditional coping mechanisms have been weakened and replaced by an increased dependence on non-farm incomes, the optimists see this as a way of enhancing the flexibility of the system and its capacity to withstand stress and remain resilient (Mortimore, 1989). Alternatively, other more pessimistic observers believe that such diversification strategies may actually contribute to the process of degradation and undermine rather than enhance the sustainability of production systems. As such, Berry (1993: 195) believes that under unstable conditions, 'farmers are reluctant to tie up land, labour, and capital in long-term projects, such as soil conservation, water control, or fixed capital formation, which may sustain soil fertility or augment the availability of land and labour.' In the case of many rural communities in northern Nigeria, Meagher and Mustapha (1997) suggest that as coping mechanisms have been radically altered, the result has been a trend towards increasing fragility rather than flexibility in livelihood portfolios. Thus the future livelihood sustainability of those living in the urban shadow appears to remain uncertain. Ultimately, Meagher and Mustapha (1997: 80) argue, 'rural non-farm activities are plagued by the increasing saturation of the rural and urban informal sectors and an intensifying cost-price squeeze, which limits their scope for flexibility or innovation.'

Conclusion

This chapter has attempted to define and clarify some of the key conceptual issues which form the building blocks of the study in this book. Many of these frequently used terms such as 'land degradation', 'sustainability', 'livelihood' or 'peri-urban zone' are conceptually elusive, and as a result can potentially become shrouded in confusion. Although it has not been possible to present an exhaustive review of these complex and interdisciplinary issues, effort has been made to substantiate the context in which they will be used in this book.

In the process, the literature reviewed in this chapter has highlighted several key points. Central to the study is the notion that both perceptions of the environment and the meanings attached to land degradation are socially constructed. In short, land degradation remains a process that is subject to varying interpretations between different actors and at different scales of analysis. The variable and changing meanings attached to the concept reflect the 'multiple realities' of different actors, as well as the great diversity in their livelihood strategies. The ability of households to cope with increased stress on their livelihoods, and avoid practices that degrade their natural capital base is a key challenge in ensuring the sustainability of production systems over time. In particular, the review has drawn attention to the diversity and complexity of livelihood portfolios in peri-urban localities, where the highest population densities and smallest average land holdings are generally found. As the competition for scarce resources intensifies and pressures associated with urban growth continue to shape land and society in dramatically new ways, it remains unclear as to whether livelihood strategies will retain the resilience that they have had in previous times.

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Chapter 3

Historical Background to Farming in the Kano Close-Settled Zone

Introduction

Although there continues to be a marked dichotomy of opinions concerning the relationship between land pressure and environmental change in the Kano CSZ, many observers would increasingly concede that the land manager should be placed at the centre of explanation. A great many researchers would also agree that such investigations must acknowledge that social and historical factors play a key role in shaping present-day relationships between land-users and their environments. The processes that influence an individual's land stewardship choices are, of course, numerous and complex. All too often in the past, however, researchers and policy makers have failed to recognize the underlying socio-economic forces that drive land management decisions and remain central to studies of environmental change.

For example, one well-known research NGO based in Ibadan, the Nigerian Environmental Study/Action Team (NEST), paints a very bleak portrait of northern Nigeria's 'threatened' environment by making frequent reference to a 'shopping list' of environmental crises, including soil exhaustion, overgrazing, deforestation, and desertification (NEST, 1991). Little attempt is made to locate these processes in their historical context, or develop a meaningful appreciation of the underlying factors that may be driving them. Indeed, as Leach and Mearns (1996) point out, many popular 'myths' about environmental change have been fashioned in this way, as assumptions about the history of a given landscape are formed on the basis of 'snapshot' views. Clearly, as other key studies have indicated, attention to historical detail remains essential in gaining a more accurate picture of environmental and land-use change (for example, see Fairhead and Leach, 1996; Scoones, 1996).

In reflecting on the foundations of deeply-held 'crisis' narratives that continue to surround people–environment debates in northern Nigeria, this chapter argues that an analysis of land–society relationships in Kano's urban hinterlands cannot be held in a historical or political vacuum. Indeed, the actions of land managers must be principally understood in the context of their social constraints and how these have been shaped historically by limited power, land hunger, misguided state policies, and incorporation into productive relations associated with wider economic systems. In the process of engaging with these issues, the discussion in this chapter provides a brief overview of the historical roots of what is often referred to as the 'agrarian crisis' in northern Nigeria, highlighting how development policy and its rhetoric has had significant consequences for both smallholder livelihoods and the environments they depend on. As we will see, these historical agents have played,

and continue to play, a defining role in driving land management decisions in the rural-urban interface.

Clearly, in the Kano CSZ, many of the contemporary problems that concern environment and development can be linked to the political economy of the colonial and post-colonial state, and can be historically connected to a long pattern of capital accumulation. The historical summary presented in this chapter thus remains particularly important for understanding how livelihood patterns have changed in recent years. More specifically, the discussion highlights how increased stress on rural livelihoods and the undermining of the rural economy have intensified the need for non-farm incomes, and have set a process of 'de-agrarianization' in motion (Bryceson and Jamal, 1997). As cities have grown in size and the need for non-agrarian income has escalated in the urban hinterlands, off-farm activities have frequently been carried out at the expense of the agrarian base (Meagher and Mustapha, 1997; El Bashir, 1997). This chapter will trace the development of agrarian policy in northern Nigeria, and in the process demonstrate how the nature of life on Kano's urban periphery has been radically transformed. To simplify the discussion, the analysis begins with a brief history of pre-colonial society in the Kano CSZ, and then the remainder of the chapter is framed around a discussion of state development and policy in northern Nigeria during three main historical periods: the colonial era (1903–1960), the post-colonial era and the oil-boom years (1960–1985), and the structural adjustment era (1986–present).

Pre-colonial empires and development in Kano and its region

In West Africa, the relationship between urban centres and their hinterlands has been shaped by a long and rich history. Pre-dating the period of colonial contact, there existed a series of well-established West African empires and kingdoms such as Ghana, Mali, Songhai, Oyo and Benin, which were based on centralized political and economic power located in cities (Binns, 1994). In the Savannah region south of the Sahara Desert, a network of important towns developed at the southern end of a flourishing trans-Saharan trade route. All of these civilizations had agricultural economies, but it was their connection with the major trade routes that allowed them to flourish and generate wealth (Stock, 2004). Initially, salt was brought southwards from the Sahara and exchanged for gold, but later the trade diversified, with European and Arab goods being exchanged for commodities such as slaves, skins, gum and spices (Binns, 1994). Kano, it is believed, dates from the late tenth century, and was originally one of the important hub centres on the trans-Saharan trade route.

Located at the intersection of several important trading routes, a series of independent Hausa states developed in present-day northern Nigeria. At some point before the fifteenth century, traditional rural life was radically transformed when groups of lineage-based units began to agglomerate, leading to the development of the first towns, or *garuruwa* (sing. *gari*), as they are referred to in Hausa (Shenton, 1986). Urban life gradually evolved, and with the emergence of the *Mai Gari*, or town head, Hausa society began to develop a state structure. Although a very rudimentary

division of labour was apparent in these early days (including the emergence of full-time craftsmen), the majority of society still remained predominantly agricultural.

It was not until the fourteenth century that Kano, northern Nigeria's greatest city at the time, developed into a *birni*, or true walled city. Kano's population grew considerably during this period, as it became populated by migrants who arrived in search of scarce resources such as iron, good farming land, and the power of an especially strong spirit cult (Shenton, 1986). Mustapha and Meagher (2000) point out that at this point in history, the structures of an emergent Hausa state had not fully penetrated into the countryside, and it was not until after the disappearance of the *Gidan Rumfa* dynasty in 1623 that the rural economy came under stricter supervision of the state. In 1806, the Islamic *jihad*, or holy war, was declared, and some 30 territorial units came into being, creating the largest and most populous state in nineteenth-century West Africa (Watts, 1983a). The hegemony of the Hausa-Fulani Emirate system marked the economic and political ascendancy of the Sokoto Caliphate over the entire central Sudan region, and the continuing incorporation of rural areas into this vast empire allowed for an increased ability for the state to appropriate resources via taxation and forced labour.

By the end of the nineteenth-century, society in the Sokoto Caliphate was still principally agrarian in nature, and it is believed that more than 80 per cent of an estimated population of ten million lived in the countryside and engaged in agriculture (Hill, 1977). The rural economy was driven by a combination of rainfed millet production (both shifting cultivation and short term fallow systems were used), irrigated wetland (*fadama*) farming (including the production of garden vegetables for the urban populace), and cattle and small livestock rearing. Even in these early days, however, much like the present situation in the Kano CSZ, local actors engaged in a wide range of adaptive mechanisms for coping with the uncertainty of the environment. Livelihood diversification through petty commodity production or alternative off-farm income-generating activities was vital for household survival, and served as an important link with the wider political economy (Hill, 1972; Baier, 1980; Meagher and Mustapha, 1997). More specifically, according to Watts (1983a), between the months of October and June during the long dry season (*rani*), the majority of adult males engaged in at least one craft or trade (*sana'a*) and migration to urban centres (*cin rani*) was not uncommon.

Of particular significance to this book, one of the main consequences of the commoditization of production within the Caliphate was the formulation of a distinctive division of labour between the city and rural areas. In Kano Emirate, the proliferation of full-time craft specialists and the development of a merchant class who engaged in petty commodity production and traded in basic foodstuffs, craft products, and luxury goods, meant that there was an increasing proportion of the workforce involved in off-farm activities. In short, even as far back as the early eighteenth century, the city of Kano has always remained dependent on its hinterlands for the importation of foodstuffs to feed its growing population. Watts (1987c) offers some insight into the nature of Kano's food production system during the time of the Caliphate:

> Staple foodstuffs were certainly drawn into the *birni* from far afield because many of the peri-urban districts were in deficit due to a highly developed craft economy, but the role of the market was limited despite the occupational division of labour. The market-dependent consumers were wage labourers, urban poor, full-time craft producers and low-level state functionaries and clients. Urbanites with small farm holdings also purchased grain and the supplies were exhausted. But much of Kano's food circuits were sustained through home production – city dwellers who were also farmers – and the huge patrimonial household network of the nobility, the aristocracy and the merchants based on estate production (1987c: 70).

Although at times, the city of Kano faced great shortages of grain, in general terms, pre-colonial agricultural systems were able to support very high population densities. In some cases, these densities were as high as 300 persons per square mile (Watts, 1983a). Typically however, one of the main stresses on Kano's food production systems was the extreme variability in precipitation, and during the nineteenth century alone, poor rainfall caused famines to occur in 1863, 1873, 1884 and 1889 (Watts, 1987c). In fact, owing to the extreme nature of the climate, it is perhaps not surprising that food shortages in pre-colonial northern Nigeria have been described as recursive processes, and the 'dialectic of feast and famine' is a recurrent motif in Hausa oral history (Watts, 1984). As such, regional harvest failures had a major impact on the city of Kano, and during periods of agricultural collapse it was only the wealthiest households that could afford to store large enough quantities of grain to assure survival. In contrast to Hopkins's (1973) romanticized 'myth of merrie Africa', it was more likely that in pre-colonial times, 'big men' in Kano profited considerably when grain prices skyrocketed in periods of high demand. These wealthy patrons were able to exert considerable power during times of need and strengthened their clientage networks in the process.

As the cost of grain rose substantially during times of food crisis, many city dwellers had no alternative but to resort to wage labour to sustain themselves during periods of hardship. Although the fundamental unit of production in the pre-colonial era was the household farm, or *gandu*, there were a variety of cultural, political and economic factors that reinforced the importance of non-farm income for most households in the CSZ. Most notably, surpluses were appropriated by the state in the form of labour rent and rent in kind (for example, grain tithes), but in addition, households were also subject to monetary rents on certain crops and crafts (Watts, 1983a). Meagher and Mustapha (1997) suggest that the influence of Islamic inheritance practices, the pre-colonial state system, and the development of food-crop agriculture made access to land and labour more vulnerable to commercialization than in other parts of Nigeria, and in turn further increased the importance of non-farm incomes for household survival.

The Colonial Years (1903–1960)

In 1903 the British occupied Kano and policy decisions were made that radically altered the structure and dynamics of rural life in the urban hinterlands. The Nigerian colonial state was founded on peasant-based export commodity production in three

separate regions – cocoa in the West, palm produce in the East and groundnuts and cotton in the North (Watts, 1987a). Kano emerged as the prime city of the north, and it developed as a vital mercantile centre for the bulking and shipment of produce and raw materials, while at the same time it continued to flourish as a centre for cattle trade and for a petty commodity economy. When the railway finally reached Kano in 1911, it further opened up vast areas of agricultural land for groundnut production to supply valuable vegetable oils to Britain.

However, the prevailing traditional peasant economy in Kano's hinterlands was drastically altered with the establishment of British colonial rule. Mou and Vivekananda (1993) note that the colonial state was able to effectively penetrate and control the peasant producing class by enforcing measures aimed at the 'monetization' of the peasant economy: British currency was introduced as the only legitimate means of market exchange, new taxation laws were enacted, and commodity prices and market access were regulated by colonial administration. During the initial stages of colonial integration, the effects of taxation and the competition from cheap imported goods were responsible for destroying many of the more specialized craft industries. This set in motion the process of private accumulation which projected Nigeria into the global economy as a supplier of raw materials (Watts, 1983a; Mustapha, 1990). In short, as Mustapha and Meagher (2000) point out, contemporary societal structures and relationships in 'rural' Kano as they presently exist, remain very much a product of the colonial 're-working' of the pre-colonial 'template'.

During the period of what is often referred to as 'Late Colonial Developmentalism' (1930–1954), the concepts of 'science' and 'progress' became increasingly intertwined with notions of 'development', and were reflected in many of the agrarian policies of the day. The Kano Agricultural Station was set up in 1922, and studies were carried out which had great influence on agriculture and livestock policies, as well as forestry and soil conservation regimes. It remains important to note that much colonial science during this period was significantly influenced by scientific debates being carried on elsewhere (Leach and Mearns, 1996), and many of the policies developed were irrelevant to the smallholder class and in numerous cases, harmful to their livelihoods. Commentators elsewhere have noted that frequently colonial policies in Africa were designed to offer explanations for environmental collapse and the solutions for their prevention, by adopting measures of strict control which supported colonial goals (Scoones, 1996). Perhaps of even more importance, however, many of these colonial ideas were inherited by post-colonial governments, and have played a fundamental role in perpetuating the 'received wisdom' which still persists today. Beginning in the 1920s, Mustapha and Meagher (2000) suggest that:

> The quest to subordinate peasant agriculture to the dictates of 'science' started in this period and continues to run deep in agrarian policy in Nigeria. In the 1990s, we will see the development of an elaborate and expensive network of national agricultural research. The only difference is that in the 1990s, concern for the 'hard' sciences – soil chemistry, irrigation and traction engineering – and economics are now mixed with more general sociological concerns (2000: 14).

In considering the goals of the colonial state, it remains important to acknowledge that there was much more going on than merely a relationship of extraction between the state and the colony. Lugard's (1922) 'Dual Mandate' model suggests that although the colonial state was principally structured by its role as an agent of metropolitan capital, it was also required to serve as a supervisor and mediator of the internal tensions within the colony itself. Lonsdale and Berman (1979) argue that the relationship between the colony and the state was rooted in 'the material necessities of a politics of collaboration.' They suggest that the state's actions became a response to the dilemmas encountered in trying to fulfil its 'dual mandate' – that of coping with the 'socially disruptive articulation' of both capitalist and indigenous modes of production (1979: 505). Simply put, the authority of the colonial state came to rest upon a compatibility of interests[1] between 'big men' in both peasant and capitalist production.

In the case of colonial northern Nigeria, such a 'compatibility of interests' was regulated through the system of 'indirect rule' which involved maintaining and modifying traditional political structures to suit the needs of the colonial state (Stock, 2004). In essence, these policies meant that British colonial interests were being implemented by subservient local leaders, who were rewarded through a patronage system of 'clientelist accumulation' (Clough and Williams, 1987). It was through this appointed neo-traditional class that colonial state agricultural policies were communicated to the peasantry, and it is against this backdrop that colonial state intervention in domestic food production must be appreciated.

Watts (1987c) suggests that the growth of the commodity economy during the colonial years had three major consequences for the city of Kano and all those who lived in its vicinity. First, the food supply catchment area surrounding the city was greatly expanded during this period. Since it was never certain if local grain harvests would be plentiful from year to year, there was considerable variability in the amount of food purchased in the catchment area, which ultimately produced instability for growers in Kano's hinterlands. Second, the dependency on groundnut production set in motion a 'boom and bust' pattern which was devastating for smallholders and played a role in eroding smallholder resilience.[2] Third, the combination of an increase in population and a shortage of land for crop production placed stress on soil fertility, especially in the CSZ where livestock manure was already in scare supply.

Initially, there was no coherent colonial agricultural policy in northern Nigeria (Forrest, 1981), but rather the food economy was shaped by British merchant capitalists who purchased peasant produce through African intermediaries (Bauer, 1954). As Mou and Vivekananda (1993) point out, these first transactions reflected

1 For example, in the case of the colonial state in Kenya, Lonsdale and Berman (1979) suggest that such a compatibility of interests was perhaps most clearly seen with respect to African labour supply. The state wanted to keep labour costs low to complete its public works as cheaply as possible, and the Chiefs (or 'big men') who dominated domestic cereal production, also benefited from these low labour costs.

2 For example, in the boom and bust period following WWI, groundnut prices are reported to have dropped from £41 per ton in January 1920 to just £7 per ton in January 1921 (Annual Report, Kano Province, 1921, cited in Mustapha and Meagher, 2000).

the policy of 'indirect rule' that operated in the political sphere. However, during the time of the Great Depression and the Second World War, marketing boards (or state marketing agencies) were introduced by the colonial state in an attempt to reduce monopoly profits, increase marketing efficiency, and channel more surplus capital back to the metropole, which was in a state of economic 'crisis' (Mou and Vivekananda, 1993). In rhetoric, as Bauer and Paish (1952) explain, the primary goal of the marketing boards was supposedly the stabilization of prices:

> By fixing a steady buying price in advance of the sale of each season's crop the Boards will cut the link between the price…in West Africa and the day-to-day price on the world market….The intention is that 'profits' will be utilised primarily to maintain the maximum possible stability in the price paid to the producer (1952: 756).

However, as has been demonstrated by Bates (1981), there is very little historical evidence to suggest that such price stabilization actually occurred, and rather the principle function of export marketing boards is best understood as a mechanism for the extraction of surplus. It is estimated by Bauer (1954) that by 1947, marketing boards in Nigeria had accumulated a surplus of 22 million British pounds. Likewise, according to Helleiner's 1947–54 period study, it is suggested that, 'In peak years, individual Marketing Boards alone withheld over 40, 50, and even 66% of potential incomes of producers of particular crops' (1964: 585). In short, although the large capital surpluses accrued by Nigeria's marketing boards may have led to 'national development' in some respects, it is generally contended that these development initiatives were irrelevant to the peasantry and contrary to the interests of the smallholder class.[3]

During the 1950s, African nationalist movements began to build momentum and the struggle against colonialism mounted. In 1954, in anticipation of independence, it was decided that Nigeria's marketing boards should be regionalized, so that the various regions of the country could develop separately of each other (Mou and Vivekananda, 1993). At this point, the origins of what Watts (1997) refers to as the 'national cake' syndrome emerged, as culturally pluralistic struggles ensued over the question of marketing board surpluses. According to Mou and Vivekananda (1993: 226), 'By generating surpluses, the Boards…served to set the stage for regional, ethnic, inter-governmental and class conflicts that have become the basis for the instability of the Nigerian political system to date.' At any rate, by 1960, when Nigeria finally did gain independence, the neo-traditional elite class saw the marketing boards – more than ever before – as a continuing source for private accumulation (Mou and Vivekananda, 1993).

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3 For example, in Africa, produce marketing boards have historically served as 'redistributive mechanisms', allowing the state to reallocate rural surplus to the city by spending it on urban development. Such redistribution allowed the colonial city to remain the 'engine of development', maintaining a 'top-down, growth pole, modernisation focus' (Riddell, 1997: 1298). The neglect of rural development and the accompanying bias towards investment in the urban sector which was typical during the colonial era has, needless to say, been extremely detrimental to the peasantry. See, Lipton (1977) for a discussion of his influential (although contested) theory of 'urban bias'.

The Post-colonial era and the oil boom years: 1960–1985

During the post-colonial era, the agricultural dilemma continued to unfold in northern Nigeria, and life in Kano's CSZ underwent further transformation. Initially, rural development policies during this period essentially built upon the policies of Late Colonial Developmentalism, and two main 'pillars' of colonial agrarian policy were carried over at independence – the continuation of the marketing boards and the upholding of the nationalization of land. The effects of the Boards on the smallholder class have already been noted, but equally significant were the consequences that the nationalization of all lands had on the livelihoods of poor grassroots actors. Mustapha and Meagher (2000: 32) remark that these policies became 'the cloak for the forcible acquisition of peasant lands for the purposes of 'development' projects and for re-allocation to others.' Such laws were later embraced by the post-colonial state through the enactment of the *Land Use Decree* (Act) of 1978, which extended the northern tenure system to the rest of Nigeria. The present-day implications of this legislation for those living and working in Kano's peri-urban zone are significant and will be discussed in some detail in Chapter 5.

At independence in 1960, Nigeria was an important Third World exporter of agricultural produce and the world's largest exporter of groundnuts, with Kano being the centre of groundnut production (Mustapha and Meagher, 2000). However, during the early 1960s, a sharp decline in world market prices brought about a dramatic reduction in real producer prices (Watts, 1987a). In response to the depressed market, the state intensified marketing board appropriations from the smallholder class. Unfortunately, at the same time, rural production costs were rising and when coupled with decreasing terms of trade, Nigeria's marketing boards soon began to suffer substantial losses.

By the late 1960s, it was apparent that smallholders and the entire system of smallholder production was in grave trouble. As the threat of fiscal crisis appeared eminent, the emergence of petroleum as the new cornerstone of the export economy and the main source of state revenue had enormous consequences for the food economy of post-colonial Nigeria. As 'petro-dollars' soon became the new source of funds for the state's development activities, the expansion of state enterprises ensued and accumulation based on oil rents developed in concert with new forms of patronage and clientelism (Beckman,1982). As Mou and Vivekananda (1993) explain:

> What the oil revenue did…was to provide an alternative source for the state and private accumulation by the dominant groups and classes. It was now possible to increase the prices of agricultural exports without endangering the need for revenue generation and accumulation (1993: 253).

Since Nigeria's oil receipts flowed directly into government coffers, the state had initially hoped to avoid some of the political problems associated with taxing individual groups that had been evident under the operation of the marketing boards (Richards, 1987). However, this was far from the case and the emergence of Nigeria's petroleum economy quickly became a catalyst for the development of new

political struggles.[4] Indeed, the overthrow of the Balewa government in 1966 and the ensuing Biafra War[5] were both the products of a period of 'crisis and transition' from a regionalized peasant based political economy to the petroleum era (Andrae and Beckman, 1985). As Iliya and Swindell (1997) further add, during this period of turbulence, the proliferation of new states with their attendant state capitals was largely an attempt to stifle inter-regional conflicts and reward political allies. In the process however, not only did provincial towns and historic urban centres grow at unprecedented levels, but as local economies became dependent on the volatile prices associated with centrally administered oil revenues, there was a movement towards 'federal consolidation' and the states became more tied into the world economy than ever before (Watts, 1983a).

In 1967, when the government announced the formation of a new 12-state structure, 'Kano State' emerged in place of the old 'Kano Province' in the former Northern Region (Stock, 2004). As state spending soared during the oil-boom years, a drastic increase in imports followed, accompanied by a new demand for non-agricultural labour. In northern Nigeria, traditional dry season non-farm employment was replaced by more specialized permanent employment, and many people in the urban periphery lost interest in farming altogether and sold their plots (Iliya and Swindell, 1997). Since practically all oil revenues entered the economy through state spending, the public sector became Nigeria's principal source of employment, income and investment (Andrae and Beckman, 1985). This major restructuring of the economy caused critical problems for the agricultural sector and by the 1980s, food imports had reached alarming proportions.[6] According to Watts (1987a), between 1971 and 1981, total food imports rose from US $130 million to US $1.794 billion. By 1981–82, annual cereal imports amounted to 2.3 billion tons and 90 per cent of all wheat consumed was imported. Needless to say, state policies which encouraged food importation not only created severe dependencies in Nigeria but had a significant impact on the lives and welfare of the peasantry as well.

As the 'crisis of reproduction' became more deeply entrenched, the peasantry began to experience grave financial problems, and consequently, a pattern of peasant

4 See Watts (1997) who focuses on how state violence has escalated in Nigeria in reaction to the development of regionally based ethnic national movements, which accompanied the creation of new regional states during the petroleum era. According to Watts, this ensuing political turmoil has fuelled the proliferation of 'new' social movements, such as the mobilization of the Ogoni people, and has caused the state to further strengthen its military authoritarianism to protect the interests of the ruling hegemony.

5 The Biafra War, like other African conflicts such as those in Sudan and Ethiopia, had disastrous effects on domestic food production. Conflict tends to uproot the younger population (who are in their prime agricultural labour years) as they become diverted into the army or guerrilla factions. As a result, crop production becomes grossly disorganized in war-affected zones, further exacerbating the food crisis.

6 Throughout the 1970s, agricultural exports steadily declined and by the late 1970s the Nigerian State, which had once been the world's leading exporter of groundnuts and palm produce, became a net importer of both of these crops (Mou and Vivekananda, 1993). For elaboration on the politics and economics of food dependence in Nigeria, see Andrae and Beckman (1985).

borrowing which had originated during colonial rule was intensified (Mou and Vivekananda, 1993). According to Shenton and Lennihan (1981), during the 1960s, 30 to 40 per cent of rural producers could not get through the yearly agricultural cycle without borrowing. Watts (1983), on the other hand, has suggested that rural indebtedness in northern Nigeria surpassed seventy per cent in some areas. The introduction of chemical fertilizers and 'green revolution' technology during the 1970s further intensified the need for off-farm income generation, so that improved inputs could be purchased (Meagher and Mustapha, 1997).

In the Kano region, intensified cycles of drought from the 1960s onwards put even more stress on rural livelihoods, and increased the reliance on non-farm income and circulatory migration strategies during difficult times. In the hope of alleviating some of the stress placed on rural society, further visions of an 'agrarian transformation' emerged in 1967, when the new Military Governor, Alhaji Audu Bako, commissioned studies for the development of a series of major irrigation projects in Kano State, including the Kano River Project. As the oil-boom spending-spree continued, fourteen dams were constructed in Kano State between 1969 and 1978, five more were built between 1979 and 1980, and the Chalawa Gorge Dam was completed in the 1990s (Mustapha and Meagher, 2000). Adams (1991; 1995) has documented the impacts of the political, socio-economic and environmental change that have gone hand-in-hand with many of the floodplain development plans in northern Nigeria. In most cases, there is evidence to suggest that these attempts at improving agrarian livelihoods have been far from sustainable.

As life was becoming increasingly difficult for those in the rural sector, the bias of state expenditure towards major cities such as Kano was expressed most dramatically by the urban construction boom of the 1970s.[7] This expansion fuelled the process of rural-urban migration, contributed to the disintegration of the rural economy by uprooting young productive labourers out of the agrarian sector, and played a role in the creation of a class of individuals who, to quote Hill (1972), were 'too poor to farm'. Watts (1987a) reports that as rural-urban income differentials widened during the 1970s, a marked socio-economic differentiation between smallholder households took place. Consequently, Watts (1987a) estimates that in Nigeria, the number of rural households below the poverty line grew by 25 per cent between 1973 and 1978. As state revenue – first accumulated through agricultural appropriation and then through oil rents – was redistributed to urban centres, the increased relative impoverishment of the rural poor ensued, exacerbating fierce competition for employment, housing and social services in cities. Todaro (1977) argues that an increased flow of rural-urban migration occurred as a consequence, primarily for economic reasons. His model postulates that migrants measure the costs of migration relative to expected gains, based on large wage-income differentials between urban formal sector wages and lower agricultural incomes. Like Lipton's (1977) theory of urban bias, Todaro's model also received widespread acceptance among many development economists

7 Other 'pull' factors which may have added to Nigeria's 'urban bias' during the 1970s included the perceived availability of wage employment and education opportunities, and a thriving informal sector. See Lipton (1977) for further articulation.

in the 1970s and early 1980s, and became accepted as a 'common sense' explanation for underdevelopment and inequality in Africa (Jamal and Weeks, 1993).

Since the oil-boom years, Kano and other urban centres in Nigeria have continued to increase dramatically in size and new pressures on urban food supplies have subsequently developed.[8] During the 1980s especially, there was a pervasive feeling that the country was on the brink of a major food crisis, which became apparent by the rising quantity of food imports during the 1970s. The resulting increased demand for food was temporarily met by the unrestricted importation of cheap subsidized grain from North America.[9] To a large extent, rising oil prices during the 1970s and vast accumulations of 'petro-dollars' allowed these massive food imports to continue unabated.[10] Andrae and Beckman (1985: 6), however, note that this high rate of oil spending was the principal reason why prices moved against domestic products and in favour of imports, capturing Nigeria in what they refer to as 'the wheat trap'. They observe that during the 1980s,

> the domestic rate of inflation, at an annual average of perhaps 20 per cent, was double the rate in those economies which supplied Nigeria's imports. Backed by petroleum, the purchasing power of the naira was protected in foreign markets, while it was crumbling back home (1985: 6).

Mustapha and Meagher (2000) further point out that smallholders in the Kano region were greatly disadvantaged by the cheap food policies pursued by the Federal Government during this period, because food prices remained below increases in agricultural production costs and the cost of living. In short, excessive imports of subsidized grain reduced the incentive for most domestic farmers to increase output, and in the process altered local preferences for food staples which were not traditionally grown by local producers (Funnell, 1988). At the same time, of course, there emerged a small group of wealthy 'gentlemen' farmers in northern Nigeria who could afford to take full advantage of rising production costs, and increase their agricultural output. These individuals benefited substantially by hoarding their grain until seasonal prices were at their peak, or by selling in the parallel market across the border in the Niger Republic where prices were much higher. For most small producers however, government attempts at a 'capitalist transformation' in agriculture during this period were a great failure and the problem of 'deficit grain

8 Between 1980 and 1990, Nigeria's average annual urban growth rate was estimated to be as high as 6 per cent (see Binns, 1993: 51).

9 For many Third World countries, subsidized US wheat surpluses have made imports an attractive alternative to the modernization of the domestic food sector. In the process, importation policies have altered traditional tastes and have created new food dependencies. For a critical discussion of the role that the US has played in exacerbating the Third World food crisis, see Friedman (1993).

10 Lubeck (1987: 278) notes that in 1970, total federal revenue was approximately US $1 billion, but by 1980 (due to rising oil prices and enhanced accumulation), it had climbed to nearly US $23 billion.

production'[11] became increasingly common, making life even more difficult for those living in Kano's CSZ.

The structural adjustment era: 1986 – present

The economic 'bust' of the 1980s was accompanied by an unanticipated decline in oil prices, resulting in a domestic budget deficit which was met with massive cutbacks in imports and constricted government spending.[12] The income generating opportunities associated with both farm and non-farm activities that had become so prominent in the livelihood portfolios of smallholders around Kano, were highly susceptible to this economic crash. Faced with declining production quotas and a strict debt repayment schedule, the Nigerian Government increased foreign borrowing to meet balance of payments shortfalls, and in June 1986, was forced to adopt the 'bitter medicine' of IMF austerity programmes (Mustapha and Meagher, 2000).

In an attempt to eliminate policy distortions associated with the oil boom, a 'standard package' of structural adjustment conditionalities was implemented.[13] In addition however, the unorthodox decision of banning the importation of rice, maize, wheat and barley was adopted by the government in the hope of reducing urban and import-based activities and shifting the terms of trade in favour of domestic production (Meagher and Mustapha, 1997). In rhetoric, although structural adjustment conditionalities were initially put in place to 'adjust' the economy and make it more efficient, in practice such structures have had grave impacts on livelihoods in Kano and its hinterlands. According to Riddell (1997: 1300), 'the conditions imposed to influence the workings of the national economy rebound upon the urban political economy', resulting in a 'second round of impacts' which end up re-shaping the urban and peri-urban fabric. In the case of Kano, the state's ability to operate 'redistributive mechanisms' such as marketing boards, which once allowed the government to give the city an artificial advantage, was eliminated. Consequently, life immediately became much more challenging for those living in and around the city. As Rakodi (2005) notes, price de-control, inflated food prices and increased cost recovery for basic services such as water and electricity had a particularly drastic impact on those who were already desperately poor, because most of their incomes were being used to meet basic needs.

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11 Mustapha and Meagher (2000) use the term 'deficit grain producer' to describe those farmers who either consume more grain than they produce or purchase more grain than they sell.

12 According to Watts (1987b), following the 'oil bust', between the years of 1980 and 1982 alone, Nigerian oil revenues plummeted from US $23 billion to US $13 billion.

13 Although conditionalities for IMF loans vary from country to country, in the vast array of over 300 programmes in Africa, Riddell (1997) notes that there are five common stipulations which can be found in most IMF prescriptions. The standard package usually includes: currency devaluation, the elimination of subsidies and price controls, trade liberalization, a reduced role of the state, and an increase in primary products for the global market.

Research undertaken in other African countries suggests that under structural adjustment programmes, the incidence of 'reverse migration', from the city to the countryside, has become progressively common (Potts, 1995; Jamal and Weeks, 1993). For example, in their work on Harare, Potts and Mutambirwa (1997) document how urban residents who had been living in a state of sheer desperation in the 'adjusted' city, increasingly began to exercise their 'exit' option and return to rural areas where the monetary cost of living was lower and it was easier to grow food. However, they point out that as city dwellers return to their villages in the countryside, new burdens are introduced to the rural sector. Of particular note, rural families lose remittances from their urban kin and scarce rural resources must accordingly be stretched even further. In the case of northern Nigeria, Meagher and Mustapha (1997) suggest that 'reverse migration' has so far not been the trend. The dependence of smallholders on crops for consumption rather than export has sheltered them somewhat from the effects of devaluation. Meagher and Mustapha do, however, point to recent evidence to suggest that long-term rural-urban ties have been weakened by adjustment, forcing many rural households to increase their reliance on off-farm avenues of income and seasonal patterns of rural-urban migration. As may be the case, rural-urban linkages and their attendant patterns of migration and resource flows have not so much been reversed, as they have been disrupted.

It is clear that since the onset of adjustment, urban food prices have increased considerably. According to Durojaiye (1998, cited in Mustapha and Meagher, 2000), between 1986 and 1992, the cost of bread, the urban 'staple', rose by 1,000 per cent. This led to the widespread smuggling of flour (Forrest, 1993) and massive public outcry over food prices.[14] One of the most visible examples of Kano residents trying to 'make ends meet' can be seen in the rise of urban and peri-urban gardening in recent years, an expression of coping with 'adjusted prices' that have made food out of reach. In Riddell's (1997: 1302) words, 'Food is less affordable in the city as currency devaluation implies that imported food products rise dramatically in price and land is removed from food production in order to produce export crops – one result has been the growth in urban farming.'

Although it may be the case that structural adjustment policies have contributed to the proliferation of urban and peri-urban farming in Kano's hinterlands, there is also evidence to suggest that adjustment policies have affected poorer smallholders particularly hard, and have played an instrumental role in changing land management practices and shaping livelihood strategies. For example, following the removal of agricultural subsidies, the use of fertilizers and high yield variety seeds declined drastically. As a consequence, lower yielding varieties of sorghum have replaced maize as the preferred grain since they require less fertilizer and insecticide (Mustapha and Meagher, 2000). Lower yields have generally meant that once again there is an increased dependency on non-farm income.

Swindell and Iliya (1992) note that in many parts of northern Nigeria, structural adjustment pressures have increased the concentration of land ownership in the hands

14 It has also been argued that instances of rioting and civil disobedience, including the bloody Maitatsine uprising or the anti-SAP student riots in 1989, have been an expression of desperation as food becomes unobtainable for the poor.

of wealthier farmers. Moreover, studies undertaken in the 1980s suggest that as the privatization of agricultural parastatals has taken place under Nigeria's liberalized economy, this has caused peasant landlessness to skyrocket. Jega (1986, cited in Watts, 1987b) documented the doubling of landlessness in Nigeria between 1972 and 1983, and Beckman and Andrae (1986, cited in Watts, 1987b) have highlighted a new trend of what they refer to as 'industry goes farming', where powerful multinational corporations have acquired vast agricultural holdings. As such, poor farmers have increasingly had to mortgage their land or sell their plots to wealthy farmers because they can no longer afford the production costs (Swindell and Iliya, 1992). At the same time, labour costs have also increased and this has forced many smallholders to reduce the amount of weeding and ridging carried out on their plots, which has lowered productivity even more.

In addition to the radical changes in northern Nigeria's political economy brought on by structural adjustment, the pressures that have always shaped land and society in Kano's CSZ have continued to mount. Rising population densities, land fragmentation and climatic uncertainty remain ever-present and continue to make livelihood diversity and off-farm income generating opportunities more important than ever before.

Conclusion

This chapter has demonstrated that since pre-colonial times, Kano and its hinterland have been shaped and transformed by historical processes which are connected to a long pattern of capital accumulation. It has been suggested that the pattern of state policy, beginning in the colonial period and pursued with even greater vigour after independence, has emphasized the need to create state revenue. State policies have emphasized cash crops and manipulated prices, and at times the state has had to rely on food imports to feed politically volatile populations. The consequences of such actions have resulted in the marginalization of rural food production which has had devastating effects on smallholders and further implications for urban residents. In the hinterlands of Kano, traditional safety nets have been eroded, poor households have been paralysed by a 'crisis of reproduction' and urban migration has often been the typical response of the desperate.

Oil-based accumulation has also generated complex and contradictory processes of change in Nigeria's political economy, in turn having crucial knock-on effects for domestic food production. Specifically, wealth accumulated during the oil boom of the 1970s drove domestic spending to unprecedented levels which was then followed by tumbling petroleum prices during the 1980s, throwing the entire development agenda into jeopardy and leaving the country with a host of new dependencies and debts. Structural adjustment programmes, which became the standard prescription for Nigeria's economic stagnation, have further depressed smallholder food production and have had severe social consequences for the rural and urban sector alike.

There is no doubt that the political economy of both colonial and post-independence state development in Nigeria has had significant consequences for smallholder production in Kano and its region. In fact, to this day, many of these

historical legacies continue to constrain agricultural practices and shape livelihood strategies, as will become very clear in the empirical chapters of the book. Most notably, since independence, but particularly during the oil boom years, the 'urban bias' policies of the government made the city much more attractive to a migratory rural population. Since this time, Kano has expanded in size at an alarming rate and as the borders between urban and rural areas have become blurred in the process, it is frequently the case that local actors have had to make difficult decisions in less than ideal conditions. As many urban and peri-urban households have resorted to farming in the urban shadow and rural households are increasingly engaging in non-agricultural activities in the urban hinterlands, heightened pressure on the availability of land and resources has ensued. Although it may be the case that a small number of large-scale farmers have been able to take advantage of the agricultural potential and 'market attractiveness' of the urban periphery, for many smallholders, farming has become much more difficult and many report that they can no longer grow enough food to sustain their families through the agricultural cycle.

Although there have been past attempts to rejuvenate sluggish agricultural performance through the federal government's 'Green Revolution Strategy',[15] the future of smallholder production is still very much uncertain. Many years ago, Hyden (1983) suggested that historically, the survival of peasant household production could be attributed to the capacity for rural smallholders to exercise their 'exit option' and revert to 'subsistence economies of affection'. However, alternatively, Watts (1983a) has convincingly argued that the penetration of capitalist production and exchange relations in Nigeria has played a key role in eroding the strength of the 'moral economy' which has been so important to farming communities in the past. Not only has the historical pattern of state appropriation drastically affected the nature of crop production and all those involved in the agrarian sector, but it has reduced the capacity for the peasantry to remain 'uncaptured', resulting in a 'crisis of simple reproduction' for peasant households (Hyden, 1980).

This chapter has located the current debate concerning land–society relationships in the Kano CSZ in its historical context and thus serves as an important backdrop for the discussion to follow. In subsequent chapters, the discussion will focus more explicitly on the present-day situation in the Kano CSZ, paying particular attention to the complex concept of land degradation and the dynamics of environmental change in the peri-urban region. In the process, it will become evident that many of the historical processes described in this chapter have continued to shape relationships between people, environment and development on Kano's urban fringe. The next chapter will provide a physical background for the area of study and will provide further contextual information that will help to elucidate how local actors' interpretations of land and history are interwoven, both at the micro level and in broader contexts as well.

15 Such efforts at agrarian transformation by the Nigerian state were characterized by a series of 'integrated' rural development projects during the 1980s, as well as 'ideological efforts' to inspire domestic production, such as 'Operation Feed the Nation.' See Watts (1983a: 489–513).

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Chapter 4

The Area of Study: The Kano Close-Settled Zone

Introduction

Complexity, uncertainty, conflict and risk are all features that are frequently described as being key elements of dryland livelihood systems, such as those that are characteristic of the Kano CSZ. These livelihood systems, we are also told, are particularly vulnerable to crisis. Unreliable and variable rainfall, poor soils and ecological unpredictability are typical of the Sahelian environment, which Hulme (2001: 20) suggests provides 'the most dramatic example worldwide of climatic variability that has been directly and quantitatively measured'. Raynaut (1997) adds that the evidence of 'sustained environmental disturbance' in the Sahelian drylands is in fact constantly increasing and continues to fuel environmental debates concerning whether or not the possibility of a major environmental emergency is eminent. Although there is no disputing that those who derive their livelihoods in dryland environments face many serious developmental challenges, all too often in the past, dramatic and disturbing explanations for environmental collapse have posed the notion of 'crisis' as yet another embodiment of the Malthusian perspective. As was noted in Chapter 1, such apocalyptic accounts have done little to unravel the uncertainty and malaise that many individuals living and working in Kano's urban shadow currently face.

In contrast to the rhetoric of Malthusian apocalypse, many researchers now have a much more advanced understanding of the complexity and diversity of dryland environments (Raynaut, 1997). For example, the dynamism of Sahelian landscapes is now better appreciated than in the past, and rather than being perceived as being locked into a spiral of 'monotonal decline', it is increasingly understood that they are constantly transformed by human action (Batterbury and Warren, 2001). Moreover, there is now a great deal of accumulated evidence to show how dryland communities have devised mechanisms to cope with their harsh environments. The adaptable and flexible nature of Sahelian livelihood strategies have been well documented in the literature (Mortimore, 1989; Mortimore and Adams, 1999), and help to explain why 'Sahelian farmers are still in business' today, given the host of new challenges that they currently face (Mortimore and Adams, 2001).

This chapter will provide a backdrop for the physical environment in the area of study. In the process of exploring the fundamental changes and challenges to the relationships between people and their environments, it first remains vital to recognize the significant ecological constraints that local actors face on a day-to-day basis. The chapter thus begins with a brief introduction to the environmental and

socio-economic characteristics of the research area, which will serve as a canvas for describing the wider context within which micro-level actors operate. Following this, however, a second objective of the chapter is to focus attention on some of the pressures associated with the expansion of Kano, which are presently shaping livelihoods in the rural-urban interface in new ways and may be placing stress on the sustainability of systems in the CSZ. For example, in the hinterlands of many growing cities such as Kano, local actors are frequently subjected to intense levels of competition for land, markets and off-farm employment, which can have serious social and environmental consequences. Of particular importance to this study is how the growth of Kano is being 'played out' on the landscape and is having implications for food security and the socio-economic status and livelihoods of various stakeholders.

Setting the scene: a brief introduction to the physical environment in the Kano CSZ

The Kano CSZ, radiating up to 100 km from Kano city, lies within the Sudan Savanna region of West Africa. Located on a flat, undulating plain at about 1500 feet (457 metres) above sea level, slope angles are gentle and range from zero to two degrees (Yusuf, 2001). The region is well drained by seasonal rivers, where brown or reddish-brown loamy soils have developed on 'windblown sands derived from acid crystalline rocks of the Basement Complex' (Mortimore, 1967: 677). The underlying rocks are of pre-Cambrian origin and have been exposed to weathering to produce fairly deep regolith, which has been subjected to widespread lateritization (Olofin, 1987). Consequently, exposed and hardened laterites and unexposed hard pans are common structural characteristics of the landscape (Olofin, 1987). Essiet (1995) adds that this laterization, coupled with the migration of clay particles out of the topsoil, has greatly limited the movement of water and the effective rooting zone of crops.

Soils

According to the UN Food and Agriculture Organization (FAO) classification (FAO, 1974), the soils of the Kano CSZ are predominantly *Alfisols*, a zonal soil of the *latosol* group that is highly weathered and notably laterized by the loss of silica (Yusuf, 2001). In regions of West Africa which are characterized by a long dry season, such as Kano's CSZ, surface soil can either be lost due to wind erosion, or can receive deposits in the form of wind-blown material (Wild, 2003). During the rest of the year, when there is a short but heavy period of rainfall, soil may be removed by water erosion. In the case of Kano and its region, soils initially developed during the late Quaternary Period as a result of the deposition of an alluvial mantle over Basement Complex, but wind drift material has further been deposited on the surface (McTainsh, 1984). Although Wild (2003) cautions that it can be dangerous to make generalizations about soil conditions in a specific area, it has been suggested that the

soils typical of the CSZ often have three common characteristics that make them low in both readily available and long-term nutrients:

1. the clays in these soils have low capacities for absorbing nutrient cations;
2. organic matter is low due to high temperatures and low inputs of organic residues; and
3. primary mineral content is frequently low.

In short, Kano's soils are generally light and sandy with low water holding and cation exchange capacity, and very low levels of organic matter. Yusuf (2001) adds that according to United States Department of Agriculture (USDA) textural classes, these soils are usually either silty loam or sandy loam, and levels of organic matter are typically less than 0.5 per cent. Although organic matter is not itself a requirement for crop growth, it is fundamentally important in managing soil properties and maintaining soil structure, and remains one of the key indices for measuring soil fertility change over time (Wild, 2003). Nitrogen and phosphorus levels are also characteristically low in the soils of the Kano region, and pH levels are neutral or moderately acid (Jones and Wild, 1975). Bennett (1978) adds that the soils of the Kano CSZ are typically 'deeper than 100cm, well drained, lacking a coarse material layer, and with iron segregation mottles occupying less than 20 per cent of any horizon' (cited in Mortimore and Adams, 1999: 99). The top soils are sandy with poor structural stability, making them highly susceptible to erosion, especially with the removal of vegetation (Essiet, 1995). Harris and Yusuf (2001) further point out that these soils are not inherently fertile, and continuous cultivation over the years has only been maintained by local land husbandry practices. A much more detailed discussion of soil conditions and management techniques will be developed in Chapter 5, where the results of the soil sample analysis are presented and discussed.

Climate, seasonal variability and 'risk'

In Kano's CSZ, and dryland Africa more broadly speaking, uncertainty and risk stem from a variety of factors. However, the harsh environment remains the major constraint under which communities must operate (Mortimore, 1998). As Mortimore and Adams (1999) suggest, climatic variability, and more specifically the unpredictability and scarcity of rainfall, are at the top of the list when attempting to understand the difficult day-to-day decisions that smallholders in the area must make. Quite clearly, the amount, duration and frequency of rainfall have a significant influence on crop production, since plant growth is only possible when there is a positive balance between rainfall and potential evapotranspiration (Barrow, 1987). Moreover, as Mortimore and Adams (1999: 56) further point out**,** in northern Nigeria rainfall can be highly episodic, 'falling in short, intense showers, only one of which might deliver one-tenth or more of the year's rainfall in less than an hour.' Thus variability of precipitation within seasons, between seasons, and over the years,

Plate 4.1 Harmattan haze, Kano, December 2001

plays a defining role in shaping the strategies that dryland communities utilize to manage and minimize risk (Mortimore, 1998).

Climate patterns in West Africa are strongly determined by the fact that the region is positioned between a vast heated land mass to the north, and a warm equatorial ocean to the south (Swami, 1973). The annual cycle is a function of the northward advancement and retreat of the warm humid air associated with the equatorial pressure system referred to as the Inter-Tropical Discontinuity (ITD) (also sometimes called the Inter-Tropical Front (ITF) or the Inter-Tropical Convergence Zone (ITCZ)). At any given time throughout the year, weather conditions are determined by the relative location of the fluctuating surface position of the ITD (Buba, 2000). The ITD itself is a zone of tropical, weak frontal weather conditions. In West Africa, the ITD moves from latitude 5ºN when the sun is lowest in December to 18ºN when the sun is highest in June, and then back to 5ºN over the remainder of the year (Olofin 1987). The ITD penetrates slowly inland at the rate of one degree of latitude per day, or 160km/month, but retreats twice as fast at 320 km/month (Kowal and Kassam, 1978). Buba (2000) adds that this explains why the rainy season in the Kano CSZ terminates relatively abruptly, but the onset of the rain progresses gradually from February in the south of Nigeria to May in the north. The northward advance of the ITD is associated with southerly winds, while the southward retreat is associated with the cool and desiccating north easterly winds blowing off the Sahara, known locally as the *Harmattan* (Olofin, 1987). *Harmattan* dust deposition in the Kano region lasts between October and April (Plate 4.1), and local farmers believe that 'heavy' *Harmattan* deposits always result in an increase in crop yields (Essiet, 1991). Mineralogical and chemical analyses conducted by Wilke *et al.* (1984) suggest that

Harmattan dust does improve soil fertility due its high phosphorus content, and the presence of potassium derived from feldspars and illite found in the deposits.

The climate of the Kano CSZ is tropical wet and dry, designated as *Aw* by the Köppen classification system. The temperature regime is warm to hot throughout most of the year, with a mean annual temperature of about 26°C (Table 4.1). However, as Olofin (1987) suggests, although the Kano region is usually described as having a 'wet' and 'dry' season, the climate is perhaps better divided into four seasons that are dry and cool (referred to in Hausa as *kaka*), dry and hot (*bazara*), warm and wet (*damina*), and dry and warm (*rani*).

Table 4.1 Long-term mean climatic conditions at Kano Airport

Month	Mean temp ºC	Monthly range ºC	Relative humidity (%)
January	21.2	17.8	28
February	23.7	20.9	25
March	27.7	18.5	23
April	30.5	16.4	36
May	30.4	13.6	51
June	28.1	13.0	65
July	25.7	10.7	78
August	24.9	9.0	83
September	25.9	10.9	79
October	26.8	16.5	58
November	24.6	19.7	37
December	21.7	18.7	32
Year	**25.9**	**15.5**	**49.6**

Source: Olofin (1987:21)

Note: Data were recorded over a long-term period (more than 50 years) but the range of years was not indicated.

The period coinciding with *kaka* extends from mid-November until February and is characterized by cool, dry conditions and *Harmattan* haze. During December and January, the coolest months of the year, the average temperature drops to about 21°C. During *Bazara*, the brief transitional period between the *Harmattan* and the wet season, which roughly lasts from February to mid-May, day time temperatures are the hottest of the year and may reach 40ºC. Average monthly temperatures during April and May, the hottest months of the year, climb to 31°C. During this period, winds are described as being variable, as the region still lies north of the ITD. *Damina* usually begins during the latter half of May and extends until mid-September. At this time of the year, southerly winds prevail and over 90 per cent of the annual rainfall occurs. Temperatures are warm and consistent, and the lowest diurnal and monthly ranges of the year are recorded. Finally, the period of *Rani* follows the end

of the rains in September and lasts until mid-November when the *Harmattan* returns. Average temperatures are the second hottest of the year and relative humidity is still high.

Based on data collected between 1905–1987, the mean annual rainfall at Kano airport was 817 mm (Hollis *et al*., 1993). Essiet (1989) reports that annual evapotranspiration is about 2538mm. However, as the preceding discussion has illustrated, over any given year, great temporal variation in precipitation occurs, with most rain falling predominantly in the five month 'wet season' between May and September (Figure 4.1). Perhaps of more crucial relevance to local farmers, however, is the variability of precipitation between years, where variations of up to 30 per cent on either side of the mean value are considered to be normal (Olofin, 1987). Rainfall can be very erratic from one year to the next, and during the 1972–73 drought, it was reported that Kano airport received only 414mm of rain, or 48 per cent of the long-term mean annual rainfall (Olofin 1987). Generally speaking, however, no two consecutive years record the same amount of rain. For example, in 1988, 1049.2 mm of precipitation was recorded, while in 1993 and 1994, 560 mm and 895 mm of rain fell respectively (Harris, 1996).

When two or more consecutive years of wide rainfall variation follow each other (30 per cent or more about the mean value), a climatological or meteorological drought is said to have occurred. In Kano State, in the previous century alone, major

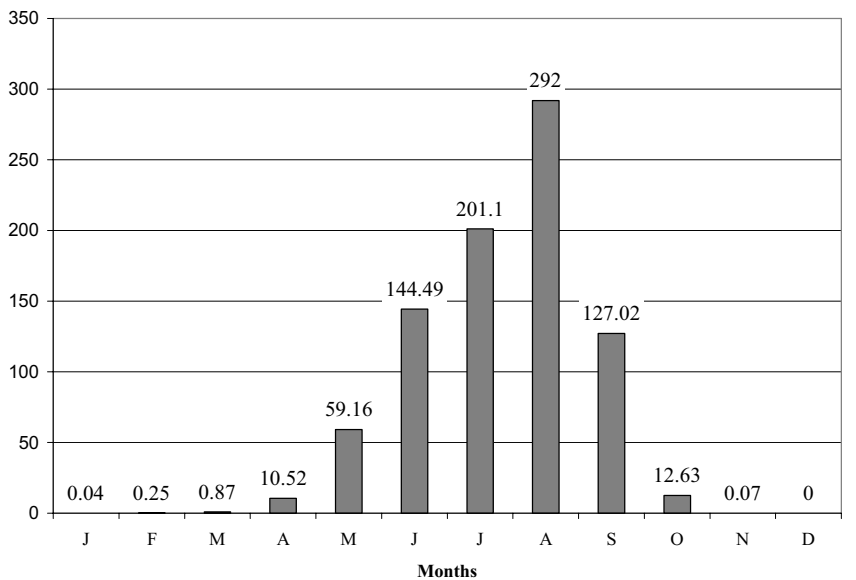

Figure 4.1 Long-term mean monthly rainfall for Kano (1906–1992)
Source: Adapted from Buba (2000)

droughts were recorded in 1913–15, 1940–41, 1948–49 and 1972–73, and minor droughts occurred in 1963, 1967–68 and 1977 (Olofin, 1987). Allan (1973: 14), on the other hand, remarks that in 'a wet year there may be more than twenty times as

much water available as in a…dry year.' Such unpredictability is indicative of the risks to which dryland farmers are subjected. On one hand, too little precipitation will stunt the growth of crops. However, on the other hand, if there is too much rainfall at once, the danger exists that the loose, sandy soil typical of the Kano CSZ will be washed away by water action, or crops may even be damaged by violent showers during the peak rainy period of July and August. Most typically, however, a lack of water availability is the limiting factor in crop production, and there has been much research into the diverse coping mechanisms that local actors adopt in times of drought (for example, see Mortimore, 1989).

Drainage and Hydrology

The natural drainage and hydrology of the region are products of the climate and the underlying rock structure. However, natural conditions have been greatly influenced by human modifications to the environment, such as the construction of dams, reservoirs and canals. Indeed, not only have dams had serious implications for hydrological conditions and the floodplain ecology of the region, but they have played a defining role in shaping both the morphology of Kano's urban landscape and local livelihoods in the surrounding CSZ. These environmental and social effects are significant and will be discussed in greater detail later in the chapter.

The Kano area can generally be considered as part of the inland drainage system of the Chad Basin, and is largely drained by the head-streams of what is referred to as the Yobe River System to the northeast in Borno State. However, as Olofin (1987) notes, two kinds of surface drainage are apparent – both 'through-flow' and 'disappearing flow.' The Hadejia and Jama'are River Systems are typical of 'through-flow' drainage, and some of the important headstreams that are drained include those of the Kano, Chalawa, Gaya, Bunga, Katagum, and Fakate Rivers (Figure 4.2). On the other hand, 'disappearing flow' drainage consists of individual streams which rise and flow freely over the Basement Complex and eventually 'lose their channels into the unconsolidated sediments of the Chad Formation' (Olofin, 1987: 28). Examples of this type of drainage include the Gari, Tomas and Jakara Rivers.

Kano and its surrounding environment can clearly be classified into two hydro-geological zones, which are delineated by the so-called 'Hydro-Geological Divide'. The land to the west and south of the Divide above the Basement Complex is characterized by high surface water discharge and retention, and groundwater accumulation is extremely scarce. East and northeast of the Divide, however, groundwater accumulation is plentiful, as the area is part of the upper aquifer of the Chad Basin. Surface water retention and flow in this region is low. During the long dry season, surface water is usually not available, even on the Basement Complex, and ground water falls to exceedingly low levels due to seepage, evapotranspiration, and human usage (Olofin, 1987). At this time of the year, communities often have to dig village wells deeper to increase the amount of available water, in a practice referred to in Hausa as *yasa*. Groundwater quality is sufficiently good to be consumed by humans without treatment, although surface water is typically susceptible to water-borne diseases, especially bilharzia (Olofin, 1987). Du Preeze and Barber (1965) add

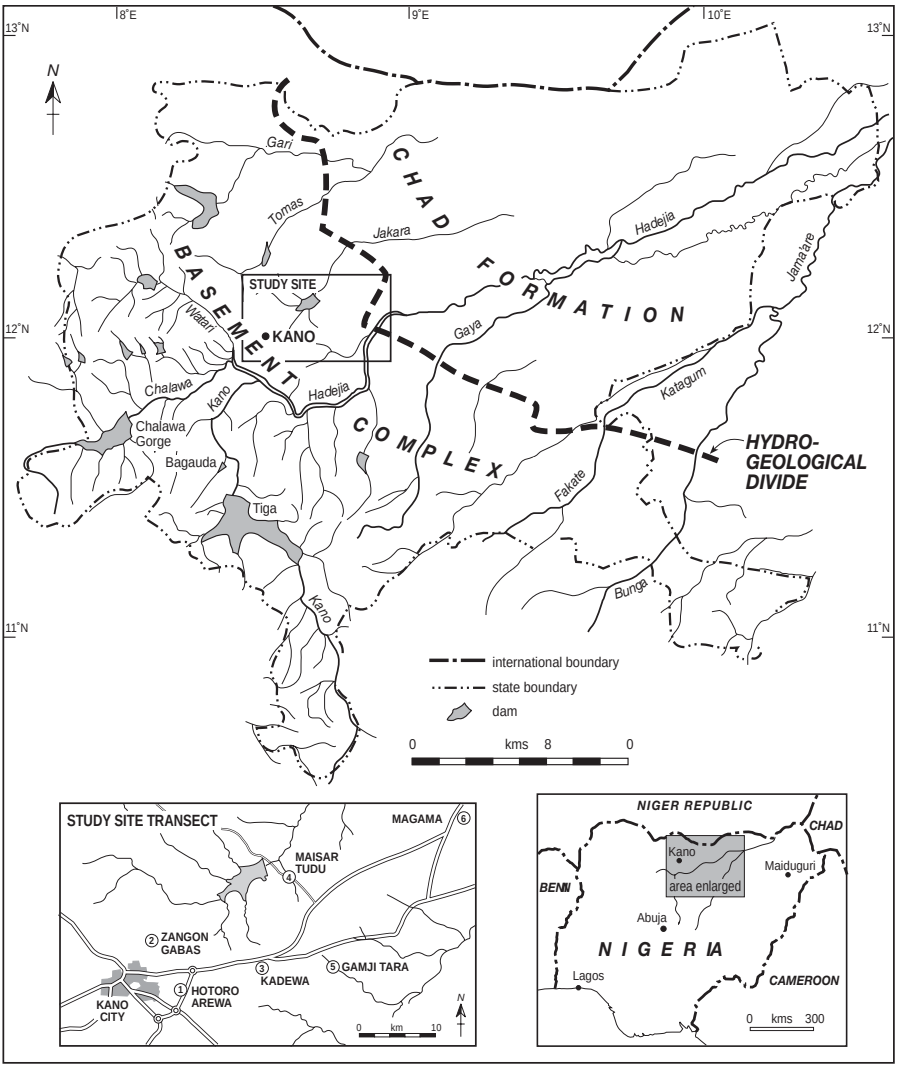

Figure 4.2 Drainage and hydrology of the Kano region

that the quality of river water in the Kano area is generally sufficient for irrigation projects. However, as will be discussed in detail in Chapter 7, the quality of some irrigation water being used in peri-urban areas is increasingly becoming threatened due to increased levels of contamination from industrial toxins.

Vegetation

The Sudan Savanna vegetation of the Kano CSZ is characterized by broad canopied, drought resistant trees, scattered over expansive grasslands (Yusuf, 1996). A variety of shrub and herb species are indigenous to the region and have great economic

importance as fodder, compost, cassava fencing, fuelwood, and traditional medicine. There are over 100 different kinds of annual grasses (mostly of the *Andropogon* and *Pennisetum* variety) which also have many uses, including animal fodder, farm boundary hedges and material for roof thatching, mat and rope making. Indigenious tree species such as the baobab or *Kuka* (*Adansonia digitata*) and a wide range of acacias (including *Faidherbia albida*, *Acacia nilotica*, *Acacia seyal*) are highly valued for their economic worth. Yusuf (1996) reports that there are, in fact, over 40 different useful farm trees in the area, many of which have multiple uses. Often, farm trees shoot up from seedlings which are not removed during weeding and they are protected and encouraged to grow naturally in a local practice known as *sassabe*. Most tree species are well adapted to drought and are characterized by long tap roots and small 'leathery' leaves that minimize evapotranspiration, a process that has great influence on soil moisture (Olofin, 1987).

Plate 4.2 The classic farmed parkland landscape in the Kano Close-Settled Zone

In many parts of the Kano CSZ, farmers have, for hundreds of years, recognized the value of many tree species, and conservation laws and community controls have long regulated the felling of trees on farms. However, it is commonly believed that the true climax vegetation of the area has been removed over the years through the influence of fire, grazing, cultivation, and woodcutting, and has been replaced by the 'cultural vegetation' which is apparent today (Yusuf, 2001). The usefulness of trees and the accompanying manicured nature of this cultural landscape has come to be known as 'farmed parkland' (Pullan, 1974), a sustainable agroforestry strategy

where certain trees are protected and integrated into farming systems[1] (Plate 4.2). In 1978, it was estimated that this parkland mosaic covered approximately 78 per cent of the Kano plain (Rackham and Rose Innes, 1978). Further research conducted in the late 1980s in the Kano CSZ estimated the average densities of mature farm trees to be 12–15/ha in the western regions of the CSZ and 7–9/ha in the eastern regions (Cline-Cole *et al*., 1990a).

Nevertheless, in spite of the fact that tree conservation has long been regarded to be both valuable to the household economy and an effective guard against soil erosion, presently it would seem that many local actors demonstrate great concern over a perceived decline in tree cover. Many in fact feared that tree numbers were being threatened by excessive demand for fuelwood from urban and peri-urban Kano. Although fuelwood is generally obtained by pruning branches off trees in a process known locally as 'lopping', Mortimore and Adams (1999) note that selling an entire tree to a woodcutter is a recognized (although infrequent) income generation strategy in times of economic desperation. Tree management, however, remains an important element of the farming system, especially since trees are the only resource that do not require inputs to be harvested (Yusuf, 1996).

In the Kano CSZ, each tree generally has an owner who looks after it. If a plot owner wishes to sell his or her land, the ownership of the trees on that plot can be retained after it is sold. Alternatively, the trees can be sold separately to a third buyer. According to Yusuf (1996), who spent two years undertaking an extensive inventory of plants and trees in the hamlet of Gamji Tara 35 km northeast of Kano, almost all trees and shrubs have some economic importance (1996). In fact, he recorded that most trees have 2 to 4 different uses (see Table 4.2). Chapter 6 revolves around a detailed discussion of local perceptions of tree cover change in the region and further detail concerning trees and their uses will be included in the analysis.

The agro-pastoral system and the importance of *fadama* ecologies

The farming system of the Kano CSZ is based on rainfed subsistence farming of annual crops, and labour inputs are supplied predominantly by the household (Yusuf, 1996). Extremely low and variable amounts of rainfall mean that growing seasons are short and consequently, smallholder farming systems have developed with the aim of spreading or minimizing risk (Yusuf, 2001). The farming economy is based on the production of drought tolerant crops, livestock and tree products (Harris, 1996). The four main food staples – millet (*Pennisetum typhoides*), sorghum (*Sorghum bicolor*), groundnuts (*Arachis hypogaea*), and cowpeas (*Vigna unguiculata*) – are intercropped in a variety of patterns, while subsidiary crops such as cassava (*Manihot esculenta*), maize (*Zea mays*), sesame (*Sesamum indicum*), sweet potato (*Ipomoea batatas*) and chilli peppers (*Capsicum annuum*) are also an important part of the food production system (Harris and Yusuf, 2001). Past studies have estimated the

1 Such conservation strategies are of course not new developments, and as Mortimore and Adams (1999: 36) point out, Kano's 'cultural landscape' was well noted by nineteenth-century European visitors to the area. For an early description of Kano's 'farmed parkland' landscape, see Barth (1857).

Table 4.2 Some important economic trees and their uses in the Close-Settled Zone

Hausa name	Botanical Name	Fruits and Income Generation	Fuelwood	Animal Browse	Timber	Other
Dorawa	*Parkia biglobosa*	xxx	xxx	x	–	Shade
Mangwaro	*Mangifera indica*	xxx	x	x	–	Shade/ medicinal
Dabino	–	xxx	–	–	xx	
Tsamiya	*Tamarindus indica*	xxx	xx	x	xxx	
Kuka	*Adansonia digitata*	xxx leaves	x	x	–	rope (bark)
Rimi	*Ceiba pentandra*	xxx	xx	xx	xx	Shade
Darbejiya	*Dalbergia sisso*	–	xx	–	xxx	Shade
Gawo	*Faidherbia albida*	–	xxx	x	x	Soil fertility
Dinya	*Vitex doniana*	xx	xx	x	xx	Shade/ medicinal
Kanya	*Diospyros mespiliformis*	xx	xxx	–	x	
Kandanya	*Butyrospermum paradoxum*	xx	x	–	x	Shade/ medicinal
Goriba	*Hyphaene*	xx	–	–	xx	
Aduwa	*Balanites aegyptiaca*	x	x	–	x	
Kurna	*Ziziphus spina-christi*	x	x	–	–	
Dushe	*Acacia seyal*	–	xxx	–	–	
Marke	*Anogeissus leiocarpus*	–	xxx	–	x	
Gangi	*Ficus platyphylla*	–	xx	xx	–	Shade
Danya	*Sclerocarya birrea*	x	–	x	–	
Cediya	*Ficus thoningii*	–	x	xxx	–	Shade/ medicinal
Durumi	*Ficus abutifolia Ficus unbellata*	–	x	xxx	–	
Yandi	*Ficus abutifolia Ficus unbellata*	–	x	xx	–	
Baure	*Ficus sycomorus*	–	x	xxx	–	
Shirinya	*Ficus ingens*	–	–	xx	–	
Kawuri	*Ficus ingens var. tomentosa, Ficus glumosa*	–	xx	–	–	

xxx = high use xx = medium use x = low use

Source: Adapted from Yusuf (1996)

average holding size of plots in the Kano CSZ to be 0.3 ha, falling to approximately half that size closer to the city of Kano (Binns and Mortimore, 1989; Essiet, 1995). However, it is most certainly the case that average plot sizes are even smaller today as both fragmentation and what is often referred to as 'land hunger' have intensified in recent years.

Farmlands are under permanent cultivation with fallow periods being extremely rare due to an intense demand for agricultural land (Harris, 1996; Harris and Yusuf, 2001).[2] Aerial photograph studies by Turner (1994, 1997) reveal that by 1950, farming intensity on rainfed upland soils had consumed an astonishing 78 per cent of available land, rising to 86 per cent of land by 1971. Harris (1996) reports that agricultural intensification has not increased since this time and today, the remaining land is occupied by roads, villages, cattle tracks and seasonally waterlogged or flooded lowland, known in Hausa as *fadama* land. Harris (1996) maintains that the key to agricultural production in the region lies in the availability of high labour inputs and the integration of crops and livestock, whereby nutrients are recycled into the system. There is, in fact, a very high level of livestock and poultry keeping even within the city limits, and in a survey carried out in 1992 as part of the National Livestock Survey (cited in Lewcock, 1995), it was estimated that within metropolitan Kano there were:

- 12,918 cattle
- 665,007 sheep and goats
- 47,605 rabbits
- 319,570 chickens and ducks
- 756,174 pigeons

According to Mortimore *et al*. (1990), animal manure, or *taki* as it is called in Hausa, is applied to farm plots in the CSZ at an average rate of 4 to 5 tonnes per hectare per annum. In a series of roadside surveys that he carried out during the 1960s, Mortimore (1972) estimated that each day between 140 and 185 tonnes of manure and urban waste were transported out of the city by donkey load, to be used as organic fertilizer on farm plots in the CSZ. In recent years, however, it seems that *taki* availability has declined in many parts of the region, perhaps partially due to its increased demand on urban and peri-urban gardens in metropolitan Kano (Essiet, 1995). A more detailed discussion of the importance of taki in soil fertility management regimes will be developed in the next chapter, which focuses on the issue of soil degradation in the rural-urban interface.

2 Although fallowing is now generally unheard of in the Kano CSZ, and was certainly not apparent in the farm plots monitored in this study, Harris and Yusuf (2001) note that such practices do still occur in extenuating circumstances, such as when sickness or calamity physically prevents farmers from planting their fields.

Although occupying a relatively small proportion of the landscape,[3] *fadama* or wetland ecologies increasingly represent important sites for acquiring livelihood resources in Kano's CSZ, particularly in a region where there is such a long dry season. Due to the spatial and temporal unpredictability of dryland environments, a variety of socio-economic benefits are derived from more relatively stable *fadama* land. Not only do these wetland environments provide key resources for dry season grazing, but with simple forms of irrigation, continuous cropping throughout the year is possible. In Chapter 7, greater attention will be given to these important wetland resources, as the discussion focuses on some of the critical issues that surround dry season agriculture in the low-lying peri-urban *fadama* depressions around Kano.

Adams (1995) believes that agricultural production may in fact be the most economically important use of *fadama* land, since the floodplain soils of these regions are rich in micro-nutrients and seasonal flooding can contribute to acquifer recharge. However, *fadamas* also provide local people with a range of essential environmental goods including: potable water, forage and hunting resources, wood supplies and fresh fish (Adams, 1995). Due to the extreme importance of *fadama* resources, much recent research has focused on how 'wetland in dryland' landscapes have increasingly become sites of intense competition between diverse groups of actors (Kimmage, 1991; Adams, 1995). Under the pressure of competition, multiple and contesting demands for valuable resources may ensue, and as has been apparent in some dryland areas of northern Nigeria, community tension and the breakdown of customary institutions can result (Milligan, 2002).

Research conducted during the late 1980s and early 1990s suggests that in many parts of the Kano CSZ, the availability of *fadama* land diminished significantly due to the construction of dams during the 1970s, which flooded vast tracts of productive land and further exacerbated resource competition (Turner, 1989; Main, 1990).[4] For example, according to one study by Nichol (1989) which analyses aerial photographs and SPOT satellite imagery, the Jakara Dam, completed in 1976 and situated approximately 20 km northeast of Kano, has inundated 1389 ha of previously cultivated *fadama* land (see Figure 4.2 earlier in this chapter). Other studies conducted in the region have noted that dams also frequently cut off downstream communities from their water supplies. Consequently, the production and income generating

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3 In Turner's (1989) research into the role of *fadamas* in land resource management in northern Nigeria, a block of land measuring 110km by 160km between Kaduna and Kano was used as a study area, and it was revealed that *fadama* wetland occupied a mean of 9.96 per cent of the land surface. However, the proportion of *fadama* land varied considerably over the whole of the area, and it was estimated that close to Kano, only 3.12 per cent of land was *fadama*.

4 As was noted in Chapter 3, during the oil boom years of the 1970s, a considerable amount of government revenue was invested in large-scale, capital-intensive development projects. Most of the investment was channelled into urban projects, but as populations in the city grew in number, an increased demand for urban food supplies led to new opportunities for government investment in large-scale food production initiatives. Oyeniyi (2000) reports that since 1970, the Kano State Government has embarked on a series of extensive irrigation development projects in the Kano region, undertaking the construction of three large-scale dams – the Tiga, Challawa Gorge, and Bagauda – and about 20 small-scale dams.

capabilities of farmers, pastoralists and those whose livelihoods depend on fishing, can be severely constrained by dams (Binns, 1984, 1992; Odihi, 2000).

After a dam has been constructed, local residents are rarely, if ever, adequately compensated for the loss of their farmland due to inundation by reservoirs. Under Nigerian land law, provision does exist for financial compensation after land has been appropriated by the state. However, compensation is not given for the land itself, but rather for the loss of 'human improvements' to the land, such as buildings, standing crops and economic trees (Main, 1990). In some cases, alternative land may be offered in lieu of financial compensation, but the land provided is likely to be less fertile and located at a great distance from the land previously farmed. The serious social and environmental impacts of dam projects in the Kano CSZ – including the loss of *fadama* plots by small farmers, an increase in non-local ownership of the most fertile land by wealthier farmers, attendant losses in the production of market-oriented crops and a lack of adequate compensation for resettlement – have most certainly played a role in fuelling increased out-migration in effected areas (Stock, 1978; Main, 1990). Having access to *fadama* land makes it possible for individuals to grow food throughout the year and clearly offers a strong incentive for individuals to remain in their villages during the dry season. However, Main (1990) points out that a loss of *fadama* land through inundation by reservoirs has meant that some people must travel elsewhere for at least part of the year in search of improved economic opportunities to supplement their livelihoods. In his investigation into population mobility before and after the construction of the Jakara dam, Main (1990) notes that of the sample interviewed, the decision of those who migrated to metropolitan Kano appears to have been strongly influenced by the difficult economic situations caused by the dam project. Surprisingly, however, his research also demonstrated that the vast majority of farmers displaced by the dam did not in fact go to the city. Rather most out-migration was to other rural locations in search of new farmland, thereby putting increased resource pressure on nearby rural areas.

While it seems likely that dam projects such as the Jakara have most probably contributed to the growth of urban Kano through increased seasonal labour migration and permanent out-migration, there is also much evidence to suggest that the localized impacts of such projects have had serious repercussions for rural livelihoods as well. As dams take productive land out of circulation, the knock-on effects associated with reduced crop outputs can have serious implications for other segments of the local economy. For example, as Odihi (2000) suggests, the well documented state of symbiosis which apparently once existed between farmers and pastoralists is further jeopardized because farmers, who are unable to generate as much income from crops as in the pre-dam period, become less willing to allow herders to graze their animals in fields after harvest. Alternatively, the post-harvest field is thoroughly 'combed' by cultivators and all crop remains, stalks and haulms, are collected for personal use or are taken to local markets to be sold as animal fodder (*harawa*). Thus pastoralists are also greatly affected by dams, not only because their migratory routes and seasonally flooded pasture lands have been altered or eliminated, but also because further stress is placed on their relationships with farmers and other land-users in the local economy (Binns, 1984).

Although it may be the case that dam projects in northern Nigeria have played a role in creating divisions in supposedly harmonious 'communities', pastoralists in the Kano CSZ have also felt pressures from numerous other fronts. By and large, traditional grazing land (referred to locally as *makiyaya*) is no longer available in the intensively cultivated CSZ, and as land hunger has become acute in recent years, even communal cattle paths (*burtali*) have been planted with crops by local residents, further exacerbating tension between pastoralists and sedentary farmers. The increased incidence of land hunger, particularly in peri-urban localities where the competition for resources is the most intense, has had a major impact on farming practices and local livelihoods, and will be examined more thoroughly in the analysis and discussion in the empirical chapters of the book, but particularly Chapter 5.

Urban growth and its effect on Kano's Close-Settled Zone: sustainability under threat?

An appreciation of the extreme physical conditions of the environment coupled with the highly competitive nature of the intensive production systems in Kano's CSZ is integral to understanding the difficult context in which local actors must operate. Thus far, this chapter has focused on some of the most significant constraints – both natural and human induced – which have been important in shaping livelihoods in Kano and its hinterlands. But within this challenging context, how is the physical growth of the city affecting the physical state of the landscape and the sustainability of livelihoods? While some commentators point out that that the period of most rapid urbanization in Africa has coincided with instances of widespread environmental degradation, other observers have noted that urbanization can have both negative and positive impacts on rural people and environments (Main, 1995). The literature on 'urban ecological footprints' suggests that some cities are in fact better able to transfer their environmental burdens away from their city limits than others, and this will determine how the ecological impacts of urbanization are felt. In short, it is generally the wealthier cities that are better able to displace their environmental burdens to distant locations, whereas poorer cities may be unable to do this and the environmental consequences become localized (Lynch, 2004). In the case of Kano, as will become apparent, the spatial relationship between urban pressure and the degradation of rural resources is not always this clear. In short, the long-established links between Kano and its hinterlands are complex, and a better understanding of the dynamic relationship between the two remains essential in any exploration into the future sustainability of the region.

As was noted in the previous chapter, in northern Nigeria, urban centres such as Kano have enjoyed a long historical relationship with their hinterlands through providing seasonal employment and markets for food surpluses (Swindell *et al.*, 1999). These long and buoyant systems of local and regional trading in Hausaland have been well documented, notably in the work of Hill (1972, 1977). As we have seen, for many centuries, Kano was an important centre on the trans-Saharan trade route, and a key production hub for cotton weaving and dyeing, tanning and leather work (Tiffen, 2001). In the densely settled region surrounding the city, permanently

cultivated fields of food crops and cotton were important for the local economy, and since these early days, rural-urban interaction has played a defining role in shaping the contours of transformation and development in both the city and the countryside. More recently, however, as urban centres have continued to physically expand in size at dramatic rates, driven by new forces at local, national and global levels, these relationships between city and hinterland have intensified. Increasingly, diverse linkages and flows of people, food and non-food goods, capital, information and waste transfers bridge the rural-urban divide, and have become significant forces in shaping the process of regional change.

In the peri-urban region surrounding Kano, mounting pressures on resources, which have certainly been intensified by rising population densities, have not only increasingly made it more challenging to gain access to farmland and agricultural inputs, but more than ever before, many farmers have been forced to diversify their income strategies and engage in a wide range of non-farm activities in order to make ends meet. As Bryceson and Jamal (1997) note, although the majority of the population in sub-Saharan Africa remains rural, each year the population is becoming less agrarian in nature, as farmers must respond to decreasing agricultural productivity and are no longer able to rely solely on their farms for survival. Set against a backdrop of apparent sustainability in the Kano CSZ, the large and growing influence of metropolitan Kano on land-use and ownership, economic activities and labour markets, has had a significant impact on agricultural production and rural livelihoods, affecting those who live in the peri-urban zone as well as those further a field in the periphery of the CSZ.

Today, households operating in the rural-urban interface have increasingly had to rely on the resilience of Sahelian resource management systems, such as detailed by Mortimore (1989, 1998). Although Kano's urban fringe is frequently an area of great dynamism, it is also an arena for the competition of basic resources *par excellence*, and has led to great social and environmental changes that have impacted upon the sustainable livelihoods of local actors. The forces in operation in this interface not only shape the contours of change locally, but serve as a useful and viable means for studying and analyzing changing agricultural systems and production relations on a wider scale. In short, Kano's peri-urban zone functions as a prism through which are refracted larger structural forces of a social, political and economic nature, to create new outcomes which are then further modified by forces operating on a micro-level.

Exploring the interaction between these forces at the local, regional, national and global spheres remains crucial in gaining a critical understanding of environment, development and change in the peri-urban interface. Surprisingly, however, although peri-urban livelihood strategies have become increasingly important survival mechanisms for a wide range of people, remarkably little academic attention has been paid to the sustainability of these strategies. It would seem crucial, therefore, that any serious discussion of the future sustainability of Kano's CSZ must take into account the many livelihood activites of the peri-urban region. Bearing this in mind, there are a number of pressing environmental issues that require careful reconsideration if the sustainability of the Kano CSZ is to be properly assessed. Although there are many potential concerns to be addressed, the knowledge and

perceptions of local actors themselves suggest that there are several key issues which demand immediate attention. While many previous explorations of African land–society relationships have not adequately made reference to the views of local actors themselves, it would seem essential that micro-level perceptions of the environment are investigated thoroughly. Such enquiry should play a major role in formulating meaningful policies that ensure the sustainability of future agricultural production. Not only are grassroots explorations of the issues likely to reveal aspects of land–society relationships that may not be apparent to 'outsiders', but they are crucial in gaining a fuller understanding of the situation since local people's perceptions most certainly affect their behaviour. As Lockwood (1991) points out, such an improved understanding is paramount in facilitating consultative and participatory change and creating environmental policies that have a realistic chance of success.

Conclusion

Although in recent years rural-urban networks have become the focus of renewed interest among policy makers and researchers (Evans, 1990), there is presently an urgent need for further studies that explore the wider implications of these linkages. According to Main (1995), urban exploitation of key resources has been flagged as a significant problem for African cities in the years to come. As Kano's region of spatial transition between the urban tract and rural environs has grown considerably, consuming greater expanses of the city's hinterland, so too have levels of peri-urban resource competition. Set against the climatic unpredictability and ecological uncertainty described in this chapter, and growing global climatic uncertainty more broadly, a more robust understanding and an increased awareness of land–society relationships is especially timely and relevant. Such insight is essential to improve understandings of how and why people transform their complex environments in increasingly difficult situations. Indeed, according to many stakeholders themselves, it is feared that heightened competition and the subsequent overuse of resources will exacerbate the incidence of land degradation in the region, which could have disastrous consequences on the environment and livelihoods. Set against this backdrop, it is to these issues that we turn in the upcoming three chapters of the book, where the empirical evidence of the study is presented and discussed.

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Chapter 5

Land, Soil and Sustainable Livelihoods

Introduction

In Chapter 2, the notion of land degradation was reviewed in detail and it was argued that it is a composite and complex concept that invariably has different meanings for different actors. Indeed, in much of the academic literature concerning environmental change in Africa, numerous definitions have been employed to explain the concept of land degradation, but most interpretations are centrally concerned with a loss in the productivity of the land (Blaikie and Brookfield, 1987). Such a broad definition covers many scenarios, and thus degradation remains a difficult process to grasp in its entirety. Clearly, the 'productivity of the land' cannot merely be assessed by a single indicator, and as there continues to be great difference in opinion as to whether or not Africa is currently facing a state of environmental bankruptcy, some critics have suggested that scientists may never reach a consensus about the biophysical processes behind land degradation (Warren, 2002).

The investigation in this book employs several different types of 'degradation measurements' in the hope of providing a mechanism for cross-checking results and identifying consistent trends in environmental change. As such, in the next three empirical chapters, three different representations of degradation are explored. Although each chapter is framed around a different environmental theme – soil, vegetation and water – it is largely recognized by local actors that there is much interlinkage between each of these natural resources. This first empirical chapter examines soil as an indicator of land degradation, an exploration that remains a prime focus for many researchers when assessing the productive capacity of the land. In fact, according to Stocking and Murnaghan (2001), changes in the soil may serve as the 'single best proxy' for most other aspects of degradation, since it is 'the medium through which many, if not most, changes in landscape status occur' (2001: 8).

The research on which this chapter is based was conducted in the six study villages along the research transect, as described in Chapter 1 (see Figure 1.2). At all six sites, local residents were engaging in farming activities, although at Hotoro Arewa, urban pressures had ultimately forced many farmers to abandon their plots and cultivate land on the other side of the Kano Ring Road, approximately 2 km away. It was also often the case that residents at the sites had diversified their livelihood strategies and were undertaking a variety of farm and non-farm activities at other nearby localities. For example, many actors at both Hotoro Arewa and Zangon Gabas were involved in irrigated vegetable gardening in nearby urban and peri-urban areas, both for income generation and personal consumption. There were clearly a variety of degradation concerns spawning from these activities and a detailed examination of the critical issues that surround irrigated peri-urban agriculture and water quality will be carried

out in Chapter 7. However, for present purposes, this chapter is based on a detailed study of eighteen rainfed farm plots that were sampled at the six study sites along the research transect. At each of the six sites, three representative farmers who were willing to participate in the study were selected. Their plots and land management strategies were monitored closely for one agricultural cycle. Topsoil and crop samples from each plot were collected and then analysed at the Department of Soil Science at Bayero University, Kano (BUK).

In addition to the analysis of soil samples, this chapter also draws on data collected using social science research methods, including questionnaire surveys and semi-structured interviews. At the outset of this study, a questionnaire survey was administered to 90 households across the research transect and it was revealed that although perceptions of degradation varied enormously, many households considered problems associated with soil conditions to be one of the main indicators of land degradation. When asked to explain what 'land degradation' meant, 40 per cent of the households surveyed mentioned that degradation was the movement or loss of soil, more than 31 per cent mentioned that it was low or declining soil fertility, and over 24 per cent believed that it involved the increasing amount of sand content in the soil. Some of the terms used to describe degradation included: 'white soil', 'tired soil', 'dead soil', 'polluted soil', 'dried out land', 'land that won't drain', and 'very soft land'. Building on these perceptions of degradation, the discussion in this chapter thus draws on both qualitative and quantitative data from a variety of different sources, in an attempt to explore these local concerns for the land and develop a more holistic analysis of soil conditions in the Kano CSZ.

The discussion begins with an analysis of the 'scientific' soil data collected during the study, and suggests that 'natural' soil conditions in the Kano CSZ are not inherently fertile. While it is demonstrated that the physical conditions that characterize each micro-environment most definitely affect soil quality, it is also shown that differences in the capabilities, opportunities and constraints of individual actors play a major role in shaping their management abilities. Indeed, local perceptions of the environment strongly shape land-use decisions and influence soil fertility management regimes, as households attempt to mediate access to scarce resources in increasingly competitive circumstances.

The chapter then goes on to deal specifically with the widely-held perception that soil fertility is steadily declining and the results of a nutrient balance study are presented. When it is revealed that local perceptions of the soil do not always correspond to scientific analysis, the discussion continues to explore the question of why indigenous and scientific knowledge sometimes do not match. It is argued that indigenous perceptions often become framed by broader concerns that affect levels of well being and influence how individual actors view their environments. For many individuals in the Kano CSZ, their life-worlds are increasingly shaped by pressures associated with urban expansion and consequently, both their environmental perceptions and soil management strategies have been transformed by the influence of the city. While there are certainly some degradation concerns that are shared by all actors across the transect, other specific forces that shape the landscape are primarily restricted to the peri-urban regions and may be a function of proximity to the city.

A physical picture of soil in Kano's Close-Settled Zone

Although it is acknowledged that there can be attendant problems associated with 'systematic' studies of the soil that are overly reliant on positivist approaches (for example, see Blaikie, 1985; Stocking, 1996), it is, nevertheless, still valuable to adopt scientific methods in soil analysis. Blaikie (1994) points out that although the 'real' environment (and its scientific study) must be considered as a social-construction, there are some aspects of the environment that are more socially-constructed than others. In other words, he suggests, some of the less socially-constructed aspects of the natural world may include the 'actual physical processes', while the more socially-constructed aspects of the environment may refer to the meaning conferred on those processes. In this chapter, an attempt is first made to understand some of the basic physical properties and processes of Kano's soils, before the issue of how and why actors imbue different meanings on their environments is addressed. Referring once again to Blaikie and Brookfield (1987), degraded land may be viewed as having experienced a reduction in capability in terms of a loss of 'intrinsic qualities'. For the purpose of this study, such intrinsic properties of the soil are taken to include characteristics such as pH, cation exchange capacity (CEC), soil structure, depth, texture and specific micro-nutrients. In the upcoming sections of the chapter, the discussion will turn to an examination of these properties.

In Chapter 4, a broad picture of the physical and chemical characteristics of the soils of the CSZ was painted, but it should be stressed that within this general classification, notable variations in soil type do occur. Attention must be drawn to spatial differences between soil types in the region. In this chapter, comparisons are made between sites on the research transect using a variety of methods. Soil characteristics are measured within a positivist scientific framework, fertility and nutrient balances are estimated and soil management practices are considered in depth. However, where possible, the data are cross-checked with indigenous soil knowledge to determine if local perceptions of soil types and characteristics match up with scientific investigations. The comparison begins by looking at soil texture, one of the key indices used in examining the resistance of soil particles to detachment and transport.

Texture

Soil texture, the relative proportion of sand, silt and clay in the soil, is perhaps the most permanent property and it is altered relatively little by a farmer's management practices. Faniran and Areola (1978) note that soil texture has great influence on soil structure, consistence, degree of compaction and stability. Of great significance to many studies of land degradation is the fact that texture also affects soil erodibility, since larger particles are more resistant to transport and require greater force to move them. Consequently, as Morgan (1986) points out, silts and fine sands are the least resistant particles to sheet and rill erosion. Of further relevance to the investigation in this chapter, is that textural class also determines the ability of soil to absorb and retain water, regulates the rate of air circulation in the soil, and can be used to indicate fertility, especially with respect to clay content (Ngeze, 1998).

Table 5.1 Surface soil properties (0–20 cm) of study plots: particle-size distribution

Plot No.	Site	Farmer	Clay (%)	Silt (%)	Sand (%)	Textural Class
1	Hotoro Arewa	M. Basiru	4.44	9	86.56	loamy sand
2	Hotoro Arewa	A. Maikano	4.44	11	84.56	loamy sand
3	Hotoro Arewa	M. Tukur	6.44	15	78.56	loamy sand
Mean	**Hotoro Arewa**		**5.11**	**11.67**	**82.53**	
4	Zangon Gabas	M. Yahaya	5.44	27	76.56	loamy sand
5	Zangon Gabas	J. Nuhu	5.44	24	70.56	sandy loam
6	Zangon Gabas	U. Inuwa	8.44	19	72.56	sandy loam
Mean	**Zangon Gabas**		**6.44**	**23.33**	**72.23**	
7	Kadewa	M. Dahiru	4.44	10	85.56	loamy sand
8	Kadewa	M. Bello	4.44	11	84.56	loamy sand
9	Kadewa	M. Sale	7.44	16	76.56	sandy loam
Mean	**Kadewa**		**5.44**	**12.33**	**82.23**	
10	Maisar Tudu	Y. Abdulwahab	5.16	5	89.94	sand
11	Maisar Tudu	I. Abdulwahab	5.16	7	87.84	sand
12	Maisar Tudu	H. Labaran	6.16	10	83.84	loamy sand
Mean	**Maisar Tudu**		**5.49**	**7.33**	**87.17**	
13	Gamji Tara	G. Liman	6.16	12	81.84	loamy sand
14	Gamji Tara	Y. Yahuza	4.16	11	84.84	loamy sand
15	Gamji Tara	S. Miko	5.16	13	81.84	loamy sand
Mean	**Gamji Tara**		**5.16**	**12**	**82.84**	
16	Magama	A. Ibrahim	3.16	6	90.84	sand
17	Magama	I. Auwalu	3.16	6	90.84	sand
18	Magama	G. Alasan	3.16	5	91.84	sand
Mean	**Magama**		**3.16**	**5.67**	**91.17**	

Source: Author's fieldwork

In Table 5.1, particle-size distribution and textural class of the soils sampled at the eighteen farm plots across the research transect are presented and it is evident that at cultivated depth, the soils of the region are predominantly sandy. Kowal and Kassam (1978) remark that high sand content underlies many of the problems associated with soil fertility, soil water availability and soil management, and this helps to elucidate some of the concerns that were noted by respondents in the questionnaire survey. Jones and Wild (1975) add that the sands of the region are often within the fine sand fraction (0.20–0.02mm), which may also explain why some farmers reported a crust developing on their plots after periods of rain.

According to interview material, the problem of 'too much sand' was perceived to be the worst at Kadewa, where almost 47 per cent of the households surveyed believed that the proportion of sand in the soil was increasing and that this was a major problem. However, Table 5.1 suggests that the soils sampled at Kadewa actually have the second lowest mean percentage of sand (82.23 per cent) on the transect. The question remains as to why Kadewa residents appeared to be more observant of sand levels than other individuals who lived in sandier environments. Focus group discussions in Kadewa revealed two possible factors which might help to explain this perception. First, many local people had recently become aware of lorries from Kano that had started extracting sand from a site adjacent to the village. Indeed, as the demand for building materials in Kano has steadily grown in recent years, this has become a more common practice. Second, residents reported that there appeared to be an increase in local flora and fauna that are typically associated with sandy environments.[1] As such, of all those interviewed on the transect, individuals at Kadewa seemed to be the most aware of the high content of sand in the soil.

A second common characteristic shared by the soils sampled on the transect is that they have all been subjected to a downward movement of clay within the profile, which has further increased the sand content of the surface soil and reduced organic matter and base exchange capacity (Kowal and Kassam, 1978). The organic content of the soil is essential for minimizing erosion, and clay, which carries important minerals, serves as an indicator of fertility (Yusuf, 2001). Essiet (2001a) adds that the loss of clay results in a reduced capacity of the soil to retain nutrients added to it in the form of fertilizers, and so the management of clay content is therefore crucial to the maintenance of agricultural sustainability. The values indicated in Table 5.1 suggest that in surface soil samples at all sites, clay content is very low. One possible explanation for this could be that centuries of intensive agriculture in the region may have lowered the clay fraction by continually disturbing the soil during cultivation, causing an acceleration of the downward movement of clay at the expense of sand and silt. In addition, however, it is also likely that natural weathering processes have played a role in destroying clay particles, and winds blowing from the north have increased the sand content of soils on farm plots. Although it appears that there is some spatial variability in mean clay content at each site, which is highest at Zangon Gabas (6.44 per cent) and lowest at Magama (3.16 per cent), it remains unclear as to whether differences can be attributed to higher levels of intensification at one site over another.

Finally, in terms of silt content, mean values of samples range from 23.33 per cent at Zangon Gabas, to 5.67 per cent at Magama. Silt particles are chemically and mineralogically similar to sand, but are smaller in size (0.02–0.002 mm in diameter)

1 Kadewa residents reported that many plots in the area are now infested with three grasses known locally as *Burruku*, *Duman Rafi*, and *Komaiya*. All of these grass varieties are believed to thrive in sandy environments, and are indigenous indicators of increased sand content in the soil and infertile conditions. Local actors also recounted increased sightings of the African Fox, referred to in Hausa as the *Yanyawa*. According to local knowledge, these foxes always choose sandy, infertile soil to burrow in and land that has been colonized by the *Yanyawa* serves as a sign that the land is excessively sandy.

and contain a greater proportion of secondary minerals in their composition. Faniran and Areola (1978) note that the importance of silt particles lies in their influence on soil structure and pore space distribution in the soil. While silt has limited permeability, the rate of capillary rise of groundwater through it is high. However, in regions where topsoils are already predominantly sandy, such as the Kano CSZ, the additional loss of fine particles such as silt and clay could lead to the soil structure becoming 'single-grained', which could cause an increased susceptibility to wind erosion (Essiet, 1989). The relatively low level of silt in the samples appears to support the generally held view that in the Kano CSZ, cultivation tends to cause the loss of fine soil particles (Essiet, 2001b).

Although laboratory analysis is useful in recognizing some of the physical variation between soils sampled on the transect, an increased acceptance of 'ethnopedology' (the study of local soil knowledge) within scientific circles reflects an acknowledgement of the important contributions that alternative epistemologies can make. According to the interviews carried out in this study, it appears that most land managers can distinguish considerable regional diversity in soil quality, and are able to identify different kinds of soil based on colour and frequently texture. Such indigenous knowledge (IK) of local soil types is important in the decision-making processes that concern crop choice and land management strategies. Although it is largely the case that the pedological properties of the soil determine the efficiency of management practices (Essiet, 2001a), local land-users are also very much aware that their management decisions have consequences for soil quality.

Discussions with farmers at all six sites revealed that soil that is white and sandy in nature is locally known as *Rairayi* (or sometimes *Fara*), is generally considered to be the least fertile, and requires large applications of *taki* to become productive. On most of the farm plots that were monitored in this study, farmers described the soils on their plots as being of this classification. However, many farmers were also able to describe other kinds of soil that appeared to be less common. Red soil is identified as *Jangargari* or sometimes *Kitsendamo*, and is heavier with better moisture retention properties. Black soil, or *Bakarkasa*, is predominantly considered to be the most fertile. Many farmers believe they can transform *Rairayi* land into *Bakarkasa* land, by applying large volumes of *taki*, which eventually turns the soil a darker colour. Hard land is often referred to as *KeKuwa*, and the term *Kwari*, which generally refers to land in a valley or depression, can also be used to describe land where water does not drain. The term *Kulesheshe* is used to describe very soft soil that is infertile.

Chemical soil characteristics

While the amount of available nutrients and their ease of adsorption is strongly determined by the physical state of soil, chemical conditions are also critical to sustainability. Table 5.2 presents some chemical properties of the soils sampled and while there are a number of characteristics that are common to all the samples, the spatial variability in soil quality is also evident.

pH

All the soils sampled are essentially neutral or moderately acidic in pH and mean values at each site range from 6.2 at Maisar Tudu, to 7.1 at Hotoro Arewa. According to Kowal and Kassam (1978), in landscapes that are characterized by natural Savanna vegetation with traditional farming systems, soil pH values that range between 6.0 and 6.8 are the most favourable for crop production. Thus for the soils sampled in this study, pH values indicate that general soil conditions are good, and with the exception of Maisar Tudu, all sites fell within this 'most favourable' category.

Although slight pH variation does occur within and between sites, there does not appear to be a clear spatial trend with distance from the urban area. It may be the case that sites with slightly lower pH values, such as Maisar Tudu, may be naturally more susceptible to humification, an acidifying process, coupled with the leaching of bases from the topsoil. Even though all the soils are intensively cultivated and are expected to show progressive acidification, Essiet (2001b: 4) suggests that at the sites with more neutral pH values, 'the addition of basic cations to such soil through manure and chemical fertilizer application among other practices, probably explains the restriction of soil acidity.' Further discussions with local farmers revealed that the high cost and poor availability of chemical fertilizer meant that it was rarely applied to plots, and so this possibility had to be ruled out. However, according to the results of the questionnaire survey, over 83 per cent of the households sampled reported that they presently applied more *taki* to their plots than they did five years ago, which almost certainly has played a role in keeping pH values at a level that is acceptable for cultivation.

Presently, the pH levels of the soils sampled appear to be within the acceptable range for healthy crop production. However, there is still a danger that as population numbers rise and intensification continues to increase, *taki* replacement rates may not be able to keep pace. In this scenario, the demands on each plot could become so great that soils would begin to experience exhaustion, causing pH levels to drop. This could affect the availability of certain nutrients to crops, which could in turn exert a toxic effect on roots and impede desirable micro-organisms in the soil. Research on exhausted soils carried out at the Kano Agricultural Experiment Station (Heathcote, 1972a) has demonstrated that soils with very low pH levels may also experience aluminium toxicity, which reduces the availability of phosphates and other nutrients to crops.

Organic carbon and soil organic matter

In recent years, the role that organic matter can play in maintaining soil fertility in dryland food production systems has attracted a great deal of academic attention, particularly in light of the fact that little or no chemical fertilizer is used in traditional agricultural practices (Harris, 1995; Powell and Williams, 1995; Yusuf, 2001). There is no doubt that organic matter is an important contributor to soil fertility, especially in sandy soils with low clay content such as all those sampled in this study. The positive effects that organic matter has on the physical and chemical properties of dryland soils are significant (Wild, 2003). Not only does organic matter have a

Table 5.2 Surface soil properties (0–20cm) of study plots: chemical analysis

Plot	Site	Farmer	ph	CEC (meq/ 100g)	Total N		Total P		Total K		Organic C		Available P		Available K	
					(%)	(kg N/ha)	(ppm)	(Kg P/ha)	(ppm)	(Kg K/ha)	(%)	(Kg C/ha)	(ppm)	(Kg K/ha)	(ppm)	Kg K/ha
1	Hotoro Arewa	M. Basiru	7.2	4	0.06	1560	95	247	218	567	0.5	13000	15	39	100	260
2	Hotoro Arewa	A. Maikano	7.3	3.7	0.05	1300	95	247	237	616	0.55	14300	19	49	102	285
3	Hotoro Arewa	M. Tukur	6.9	4.5	0.06	1560	87	226	259	673	0.64	16640	18.5	48	110	286
Mean	**Hotoro Arewa**		**7.13**	**4.07**	**0.056**	**1473.33**	**92.33**	**240**	**238**	**618.67**	**0.56**	**14646.67**	**17.5**	**45.33**	**104**	**270.33**
4	Zangon Gabas	M. Yahaya	6.7	3.5	0.03	780	97	252	215	559	0.2	5200	10.5	27	70	182
5	Zangon Gabas	J. Nuhu	6.7	3	0.04	1040	120	312	227	590	0.4	10400	12	31	87	226
6	Zangon Gabas	U. Inuwa	7	4.2	0.04	1040	110	286	216	561	0.44	11440	12.5	33	92	239
Mean	**Zangon Gabas**		**6.80**	**3.57**	**0.037**	**953.33**	**109**	**283.33**	**219.33**	**570**	**0.35**	**9013.33**	**11.67**	**30.33**	**83**	**215.67**
7	Kadewa	M. Dahiru	6.9	3.3	0.04	1040	100	260	215	559	0.36	9360	13.4	35	80	208
8	Kadewa	M. Bello	6.7	3.5	0.04	1040	120	312	206	536	0.45	11700	15	39	98	255
9	Kadewa	M. Sale	6.8	4	0.06	1560	132	343	250	650	0.56	14560	19.2	50	120	312
Mean	**Kadewa**		**6.80**	**3.60**	**0.047**	**1213.33**	**117.33**	**305**	**223.67**	**581.67**	**0.46**	**11873.33**	**15.87**	**41.33**	**99.33**	**258.33**

Table 5.2 continued

10	Maisar Tudu	Y. Abdulwahab	6	4.7	0.04	1040	200	520	250	650	0.5	13000	18.7	49	132	343
11	Maisar Tudu	I. Abdulwahab	6.3	6.2	0.05	1300	230	598	295	767	0.55	14300	20.3	53	140	364
12	Maisar Tudu	H. Labaran	6.4	3.5	0.04	1040	210	546	230	598	0.5	13000	19.2	50	125	325
Mean	**Maisar Tudu**		**6.23**	**4.80**	**0.043**	**1126.67**	**213.33**	**554.67**	**258.33**	**671.67**	**0.52**	**13433.33**	**19.4**	**50.67**	**132.33**	**344**
13	Gamji Tara	G. Liman	7	3.2	0.03	780	94	244	220	572	0.4	10400	11.5	30	100	260
14	Gamji Tara	Y. Yahuza	6.4	2.5	0.02	520	70	182	219	569	0.2	5200	9	23	95	247
15	Gamji Tara	S. Miko	6.5	3.5	0.03	780	210	564	230	598	0.3	7800	11	29	127	330
Mean	**Gamji Tara**		**6.63**	**3.07**	**0.027**	**693.33**	**124.67**	**324**	**223**	**579.67**	**0.30**	**7800**	**10.50**	**27.33**	**107.33**	**279**
16	Magama	A. Ibrahim	6.6	3.9	0.04	1040	94	244	280	728	0.32	8320	10	26	102	265
17	Magama	I. Auwalu	6.6	3.2	0.03	780	82	213	239	621	0.25	6500	10	26	100	260
18	Magama	G. Alasan	6.6	2.9	0.03	780	90	234	248	644	0.3	7800	11.3	29	102	265
Mean	**Magama**		**6.60**	**3.33**	**0.033**	**866.67**	**88.67**	**230.33**	**255.67**	**664.33**	**0.29**	**7540**	**10.43**	**27**	**101.33**	**263.33**

Source: Author's fieldwork

beneficial effect on the moisture holding and cation exchange capacity of soil, but the decomposition of organic matter by micro-organisms in the soil is crucial to the circulation of nutrients in the ecosystem. In short, adequate organic matter is essential to crop productivity, because it plays a vital role in providing the necessary nutrients and buffer properties, and is critical in creating and stabilizing soil aggregates (Wild, 2003).

According to Rowell (1994), the amount of organic carbon present in soil still serves as the best indirect measure for determining the amount of soil organic matter that is present. On the assumption that soil organic matter contains 50 per cent carbon, Jones and Wild (1975) estimate that the organic matter content of surface soils in the brown and reddish-brown soils around Kano should average approximately 0.5 per cent. These amounts are low and are largely a consequence of the extremely low mean annual rainfall that the region receives, as was described in Chapter 4. Stocking and Murnaghan (2001) suggest that the level of organic matter is also a good indicator of a soil's susceptibility to erosion. They explain, 'where the organic matter of a soil falls below 2 per cent, the soil is more prone to erosion, because soil aggregates are less strong and individual particles are more likely to be dislodged' (2001: 13). Referring to the organic carbon levels presented in Table 5.2, it is apparent that the organic matter content is significantly below 2 per cent in all samples, indicating that the soils of the CSZ can be considered to be highly erodible. Although local farmers do not possess a scientific knowledge of local soil conditions, it is almost universally acknowledged that one of the most important ways of boosting soil organic matter is through the application of manure, which is discussed later in this chapter.

Cation exchange capacity (CEC)

Cation exchange is the process whereby ions are held by electrostatic forces between the negative clay or organic matter charge and positive ion charge (Stocking and Murnaghan, 2001). CEC affects the ability of soils to hold nutrients in a form that is readily available for plants to use. CEC values are closely related to the soil organic matter and clay contents of the soil, both of which have already been described as being characteristically low in the soils of the region. Kowal and Kassam (1978) note that when measured in the laboratory at pH 7.0, CEC values for Savanna soils are typically in the 3–8 meq/100g range. However in the field, values are usually lower since most soils have pH values below 7.0 and CEC is measured at pH 7.0 with molar ammonium acetate. Based on information from Table 5.2, it is apparent that CEC levels at all the sites are low and fall below 5 meq/100g. The lowest CEC values are seen at Gamji Tara and Magama, which also have the lowest levels of organic carbon (and hence the lowest amount of soil organic matter). The highest CEC values are apparent at Maisar Tudu and Hotoro Arewa, and unsurprisingly, correlate with the highest levels of organic carbon. These findings agree with Mayer *et al.* (1994), who note that CEC values decline with pH and increase with higher levels of carbon and clay content.

Spatial variability in CEC appears to be largely a function of differences in natural conditions, but also may be influenced by varying management capabilities. Those farmers who are able to enhance soil organic matter by gaining better access

to *taki* or increasing the amount of crop residue left on their fields experience higher CEC levels. Referring to the plots with lower CEC values, such as those observed at Gamji Tara and Magama, Jones and Wild (1975) note that there are a number of implications associated with low exchange capacity in Savanna soils. Typically, as soils experience an inability to meet the nutrient demands of crops, an increased dependency on chemical fertilizer occurs, followed by rapid soil acidification. Breman *et al.* (2001) note, however, that the present agricultural policy environment in much of drylands Africa means that few farmers can actually afford to purchase fertilizers to correct the over-exploitation of the soil. Consequently, it would appear that if farmers are unable to gain access to sufficient amounts of *taki*, for many individuals soil nutrient depletion may continue to be a threat in the years to come.

Nitrogen

Nitrogen is one of the most important crop nutrients in the West African Savanna and amounts required for sustainability are large, exceeding 100 kg N/ha for good cereal and legume crop production (Kowal and Kassam, 1978). A lack of available nitrogen severely restricts the vegetative growth of plants and is one of the nutritional factors most frequently associated with limiting crop yields (Jones and Wild, 1975). The amount of nitrogen present in the soil is closely associated with soil organic matter and Kowal and Kassam (1978) note that total soil nitrogen in the Savanna ranges from 0.008 per cent to 2.90 per cent, with an average value of 0.051 per cent in the topsoil of cropped soils or soils under grass fallow. Based on this information, referring to Table 5.2, it is apparent that mean levels of total nitrogen at all sample sites are below average, except for the soils at Hotoro Arewa which are about average at 0.056 per cent. Not surprisingly, the soils sampled at Hotoro Arewa also demonstrate the highest levels of organic carbon. Kowal and Kassam (1978: 139) note: 'Under the prevailing climatic and soil conditions in the Savanna…crop nitrogen requirement is poorly matched to the availability of mineral nitrogen in soils, and in order to satisfy crop nitrogen requirements a supplementary nitrogen fertilizer must be applied in adequate amounts at the right time.' Unfortunately, as has been previously noted, in the Kano CSZ the high costs and erratic availability of inorganic fertilizer have largely made it out of reach for impoverished farmers who lack the capital, or sometimes the land security, to invest. Therefore nitrogen deficiencies must generally be made up through the application of *taki*, or by planting leguminous crops such as groundnuts or cowpeas. Although leguminous trees and shrubs are common in the Kano CSZ, Jones and Wild (1975) point out that they do not usually support many active nitrogen-fixing bacteria, and perhaps with the exception of *Faidherbia albida*, their contribution to the soil nitrogen economy is probably minimal.

Phosphorus

The average amount of total phosphorus in the soils of the West African Savanna is low and ranges from 80 to 150 ppm (Enwezor and Moore, 1966). Table 5.2 indicates that at all the sites, mean total phosphorus content falls within the average range,

except at Maisar Tudu where the mean is above the regional average at 213.3 ppm. However, it should be noted that in reality, the actual availability of soil phosphate to plants would be lower than the amounts indicated by the levels of total phosphorus. Much of the total phosphorus in the soil may be fixed and unavailable to plants, and thus the exchangeable phosphorus which the crops can use would be even lower.

It is not clear why total phosphorus levels at Maisar Tudu are so much higher than the other sites, but it may be the case that local farmers in the region have better access to chemical fertilizer. It was reported by all three farmers monitored at Maisar Tudu that in recent years, chemical fertilizer had been applied annually, albeit sometimes in very small quantities. The lowest mean phosphorus level (88.7 ppm) was observed at Magama. Although Kowal and Kassam (1978) note that total phosphorus content is generally not a good measurement of crop requirements, the exceptionally low values typical of the soils of the Kano region suggest that there is a widespread phosphate deficiency in the area. Typically, losses of soil phosphate due to leaching are very minimal and so the primary loss of phosphorus under arable Savanna conditions most likely occurs in crop removal and soil erosion. Moreover, because the majority of phosphorus taken up by crops accumulates in the grain portion of the plant (which is either eaten or sold, and therefore leaves the farming system), any crop residues which are left on the plot return very little phosphorus back to the soil. Phosphorus losses due to soil erosion are estimated to be in the region of 5–10 kg P/ha per annum (Kowal and Kassam, 1978). However, these values will vary greatly according to differences in natural conditions, inputs from *Harmattan* dust deposits and management practices.

Potassium

The total content of potassium in Savanna soils varies greatly depending on the underlying parent material, but estimated levels range in the region of 0.2 to 2 me/100g of soil (Kowal and Kassam, 1978). Removal by crops constitutes the greatest potassium loss from the soil and according to many researchers, deficiencies of potassium in northern Nigeria are common under conditions of agricultural intensification (Heathcote, 1972b; Heathcote and Stockinger, 1970). In contrast to phosphorus, potassium accumulates predominantly in plant stalks and residues rather than grain, and therefore any crop residue that returns to the plot is important to the nutrient cycle. Other important natural sources of potassium include additions from the transformation of non-exchangeable to exchangeable potassium under drying and wetting cycles, and atmospheric contributions, especially from *Harmattan* dust deposition. Table 5.2 indicates that potassium levels in the soils sampled varied considerably between sites and the highest levels were found at Maisar Tudu and Magama, the two locations furthest from Kano. The lowest level of potassium was observed at Zangon Gabas. In the Kano region, potassium losses from leaching are not considered to be overly excessive and estimates of losses in the West African Savanna range from 8 to 17 kg K/ha (Kowal and Kassam, 1978). In northern Nigeria, Kowal (1970) has estimated potassium losses due to erosion and surface run-off to range from 7.5 to 13.4 kg K/ha per annum.

Soil (in)fertility

Adequate soil nutrients, such as nitrogen, phosphorus and potassium, are essential for maintaining healthy crops and abundant yields, and nutrient deficiencies are one of the most frequent ways that land degradation affects agricultural production (Stocking and Murnaghan, 2001). Inextricably linked to the competition for land and resources, concern for soil fertility decline was articulated by a large number of respondents in this study, especially those in the two sites in closest proximity to Kano, Hotoro Arewa and Zangon Gabas. The fertility of local soils is determined by both their physical properties and their nutrient resources (Jones and Wild, 1975) and Wild (2003) notes that nutrient depletion is the most common form of chemical soil degradation. A number of frequently cited studies looking at the nutrient budgets of African soils support this belief and indicate that nutrient depletion is occurring in many countries (van der Pol, 1992; Stoorvogel and Smaling, 1990). These accounts appear to subscribe to the notion that human land-use pressures have played a role in exacerbating degradation in the African drylands, and such 'orthodoxies' have had great influence on development policy (for example, see Cleaver and Schreiber, 1994). At the same time, however, other researchers have questioned many of the underlying assumptions, methodologies and scales upon which these studies are based (Scoones, 1997). Indeed, as emerged from the discussion in Chapter 4, several recent micro-level studies carried out in the Kano region have provided counter-claims to these degradation narratives (Harris, 1995; Mortimore, 1998). As such, in the case of Kano and its CSZ, the exact relationship between land managers and soil fertility remains unclear.

Without access to past records of soil properties in the area, a direct measure of soil fertility change over time remains difficult. To deal with this problem, Tiffen *et al.* (1994) adopt what they refer to as the 'spatial analogue method', where samples from a known management regime are compared with samples from uncultivated control sites under natural vegetation. However, it was not possible in this study to compare samples from cultivated sites with those from a 'virgin' control site, since all available land has been under permanent cultivation for at least the last 30 years (Harris, 1995). Nevertheless, discussions with a wide range of actors indicate that 'nutrient mining' is increasingly becoming a common local explanation for soil infertility in the Kano CSZ. Although as we saw in Chapter 4, for years intensive cultivation has placed great pressure on the land, many farmers have successfully integrated crop production with livestock raising to maintain soil fertility (Plate 4.3). However, recent focus group discussions with land managers revealed that the present-day situation has made access to these inputs increasingly challenging and as a result, many farmers reported that declining yields are becoming more commonplace. In the words of one respondent:

> There are great problems with the land today. Before, a person would just use one piece of land to plant his crops and the land would produce as many as 100 bundles. But today, it is different. Last year, that old man over there farmed 18 different pieces of land, but before the rainy season he had to sell some cattle because he had run out of food. With intensive farming, there are very little yields. The land has to work harder, because with fragmentation and confiscation, the amount of farmland is small. We don't have enough

> taki for our plots, and if we use taki this year, there is a need to reapply it again next year. Sometimes, we have to cultivate without applying any taki at all (Ahamed, pers. com., 2002).

The results of the questionnaire survey administered across the transect confirm that the majority of households sampled believed that growing conditions for crops in the Kano CSZ were now worse than in the past. In fact, more than 62 per cent of households in the sample believed that fertility rates were declining each year, and soil nutrients were not being replenished in the farming system. Paradoxically however, at the same time that over 83 per cent of households reported that they were applying increased amounts of *taki* to their plots each year, almost 66 per cent believed that their yields were presently higher than 10 years ago. It seems that although many farmers believed that soil conditions were currently worse than ever, they also claimed that they were producing more food from their plots than in the past. A similar mismatch in perceptions of degradation and increased productivity is also reported in a study by Gray and Morant (2003) who explore local soil knowledge in southwestern Burkina Faso. Such inconsistencies, they argue, do not indicate that farmers are confused, but rather highlight the complex relationship between yield, soil fertility and fertilizer application, which can appear to 'hide' degradation. In the next section, an attempt is made to elucidate the discrepancy in opinions that concern soil conditions, and nutrient balances are computed for each of the eighteen plots on the research transect.

Nutrient balances

In recent years, nutrient balance studies have become increasingly common tools in studies which evaluate farming practices in Africa (for example see, van der Pol, 1992; Pieri, 1992; Smaling *et al*., 1993; Powell and Coulibaly, 1995; Krough, 1995; Harris, 1996, 1999; Ramisch, 1999). The term 'nutrient balance' is used to describe the comparison of the total inputs of selected soil nutrients, with the total outputs of those nutrients in a bounded system. Scoones and Toulmin (1999) describe the procedure as a 'simple routine' where an estimation of the flows of one or more nutrients take place, either through direct measurement or estimates based on literature. If the total output exceeds the total input, then soil nutrient supplies are presumed to be depleted (Wild 1993). Scoones and Toulmin (1999: 2) add that nutrient balances are thus, 'essentially simple accounting exercises, whereby balances are calculated for each of the identified nutrient 'currencies' through summation.' From the data collected for this study, it has been possible to make a crude estimate of the net nutrient balance for the plots that were monitored. However, it should be noted that there are many attendant problems associated with calculating nutrient balances, some of which will be highlighted in the following discussion.

In this study, the term 'nutrient' is used to refer to the three macro-nutrients, nitrogen (N), phosphorus (P), and potassium (K). In calculating nutrient balances for each of the eighteen study plots being monitored, inputs and outputs had to be measured and quantified. Levels of N, P and K were determined for each of the inputs and outputs, and net surpluses or deficits of nutrients were determined

Table 5.3 Inputs and outputs measured

Inputs	**Method of Measurement**	**Reference**
Taki	Weighing of air dried *mangalas* with balance scale	Researcher's fieldwork notes
Chemical fertilizer	Farmers reports, weighing *mudu* with balance scale	Researcher's fieldwork notes
Harmattan dust	Estimated from the literature	Researcher's fieldwork notes
Outputs	**Method of measurement**	**Reference**
Crop harvest for millet	Weighing of air dried, unthreshed grain heads with spring scale	Researcher's fieldwork notes
Crop harvest for sorghum	Weighing of air dried, unthreshed grain heads with spring scale	Researcher's fieldwork notes
Crop harvest for cowpea	Weighing of air dried cowpeas and pods with balance scale	Researcher's fieldwork notes
Crop harvest for groundnut	Weighing of air dried cowpeas and pods with balance scale	Researcher's fieldwork notes
Stalk harvest for millet	Weighing of air dried stalks with spring scale	Researcher's fieldwork notes
Stalk harvest for sorghum	Weighing of air dried stalks with spring scale	Researcher's fieldwork notes
Harawa (crop residue) harvest for cowpea	Weighing of *harawa* bundles with spring scale	Researcher's fieldwork notes
Harawa (crop residue) harvest for groundnut	Weighing of *harawa* bundles with spring scale	Researcher's fieldwork notes

Source: Author's fieldwork

by summing all of the 'imports' and 'exports' of resources from each plot. In the laboratory, Total K was determined by flame photometry, Total P was determined by colorimetry, and Total N by the Kjeldahl distillation method. Table 5.3 provides a summary of the inputs and outputs that were measured, and the procedures that were used to estimate them.

One of the most common criticisms of nutrient balance models is that they are based on limited data which have been gathered over a relatively short period of time, and that they can merely provide a 'snap-shot' view of soil fertility change (Scoones and Toulmin, 1999). Some commentators thus argue that the limitations of nutrient balances make them inappropriate for exploring the dynamics of environmental change in African farming systems in some situations. In any given nutrient balance study, it is quite apparent that not all nutrient input and output factors can be quantified. Consequently, most nutrient balance studies focus on measuring farm components, while failing to include soil processes which are more difficult to estimate.

Wild (1993) points out that a complete balance sheet would include nutrients from the atmosphere in rain, dry deposition, nitrogen fixation, weathering, leaching, and volatilization (among many other sources). Due to the limited scope of this research, the inclusion of such data was not possible. However, Ramisch (1999) warns that many nutrient balance studies do include many of these soil processes in their calculations, even though they are often poorly understood and difficult to evaluate. As a result, he suggests that calculating nutrient budgets 'quickly becomes an exercise involving 'black boxes' nested within other 'black boxes'' (1999: 3). While such analysis may be useful in identifying the constraints and faults of present-day production systems, the extrapolation of results to wider scales and any subsequent predictions for future environmental change becomes problematic. For the purpose of this investigation, the nutrient balances calculated must not be regarded as a definitive account or a predictive tool. Rather they are included in the study to paint a comparative picture of the spatial variability in farming systems in Kano's CSZ. When the information from these balances is coupled with other more qualitative methods and observations, important insights can be gained into the key dynamic characteristics of environment and society in the region.

For this study, the main farm components which are relatively easy to measure, such as flows of fertilizer, manure, harvested grains and crop residues, have been included in the balance. *Harmattan* dust deposition, one of the more difficult processes to monitor, but of vital significance to the farming system, has been estimated from the literature. *Taki* application, another of the most important inputs in the farming system, was quantified by counting and weighing the *mangalas* on each plot using a balance scale.[2] Post-harvest crop residue left on the plots, as well as the grains, stalks and *harawa* harvested from each plot, were all air dried and weighed with either a balance scale or a spring scale. Composite samples of *taki*, grains, stalks and *harawa* were made at each site to facilitate the chemical analysis at Bayero University, Kano (BUK).

Unlike other nutrient balance studies carried out in dryland areas (such as van der Pol, 1992; Smaling *et. al*., 1993; Pieri, 1992; Harris, 1995; Powell and Coulibaly, 1995; Krough, 1995), the plots monitored in this study were sampled on a distance decay transect to determine the influence that proximity to urban Kano had on management practices and ultimately on nutrient flows. The data are summarized in

2 In the Kano CSZ, one *mangala* is equivalent to one pannier sized donkey load of manure. Farmers transport each *mangala* to their plots during the dry season and allow it to remain on the field until the rains begin, when it is spread and ploughed into the soil. Each *mangala* is unloaded individually and can easily be identified as an isolated heap. The local *mangala* measurement varies slightly from farmer to farmer, but there is not a great deal of variability between the pile sizes on each plot. Thus to calculate the average size of one *mangala* on each plot, a representative number of piles was selected and weighed (depending on the total number of mangalas on the plot) and the mean weight was determined. There was also variability in manure quality between each plot, and so theoretically, the manure nutrient content should have been assessed individually for each plot. However, due to financial constraints and time limitations, and a shortage of chemical reagents in the laboratory at BUK, a composite sample of *taki* was made at each site by taking sub-samples from the *mangalas* on all three plots and mixing them together.

Table 5.4 Summary of nutrient balances for plots monitored

Plot	Site	Farmer	N Balance		P Balance		K Balance	
			(kg)	(kg/ ha)	(kg)	(kg/ ha)	(kg)	(kg/ ha)
1	Hotoro Arewa	M. Basiru	6.38	14.18	18.24	40.53	15.41	34.24
2	Hotoro Arewa	A. Maikano	2.91	6.33	15.27	33.2	15.18	33
3	Hotoro Arewa	M. Tukur	6.04	9.6	15.25	24.21	20.35	32.3
Mean	**Hotoro Arewa**		**5.11**	**10.04**	**22.33**	**32.65**	**16.98**	**33.18**
4	Zangon Gabas	M. Yahaya	3.24	29.45	5.05	45.91	4.26	38.73
5	Zangon Gabas	J. Nuhu	4.25	6.75	3.07	4.87	19.12	30.35
6	Zangon Gabas	U. Inuwa	1.81	10.06	2.35	13.06	5.82	32.33
Mean	**Zangon Gabas**		**3.1**	**15.42**	**3.49**	**21.28**	**9.73**	**33.8**
7	Kadewa	M. Dahiru	0.65	4.33	3.51	23.4	4.61	30.73
8	Kadewa	M. Bello	6.78	37.67	5.56	30.9	6.55	36.39
9	Kadewa	M. Sale	0.05	0.45	2.26	20.55	3.35	30.45
Mean	**Kadewa**		**2.49**	**14.15**	**3.78**	**24.95**	**4.84**	**32.52**
10	Maisar Tudu	Y. Abdulwahab	-1.48	-2.96	5.32	10.64	15.48	30.96
11	Maisar Tudu	I. Abdulwahab	17.68	32.74	22.85	42.31	23.46	43.44
12	Maisar Tudu	H. Labaran	9.98	16.36	13.51	22.15	20.68	33.9
Mean	**Maisar Tudu**		**8.73**	**15.38**	**13.89**	**25.03**	**19.87**	**36.1**
13	Gamji Tara	G. Liman	5.25	12.21	4.03	9.37	14.6	33.95
14	Gamji Tara	Y. Yahuza	7.31	27.07	3.7	13.7	9.62	35.63
15	Gamji Tara	S. Miko	2.23	13.12	2.16	12.71	5.76	33.88
Mean	**Gamji Tara**		**4.93**	**17.47**	**3.3**	**11.93**	**9.99**	**34.49**
16	Magama	A. Ibrahim	-4.26	-6.66	3.63	5.67	18.84	29.44
17	Magama	I. Auwalu	10.7	31.47	9.37	27.56	12.21	35.91
18	Magama	G. Alasan	-20.02	-18.71	3.46	3.23	30.06	28.09
Mean	**Magama**		**-4.53**	**2.03**	**5.49**	**12.15**	**20.37**	**31.15**

Source: Author's fieldwork

Table 5.4 and quite unexpectedly, the results indicate that quantitative evaluations of the nutrient status of plots do not agree with farmers' perceptions of soil fertility. In fact, contrary to most farmers' beliefs, there is no real evidence here to suggest that soil fertility rates are dropping. This is not to say that there are not some plots in the Kano CSZ that are declining in fertility. However, the data do suggest that the success of nutrient cycling depends primarily on the land-users' capability to gain access to key inputs, particularly *taki*, which is identified as one of the most important elements of the system.

The importance of *taki*

The input and output data illustrate that farmers were able to maintain healthy nitrogen, phosphorus and potassium balances by applying large amounts of *taki* to their plots (Maconachie, 2004). It is also apparent that both the quality and quantity of *taki* varied considerably from site to site, and therefore some farmers were able to sustain higher nutrient balances than others. For example, referring to Table 5.5, nitrogen concentrations in *taki* samples ranged from a low value of 0.3 per cent at Zangon Gabas, Kadewa and Magama, to a medium value of 0.32 per cent at Hotoro Arewa and Maisar Tudu, to a high value of 0.35 per cent at Gamji Tara. With respect to phosphorus, the mean levels supplied from *taki* were marginally lower and while the transect mean was 0.23 per cent, values ranged from 0.13 per cent at Gamji Tara to 0.35 per cent at Hotoro Arewa. Additions of potassium from *taki* were substantially lower still. Although the transect mean was 0.059 per cent, potassium levels varied from a low value of 0.047 per cent at Kadewa to a high of 0.078 per cent at Gamji Tara.

While the nutrient content in *taki* is influenced by both the varieties of animals that farmers keep, as well as the fodder that is available to them, such spatial

Table 5.5 Chemical analysis of *taki*

Sample type and location	Total K (%)	Total K g/kg	Total P (%)	Total P g/kg	Total N (%)	Total N g/kg
Taki, Hotoro Arewa	0.054	0.54	0.35	3.5	0.32	3.2
Taki, Zangon Gabas	0.067	0.67	0.24	2.4	0.3	3.0
Taki, Kadewa	0.047	0.47	0.2	2.0	0.3	3.0
Taki, Maisar Tudu	0.054	0.54	0.25	2.5	0.32	3.2
Taki, Gamji Tara	0.078	0.78	0.13	1.3	0.35	3.5
Taki, Magama	0.0545	0.545	0.19	1.9	0.3	3.0

Source: Author's fieldwork

variability in *taki* quality can also be partially attributed to varying degrees of IK concerning manure production and management. For example at Gamji Tara, where samples revealed the highest levels of nitrogen and potassium, farmers demonstrated considerable expertise concerning the importance of *taki* storage prior to its application on their plots. It was reported that if *taki* was stored in the open sun, it 'took away' the nutrients. Although farmers could not explain why this was so, they were most likely describing the process of 'volatilization',[3] which may play a role in lowering the nitrogen concentration of *taki* when it is stored in piles on open fields for extended periods of time (Harris and Yusuf, 2001). It was also acknowledged that

3 'Volatilization' is the conversion of a chemical substance in liquid or solid state, to a gaseous or vaporous state, by the application of heat, by reducing pressure, or by a combination of these processes (Parker, 1994).

if manure heaps were left in the compound for too long, small white worms, referred to as *Gwazarma* in Hausa, would 'eat' the *taki* and losses would occur.

While it was quite clear that some farmers had more knowledge about the value of local manure than others, spatial variability in *taki* quality and quantity may also be a function of the different constraints that farmers face between sites. In discussions with the eighteen farmers taking part in the study, it was reported that access to *taki* was now much more difficult than in the past because it was believed that there were generally fewer animals. Moreover, focus group discussions at all of the transect sites revealed that increased economic stress had played a significant role in reducing the capability of households to acquire *taki*. The situation is clearly explained by one group of women from Gamji Tara:

> One of the reasons why we don't use the local manure as much anymore is because there are fewer animals around today. This is largely because we have had to sell some of them to buy food items. Now, because of the very low yields of the crops, we will not end up producing enough to feed the whole family for the entire year, so we will have to sell something. We will sometimes have to sell animals to buy more food for the family (Women's focus group session, Gamji Tara, pers. com., 30 April, 2002).

Many respondents in the study also believed that the reason livestock numbers were presently lower was because there was less rangeland available due to land shortages, which had caused a scarcity in animal fodder. All the farmers in the study recognized that their animals would not produce enough *taki* if they did not have adequate amounts of grass to eat. Consequently, many farmers indicated that they could now only afford to keep a limited number of animals. Many also explained that it had become increasingly difficult to gain access to *taki* through their relationships with nomadic Fulani, who at one time were plentiful in the area each dry season. This was especially the case at Hotoro Arewa and Zangon Gabas, where the landscape was more heavily under the influence of Kano, and Fulani had long since altered their migratory routes. Discussions revealed that in recent years, virtually all rangeland in the area had disappeared, largely due to land hunger fuelled by urban development. However, a reduction in rangeland was also noted by farmers at the other four research sites. It was pointed out that many local people who had sold their plots to urban developers in the peri-urban regions had moved further afield and purchased new plots in locations on the periphery of the CSZ where land prices were lower.

Although some farmers acknowledged that they could no longer grow enough food to feed their families for the entire year and several admitted that at times they had to sell animals or crop *harawa* to purchase food, stress on Kano's food production systems is in no way a new phenomenon. As was noted in Chapter 3, stress on the system has been a common occurrence since pre-colonial times, and Mortimore (1993a) points out that the inner CSZ has probably been deficient in food grain production for at least the last three decades. However, what probably has changed more recently are the general economic conditions of the region, which have been further eroded by new external global forces. Today, local actors arguably feel economic hardships more acutely, and those farmers living at the sites in closest proximity to the city complained bitterly that the high cost of urban living had made food much more expensive.

In addition to increased competition for local manure, it is also possible that the quality of *taki* has changed over time. Research carried out by de Leeuw *et al*. (1995) suggests that over the last 20 years in northern Nigeria, those who rear livestock animals have often decided to keep more small ruminants than cattle, since they are hardier and reproduce more easily. However, not only is it possible that the kinds of animals being kept in the Kano CSZ may have changed in recent years, but it may also be the case that the manure from urban Kano, referred to in Hausa as *shara*, may now contain more 'non-animal' based content (Harris and Yusuf, 2001). Urban solid waste from Kano, which has traditionally been composed of a combination of street sweepings, household refuse and *taki*, has long been used as a fertilizing material by farmers in the peri-urban regions. Although there is very little historical information available that concerns the composition of Kano's urban waste, a study by Lewcock (1995) reports that increasingly peri-urban farmers must spend considerable time sorting through piles of *shara*, separating out the organic waste from stones, rubble, unwanted metal and glass, and polythene bags (Plate 5.1).

Interviews with local actors revealed that there were several other notable factors that influenced *taki* distribution patterns. Each growing season, it is common practice for a farmer to cultivate several separate pieces of land at the same time and *taki* is rarely spread evenly over all the plots. Rather, *taki* applications are most often

Plate 5.1 Farmer sorting out organic waste from a pile of *shara*

concentrated on plots that appear to require the most nutrients. The choice of the specific crops being planted in a given year also plays a role in determining how much *taki* a specific plot will receive. Farmers interviewed on the research transect were able to recall the quantities of *taki* that were applied to all their plots from year to year. Moreover, farmers also appeared to understand that *taki* nutrients were

released into the soil over time and many cultivators noted that if a plot received a heavy application of manure one year, it would receive substantially less *taki* over the following two years. This belief, that *taki* has a temporal effect, has been confirmed by Williams *et al.* (1995) who determined that the decomposition rate of manure follows a pattern of 50:40:10 over a three year period.

Referring to Table 5.6, where the volumes of *taki* applied to plots are summarized, it is apparent that the variability in quantities used is enormous. Farmers along the transect applied a mean of 7989.11 kg/ha of *taki* to their landholdings, with application on individual plots ranging from 983.18 kg/ha in Magama, to 18,936.36 kg/ha in Zangon Gabas. Many farmers acknowledged that these amounts of *taki*

Table 5.6 Quantities of *taki* applied by site

Plot No.	Site	Farmer	Plot Size (ha)	Taki (kg)	Taki (kg/ha)
1	Hotoro Arewa	M. Basiru	0.45	4920	10933.33
2	Hotoro Arewa	A. Maikano	0.46	4074	8856.52
3	Hotoro Arewa	M. Tukur	0.63	3915	6214.3
Mean	**Hotoro Arewa**		**0.51**	**4303**	**8668.05**
4	Zangon Gabas	M. Yahaya	0.11	2083.2	18936.36
5	Zangon Gabas	J. Nuhu	0.63	662	1050.8
6	Zangon Gabas	U. Inuwa	0.18	825	4583.33
Mean	**Zangon Gabas**		**0.31**	**1190.07**	**8190.16**
7	Kadewa	M. Dahiru	0.15	1729	11526.67
8	Kadewa	M. Bello	0.18	1910.8	10615.56
9	Kadewa	M. Sale	0.11	1096.2	9965.45
Mean	**Kadewa**		**0.15**	**1578.67**	**10702.56**
10	Maisar Tudu	Y. Abdulwahab	0.5	1476	2952
11	Maisar Tudu	I. Abdulwahab	0.54	6751	12501.85
12	Maisar Tudu	H. Labaran	0.61	4530	7426.23
Mean	**Maisar Tudu**		**0.55**	**4252.33**	**7626.69**
13	Gamji Tara	G. Liman	0.43	1607.2	3737.67
14	Gamji Tara	Y. Yahuza	0.27	2467.5	9138.9
15	Gamji Tara	S. Miko	0.17	1504.8	8851.76
Mean	**Gamji Tara**		**0.29**	**1859.83**	**7242.77**
16	Magama	A. Saidu	0.64	1299.2	2030
17	Magama	I. Galadima	0.34	4590	13500
18	Magama	G. Alasan	1.07	1052	983.18
Mean	**Magama**		**0.68**	**2313.73**	**5504.39**

Source: Author's fieldwork

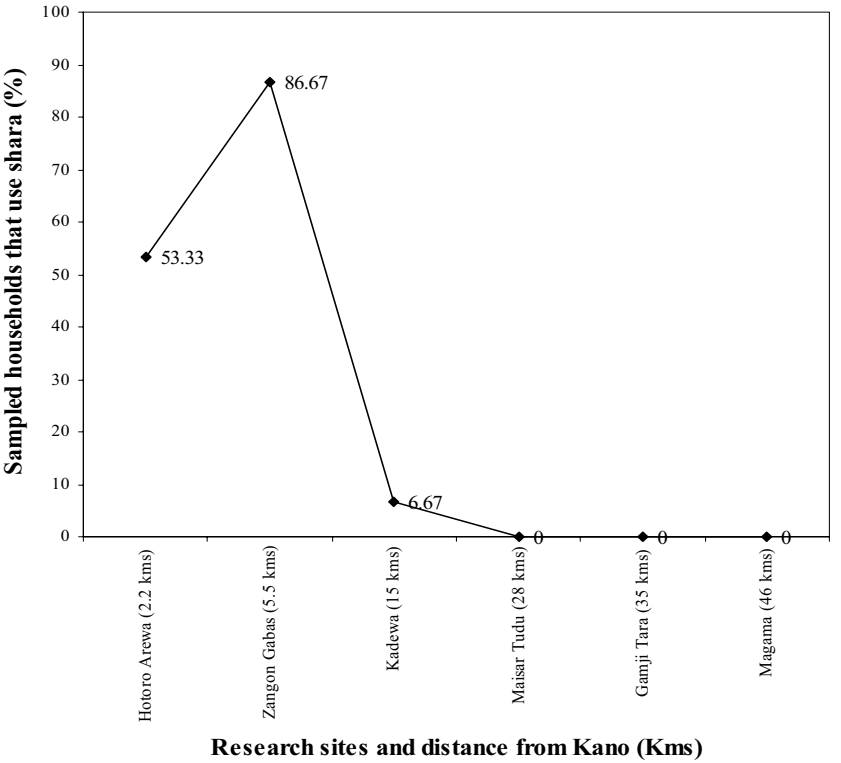

Figure 5.1 Shara use with distance from Kano
Source: Author's fieldwork

often did not remain on farm plots, since it was sometimes washed off the fields by rain action. Farmers at Zangon Gabas and Hotoro Arewa also remarked that due to their close proximity to the city, they had better access to *shara* if they wanted to buy it, since it became progressively more expensive and less available with distance from Kano.[4]

4 Lewcock (1995) conducted a study on farmers' use of urban waste in Kano and found that the application of *shara* extended to a radius of 10–15 km around the city. However, in interviews conducted for this study, lorry drivers from the Kano State Waste Disposal Service (KASEPPA) commented that they sometimes sold their tipper lorries of waste as far from Kano as Minjibir (just over 40 km), and they received prices as high as 1000–1500 *naira* per load (circa £5–8 in April 2002). More frequently, however, it was revealed that most urban waste was sold to farmers in peri-urban villages along the roadside, where individuals had better access to off-farm labour jobs and could afford the cheaper price per load of 800–1000 *naira* (circa £4–5). Drivers further remarked that the price of *shara* not only varied with distance from Kano, but also with the time of year, and the cost for a tipper load of waste dropped to 400 *naira* (circa £2) during the rainy season when crops were already planted.

Confirming this information, the results of the household questionnaire revealed that *shara* use diminished with distance from the urban area (Figure 5.1). At Zangon Gabas, almost 87 per cent of the households surveyed applied *shara* to farm plots, while at Hotoro Arewa it was 53 per cent of households. However, at Kadewa, the survey indicated that *shara* use dropped to just below 7 per cent of households and then in the remaining three sites, 0 per cent of the households used urban waste on their farms.

While farmers' capabilities to gain access to inputs are certainly shaped by the constraints and limitations they face, individuals also make conscious choices about how and where limited resources should be utilized. Farmer Yahaya (Plot 4, Zangon Gabas) and Farmer I. Abdulwahab (Plot 11, Maisar Tudu) specifically mentioned that their plots were receiving disproportionately high amounts of *taki* because they had applied very little in recent years.[5] Even within individual plots, decisions were also made concerning which specific crops would receive *taki* and which would not.[6] It was frequently the case that millet received the highest proportion of *taki*, not only because it is considered to be one of the most important grains for achieving household food security, but also because farmers believed that it had the highest soil nutrient demands.

Quantifying inputs

The other sources of nutrient inputs that were recorded for this study were: crop residues, chemical fertilizer (when it was applied in small quantities) and *Harmattan* dust deposits. There were, of course, numerous other inputs that could have been included in the balance, but the decision not to measure them was made for various reasons. For example, it is acknowledged that the practice of fallowing returns substantial amounts of nutrients to the soil.[7] However, as has been previously noted, practically all available land in the Kano CSZ is under permanent cultivation and in fact, none of the farmers taking part in the study were fallowing land. Likewise, nitrogen fixation has been the focus of much research in recent years and the potential for leguminous crops such as cowpea or groundnut to enhance soil fertility is well

5 At the time of this study, both of these farmers were fortunate to have secure jobs and thus they had dependable sources of income which could be reinvested into their farms. Farmer Yahaya was employed by the KTP Textile Factory in Bompai Industrial Estate, and Farmer I. Abdulwahab was a civil servant.

6 The agro-pastoral system of the Kano CSZ was described in Chapter 4, and it was noted that *taki* is transported to fields by donkey or headpan and deposited on the plot in individual piles, referred to as *mangalas*. Once on the plot, farmers spread the *taki* onto specific parts of the field, or apply manure to the base of specific plants within the intercropped field in a practice referred to locally as *ganaka*. Such an example demonstrates how farmers must make difficult choices, even at the individual plot level, to ensure that scarce resources are used optimally.

7 Morgan (1986) believes that the nutrients returned to the soil by a three-year grass fallow are equivalent to an annual application of farmyard manure at 1.2 kg/m² or 12,000 kg/ha. Alternatively, Harris (2000) estimates inputs of nitrogen and phosphorus in fallow land protected from nutrient offtake to be 2 kg N/ha, and 1.57 kg P/ha respectively.

documented (Giller and Wilson, 1991; Hauser 1992; Harris 1995). However, in low and medium-intensity farming systems, nitrogen inputs through fixation are typically minimal, since most cultivators plant very few leguminous crops and concentrate more on the main cereal food crops such as sorghum or millet. With the additional complexity of uncontrolled conditions in the field where intercropping was being practiced, no attempt was made to measure nitrogen fixation in this study. Although Harris (1995) attempted to estimate inputs from nitrogen fixation in her two-year study in Gamji Tara, she acknowledged that there were so many variables involved that many measurements remained little more than informed guesses.[8]

In Chapter 4, it was noted that crop-livestock integration remains a key element in the farming cycle and during the dry season, animals can be observed grazing on field stubble and depositing *taki* on farm plots. While much of the crop residue remaining on fields is consumed by livestock, a large quantity of this residue is also ploughed back into the soil before planting and nutrients are recycled into the farming system. Thus in order to estimate nutrient inputs, crop stubble and the residues left on plots were gathered and weighed immediately prior to ploughing, and samples were sent to the laboratory at BUK to determine amounts of nitrogen, potassium and phosphorus. According to the input data collected for this study (Maconachie, 2004), it is apparent that the amounts of crop refuse left on plots varied considerably, ranging from just 175 kg/ha (Plot 15, Gamji Tara) to 3,575 kg/ha (Plot 6, Zangon Gabas). It is also clear that there were slight variations in the nutrient values of the crop residue, depending on management strategies (see Table 5.7 and Figure 5.2).

Table 5.7 Chemical analysis of crop residue

Sample type and location	Total K (%)	Total K g/kg	Total P (%)	Total P g/kg	Total N (%)	Total N g/kg
Crop Residue, Hotoro Arewa	0.023	0.23	0.01	0.1	0.14	1.4
Crop Residue, Zangon Gabas	0.043	0.43	0.02	0.2	0.18	1.8
Crop Residue, Kadewa	0.041	0.41	0.014	0.14	0.19	1.9
Crop Residue, Maisar Tudu	0.018	0.18	0.02	0.2	0.14	1.4
Crop Residue, Gamji Tara	0.029	0.29	0.005	0.05	0.15	1.5
Crop Residue, Magama	0.066	0.66	0.05	0.5	0.22	2.2

Source: Author's fieldwork

The mean phosphorus level in all the residue samples was 0.02 per cent, but site-specific values ranged from 0.005 per cent at Gamji Tara to 0.05 per cent at Magama. Likewise, potassium levels in the residue varied from 0.018 per cent at Maisar Tudu to 0.66 per cent at Magama, and the overall mean was 0.036 per cent. Nitrogen inputs from residue were the most significant, with an overall mean of 0.17 per cent. In fact, for most farmers who could not afford inorganic fertilizer, residue was the

8 In her study, Harris (1995) estimated that groundnuts fixed 0.611 g nitrogen per plant, and cowpeas fixed 1.706 g nitrogen per plant.

second most important source of nitrogen after *taki*. Nitrogen values from residue ranged from a low of 0.14 per cent at Maisar Tudu to a high of 0.22 per cent at Magama. Variation was largely determined by the different nutrients found in the specific plants and trees bordering each plot, and the choices that each farmer made concerning which residue should be transported back to the compound and which should remain on the plot.

Although applying inorganic fertilizer may be the easiest way to add nutrients to the soil in high concentrations, it is a relatively insignificant part of the farming system in the Kano CSZ. Of the 18 farmers who took part in this study, only 8 individuals were able to gain access to very small amounts of NPK fertilizer. Most farmers bought fertilizer by the *mudu*, a standard sized bowl measurement that is used in the market place, because they could not afford to buy an entire sack. In

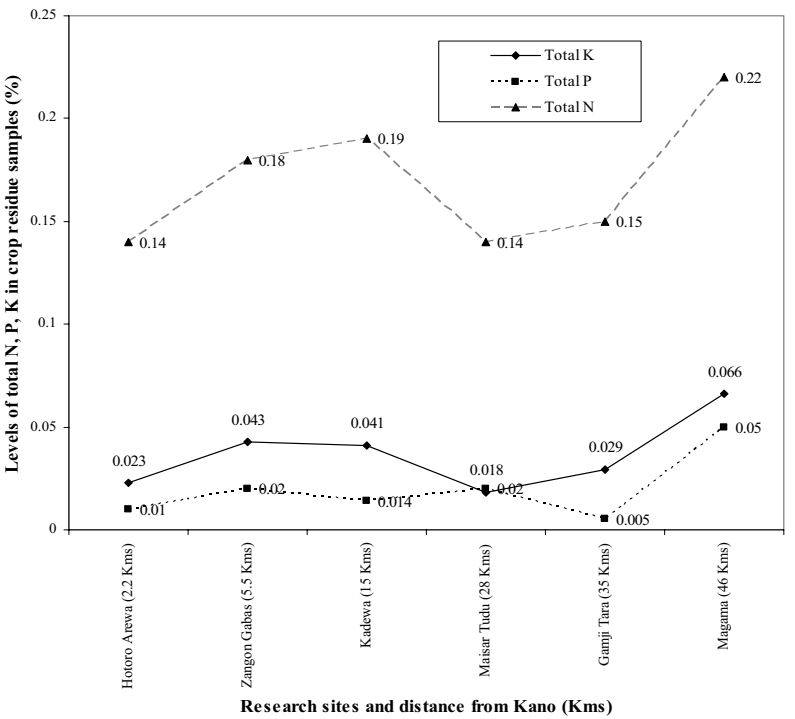

Figure 5.2 Nutrient values of crop residues with distance from Kano
Source: Author's fieldwork

August 2002, the cost of one *mudu* of NPK fertilizer was 120 *naira* (circa £0.63), and the mean amount of fertilizer used by the 8 farmers was 35.26 kg or about 11.5 *mudu* per farmer (costing approximately £7.25 each). As Harris (2000: 28) notes, due to its high cost and erratic availability, farmers typically apply fertilizer to their fields by hand, using the *ganaka* technique to target specific crops within the plot. From year to year there may be variation in the specific types of fertilizer that are available but

in this study, all the farmers who did have access to fertilizer used NPK, which is 20 per cent nitrogen, 10 per cent phosphorus and 10 per cent potassium by volume.

The final input estimated for the nutrient balance in this study was the amount of *Harmattan* dust deposited on plots. As was noted in Chapter 4, each year, roughly between the months of October and April, semi-arid West Africa is subjected to seasonal dust deposition which accompanies the *Harmattan* wind. Consequently, a layer of fine sediment is left on farm plots, which contains various micro-nutrients as well as relatively high amounts of nitrogen, potassium and phosphorus. In northern Nigeria, there have been a number of studies that have analyzed the chemical content of dust samples (Beavington and Cawse, 1979; McTainsh and Walker, 1982; Wilke *et al*., 1984). Although deposition rates may vary from year to year, this study has used the results of research carried out by Wilke *et al*. (1984) to estimate the contribution that *Harmattan* dust makes to the nutrient balance.

According to McTainsh and Walker (1982), who used wet dust traps to carry out their fieldwork, annual deposition rates of dust have been estimated to amount to 991 kg/ha. Wilke *et al.* (1984) use this figure to calculate the macro-nutrient contents of dust in terms of kg/ha and they estimate that each year, *Harmattan* dust contributes 2.18 kg P_2O_2/ha, 29.2 kg K_2O/ha and 3.37 kg N/ha to farm plots in the Kano CSZ. It should be noted that when these figures are used to estimate inputs of N, P and K, they add substantial amounts of these elements to the balance. Of particular note, the amounts of potassium added to the budget are vast and they push the balance way into the positive. In reality, these large amounts of nutrients would probably not end up on each of the farmer's fields and as Wilke *et al*. (1984) point out, only a small portion of the nutrients supplied by the dust would be available to crops at once. Furthermore, dust would almost certainly not be distributed evenly over the fields and it would be blown off plots by wind action and washed off by the rains. With this in mind, the deposition figures used in the nutrient balance for this study must be viewed with caution and are almost certainly over-estimated. Nevertheless, the micro-nutrients present in *Harmattan* deposits can be considered to be an important input into the system, even though, as Wilke *et al.* (1984) warn, N, P and K contributions are lower than the amounts removed by the most prominent West African crops and cannot substitute as a 'maintenance dressing.'

Quantifying outputs

In terms of the outputs measured, the primary focus of enquiry was on estimating the main outputs that farmers could manipulate, such as nutrient losses from the grain, stalk and *harawa* harvest. In his evaluation of soil nutrient budgets in Southern Mali, Ramisch (1999: 25) sums up one of the major problems associated with calculating balances when he notes, 'too many of the components in nutrient balances are environmentally determined, and difficult to evaluate properly even though they contribute enormously to the end result.' Indeed, it was decided in this

study that it would have been unrealistic to attempt to accurately measure many of these processes and consequently they were not included in the balance.[9]

In Table 5.8, the percentages of nitrogen, potassium and phosphorus that were removed from the nutrient cycle in the harvest are presented. From these figures, it is apparent that the leguminous crops appear to be removing a higher percentage of nitrogen than the cereal grains. In reality, however, this loss would probably be compensated for by the nitrogen fixing properties of the legumes. Concerning the amounts of phosphorus and potassium removed from the soil, the difference between the cereals and legumes is much less. But for both nutrients, losses are slightly higher in the legumes. In the Kano region, however, millet and sorghum are the two most important crops in the farming system and on the majority of plots, most of the land cultivated is devoted to these two staples. Therefore, overall the two cereal crops are the largest nutrient sinks.

Table 5.8 Chemical analysis of crops, stalks and *harawa*

Sample no	Crop	Total Potassium (%)	Total Potassium (g/kg)	Total Phosphorus (%)	Total Phosphorus (g/kg)	Total Nitrogen (%)	Total Nitrogen (g/kg)
	grain						
1	Millet (composite)	0.0235	0.235	0.0115	0.115	0.34	3.4
2	Sorghum (composite)	0.021	0.21	0.012	0.12	0.3	3
3	Groundnut (composite)	0.0358	0.358	0.0167	0.167	0.78	7.8
4	Cowpeas (composite)	0.0274	0.274	0.0133	0.133	0.63	6.3
	stalks						
1	Hotoro Arewa	0.035	0.35	0.0197	0.197	0.36	3.6
2	Zangon Gabas	0.041	0.41	0.0215	0.215	0.27	2.7
3	Kadewa	0.0425	0.425	0.0173	0.173	0.25	2.5
4	Maisar Tudu	0.0286	0.286	0.0137	0.137	0.22	2.2
5	Gamji Tara	0.031	0.31	0.0107	0.107	0.21	2.1
6	Magama	0.0382	0.382	0.023	0.23	0.37	3.7
	harawa						
1	Hotoro Arewa	0.0421	0.421	0.021	0.21	0.44	4.4
2	Zangon Gabas	0.043	0.43	0.024	0.24	0.42	4.2
3	Kadewa	0.0396	0.396	0.022	0.22	0.37	3.7
4	Maisar Tudu	0.0438	0.438	0.021	0.21	0.4	4
5	Gamji Tara	0.0416	0.416	0.0234	0.234	0.43	4.3
6	Magama	0.0453	0.453	0.0271	0.271	0.51	5.1

Source: Author's fieldwork

9 For example, leaching, one of the outputs often included in nutrient balance calculations, was not included in this study. In the Kano CSZ, water flowing through the soil profile is extremely low, and water balance studies by Harris (1995) suggest that leaching is likely to be negligible.

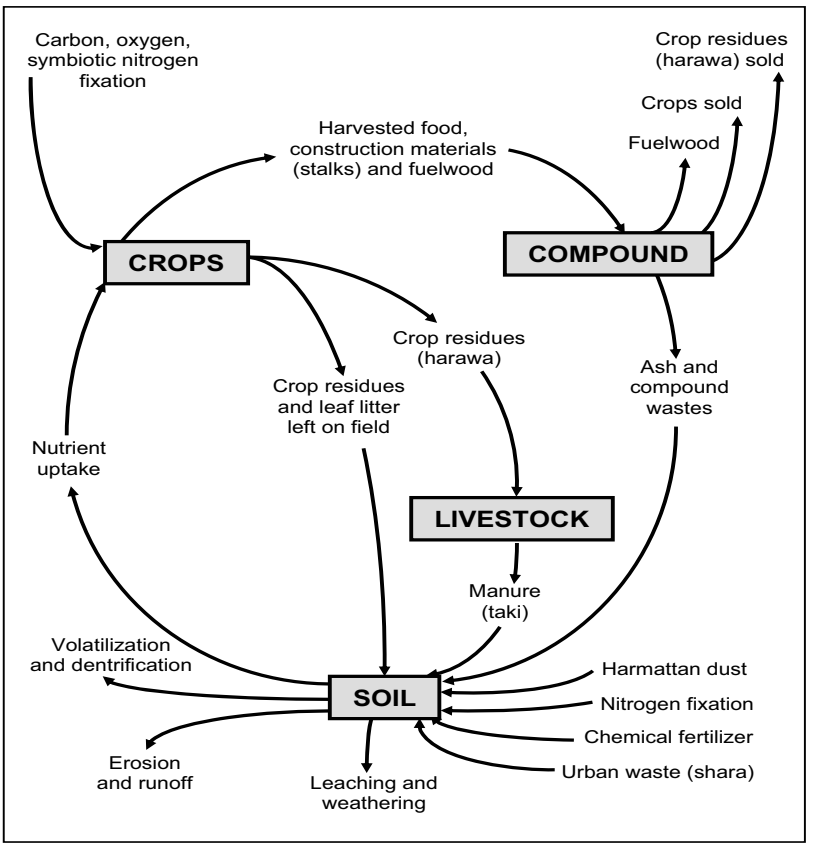

Figure 5.3 Nutrient cycling under smallholder farming
Source: Adapted from Harris (1995:39)

As became apparent in the discussion in Chapter 4, due to the highly intensive nature of the farming system in the Kano CSZ, all available resources are efficiently used, including crop by-products. For example, sorghum and millet stalks are a valuable component of the harvest and are stored in piles called 'stooks' on the post-harvest plot, so that animals cannot eat them (see Plate 4.1 in Chapter 4). Stalks are used as animal fodder, building material and fuel for fires. Farmers often save their stalks until the dry season when they can sell them for a higher price. As there is such a high demand for livestock fodder, the leaves of the cowpea and groundnut plant are also collected as *harawa* and fed to animals or sold at the market. Referring to Table 5.8, it is apparent that significant amounts of nutrients are removed by the harvesting of these secondary crops and it is therefore necessary to include them in the balance. Some of the nutrients that are removed from the system are recycled to the soil in the form of animal *tak*i. It is particularly worth noting that substantial losses of potassium occur in the stalk harvest and *harawa* appears to be a significant sink for both nitrogen and potassium. Figure 5.3 summarizes how nutrients are removed

from the soil and then are recycled back into the system under smallholder farming in the Kano CSZ.

Understanding fertility: what does the nutrient cycle actually tell us?

Thus far, the analysis of soil conditions in this chapter has been largely based on 'scientific' data that have been used to describe the 'intrinsic' qualities of the soil, or estimate the nutrient inputs and outputs in the farming system. But while quantitative estimates of specific nutrient flows may provide a 'snap-shot' picture of fertility, it should be noted that this is not a measure of 'sustainability'. As we have noted, nutrient budgets may be useful in recognizing the faults of present systems, but the extrapolation of present balances into the future has little predictive power (Ramisch, 1999). In short, although nutrient balances can make contributions to understanding fertility management, they are tools that must be applied with caution.

The data summarized in Table 5.4 suggest that with the exception of only three plots, all the fields monitored in the study had positive nutrient balances. Interestingly, Farmer Y. Abdulwahab (Plot 10, Maisar Tudu), and Farmers Ibrahim and Alasan (Plots 16 and 18, Magama) all recorded negative nitrogen balances. The reason for this is almost certainly because the amount of *taki* they applied to their plots was not sufficient to replace the quantity of nitrogen taken out by their crops. Referring to Table 5.6, it is evident that these three farmers applied the least amount of *taki* of all the land managers, with the exception of Farmer Nuhu (Plot 5, Zangon Gabas). However, the data suggest that the majority of farmers maintained positive balances on their plots and were able to replace the nutrients depleted in sufficient quantities to prevent soil mining from occurring. For most of these individuals, crop yields were also sufficiently low such that the nutrient offtake in the harvest remained small, helping to maintain a high nutrient balance.

In short, the data obtained in the nutrient balance study suggest that the two most important inputs into the farming system are *taki* and *Harmattan* dust. Although farmers cannot influence the amount of atmospheric dust that is deposited on their plot each year, they do, however, have some control over the amount of *taki* that is applied to the soil. The continued ability to gain access to *taki* remains one of the key elements in the farming system and as Kano's urban shadow is cast even further into its hinterland, the constraints associated with city pressures will undoubtedly make it even more difficult to maintain soil fertility. Indeed, virtually all the farmers interviewed in the study complained bitterly about the difficulty of obtaining manure, suggesting that sustainability will become increasingly challenging in the years to come. Moreover, when farmers' qualitative assessments of soil conditions and fertility are compared to the summaries of nutrient balances presented in Table 5.4, we see a great disparity. The vast majority of farmers described the soil by using terms such as 'tired' or 'worn out', and we must ask ourselves whether it is the case that the nutrient balance data simply do not capture the kinds of changes that are of most significance to farmers.

Gray and Morant (2003) report that finding differences between local and scientific knowledge is quite common. While Kiome and Stocking (1995) describe

great disparities between indigenous and scientific perceptions of environmental degradation in their study of soil conservation in semi-arid Kenya, Stocking and Murnaghan (2001: 2) further add that 'there is clearly a mismatch between the perspectives of …scientists, technology developers and local professionals, and the views of land users who are expected to implement the recommendations.' More often than not, smallholder innovations in soil improvement have not been recognized by scientists and instead, soil fertility studies have been based on trying to measure a loss in 'original fertility' (Sanchez *et al*., 1997). Thus, the apparent contradictions in indigenous and scientific knowledge in this study should in no way be interpreted as discrediting local knowledge. Rather, as Gray and Morant (2003) also maintain, these discrepancies illustrate some of the methodological complexities involved in assessing soil fertility, with respect both to farmers' perceptions and to quantitative soil assessment methods.

It remains imperative therefore to acknowledge that attempts to assess soil fertility simply by calculating nutrient balances may be unrepresentative and highly problematic. A critical understanding of soil fertility change must appreciate that local decisions to invest or disinvest in the soil are embedded in wider social and economic determinants that shape and define the way the landscape is managed. Contradictions between local and scientific knowledge may merely reflect that farmers are more concerned with broader livelihood issues that have greater bearing on their life-worlds. For example, studies by Dahlberg and Blaikie (1999) and Elias and Scoones (1999) indicate that broader concerns for the climate may play a role in transforming farmers' perceptions of soil quality. It is also quite plausible that farmers' perceptions of the environment may reflect negative changes in their social and economic well-being. Based on focus group discussions with a wide range of actors who expressed great concern for increased levels of competition in the Kano CSZ, perceptions of soil fertility decline may be based on reduced access to land resources, or inputs such as *taki*. Since the nutrient balances indicate that the vast majority of local cultivators are not mining the soil, it is possible too that while farmers perceive a decline in soil fertility, they are reacting to conditions in ways that could improve overall soil productivity.

While the technical understanding of the soils around Kano presented thus far may be useful in helping to build a fuller picture of land degradation in the region, such knowledge must be allied to a greater understanding of livelihood diversity and change. It remains important to realize that local perceptions of soil fertility are framed by broader views of environmental change, and it is equally critical to understand that social, economic and cultural contexts almost certainly influence the processes of soil change. In the final sections of this chapter, some of the most significant forces that are driving the process of environmental change in Kano's hinterlands are identified, and a more detailed discussion is developed of the broader issues that affect soil fertility management.

Socio-economic pressure, differential access to resources and implications for sustainability

While an individual's soil management capability is greatly affected by access to resources, the management techniques of different actors must be understood in their social contexts, and how these are shaped by limited power, land hunger, misguided state policies and incorporation into productive relations associated with wider economic systems. Indeed, observations at each of the sites on the transect suggest that decision-making abilities in the Kano CSZ vary considerably across space, but differences are also evident at the micro-level within the community at each site. The question of how changing social and economic relations influence stewardship practices remains central to the investigation, and it is crucial to consider how regional economic, political and demographic changes have transformed the dynamics of environmental change.

In the Kano region, as elsewhere in Africa, the incentive and capacity for local actors to invest in the land is shaped by numerous factors, including the cost and availability of land, livestock, and labour, access to capital and the social relations which govern access to these resources. In this respect, although micro-level understandings of soil fertility are important, they are nested within a variety of social, political and economic factors that clearly encourage or prohibit investment in the land. Following Osbahr (2001), who conducted research in southwestern Niger, soil quality can be observed to fluctuate from year to year and fertility levels may change over time, depending on wider contexts.

Land hunger

In considering soil nutrient management, Scoones and Toulmin (1999) note that much of the current debate surrounding soil fertility often fails to take into account the role that farmers play in shaping the process of environmental change. In short, farmers are the key actors in the cycling of nutrients and their differential access to resources has great bearing on their ability to manage the soil sustainably. As land has become increasingly scarce and valuable in the Kano CSZ, farmers have had to reassess their options and management practices. Increasingly, as a wide range of stakeholders in this study revealed, it is feared that the competition for land is constraining farmers' ability to care for the soil and is having significant consequences for livelihoods. An increase in the incidence of 'land hunger' was particularly noteworthy at the two sites in closest proximity to Kano, namely Hotoro Arewa and Zangon Gabas.

Competition for land is not a new development in the Kano region. For many years, the traditional subdivision of farm plots through inheritance has led to land fragmentation and local actors have long acknowledged that cultivated areas are now much smaller than in the past. Not only did most households interviewed in this study confirm that individual plots were smaller, but also almost 37 per cent of households reported that the total size of family landholdings had decreased in recent years. According to Mortimore (1970), such competition is not a new development

and there has been a steady decline in the size of average family land-holdings in the Kano region over the years. Referring to records between 1932 and 1964, he notes:

> The number of separately occupied plots on the 448 acres which were surveyed increased by 42% to 185…During the same period the cultivated area increased by 26 acres [of] mostly marginal land….Of all plots registered in 1932, 41% had been subdivided by 1964 while only 16% had been consolidated….Fragmentation is also increasing. The average plot decreased in size by 22% between 1932 and 1964, [and] the average holding by 11% (Mortimore, 1970: 385; cited in Watts, 1983a: 353).

More recently, many farmers noted that as plots have been required to feed increasing numbers of people, smaller parcels of land have consequently been forced to 'work harder' in contributing to household survival. It seems that this increased stress on the soil has played a role both in constraining production and also in transforming management practices. Although many local cultivators possess an impressive fund of environmental knowledge and a sound understanding of traditional land conservation techniques, it may be the case that insurmountable pressures and constraints inhibit some farmers from acting 'sustainably'. For example, discussions with peri-urban farmers at Hotoro Arewa and Zangon Gabas revealed that although it is uniformly acknowledged that the fallowing of land is an important practice for maintaining soil fertility, recent increases in land hunger, coupled with new economic pressures, have meant that for at least the last 30 years, all available land has been cultivated and it remains virtually impossible to leave any land idle. Consequently, many smallholders appear to engage in unsustainable activities, not because they are lazy or ignorant, as the 'classic view' of degradation implies (Jones, 1996), but rather because they find themselves in desperate situations with few alternative coping strategies. A large number of respondents who were contributing to peri-urban degradation in the Kano CSZ may well have been aware that they were doing so, but lacked the political or economic power to change their actions.

Urban pressure and land speculation

Exacerbating the incidence of land hunger, a number of pressures associated with an expanding rural-urban interface have further reduced land availability, and led to greater competition for resources and markets. As urban development has increased the value and demand for land in peri-urban Kano, many residents have decided to abandon farming altogether and have actually sold their plots to urban developers. One respondent in the study described the gradual transformation of farmland succinctly:

> Our main problem is that we don't have as much land as we used to because of the growth of the city. Our farming activities are suffering here, and now we must go elsewhere to farm. There is less agricultural land than in the past, and although we now have tap water and electricity, we are selling our land because other people want to build their houses here as the area becomes developed (Basiru, pers. com., 2002).

In some cases, the rising cost and scarcity of available agricultural inputs have played a role in the creation of a rural class who, as Hill (1972) suggested more than 30 years ago, are in danger of becoming 'too poor to farm'. Consequently, in many instances poor farmers have been driven to sell their land, not out of choice, but rather out of desperation. However, in other situations, high peri-urban real estate prices have enticed some farmers to liquidate their land assets, and purchase farmland in other less expensive peripheral areas. Some individuals have clearly taken advantage of rising land prices and have seen it as an opportunity to benefit financially. At the same time, however, as a growing percentage of peri-urban land has been appropriated by developers, farming has become increasingly difficult for those who choose to continue cultivating in the Kano CSZ. The situation is clearly recounted by one young farmer:

> When strangers come and buy our plots…they improve our economic standards, and assist us more than our relatives ever could. We can benefit financially, and many people buy farm plots further out from this place. So they are now farming elsewhere. But much of this farmland has now been allocated for other purposes – maybe for settlements or the construction of the Ring Road. Many people no longer farm at all, and this will definitely affect the income of their families (Ali, pers. com., 2002).

After a developer acquires a new plot, the land is often surveyed and the cornerstones of a building are laid on the site to indicate formal ownership and the 'intention' to build a structure in the future (Plate 5.2). However, frequently the plot is bought for speculative reasons and the land may remain idle for many years in the hope that property values will further increase and the property will later be resold. As instances of 'land grabbing' have increased in recent years and greater numbers of peri-urban plots have been temporarily taken out of circulation, land hunger has become so acute that in some cases poor peri-urban cultivators have continued to grow crops inside the walls of uncompleted buildings. Echoing these observations, a previous study into peri-urban agriculture in Kano by Olofin *et al.* (1997: 11) revealed that the sale of undeveloped land to urban developers was threatening the future of cultivation by the urban poor, and noted that, '…for most sites, tenancy is a combination of permitted and non-permitted squatting'.

Security of tenure

Closely related to the issue of land hunger are questions that concern the legality of land-use and the security of tenurial arrangements, both of which are vital considerations when farmers make decisions about soil investment. Scoones and Toulmin (1999) point out that an individual's willingness to invest in soil improvement strategies may largely be driven by their perceptions of the potential benefits which may accrue in future. When the benefits are perceived to be uncertain, the desire to invest is almost certainly reduced. In this study, many respondents admitted to commuting many kilometres each day to cultivate plots where their land tenure was not secure. In fact, almost 25 per cent of the households sampled believed that their land tenure was insecure.

Plate 5.2 Cornerstones laid on plots by developers indicate an 'intention' to build

Concerns seemed to be the highest in Hotoro Arewa and Zangon Gabas and one farmer, who was cultivating a plot that was on loan to him, claimed that because he did not own his land and was only farming there temporarily, there was little point in his trying to use soil conservation practices or improve the quality of the land. Other respondents who also lacked security of tenure, agreed that they had perhaps exacerbated a number of problems associated with soil degradation, because they had been forced to cultivate marginal and/or unproductive land out of sheer desperation.

Adding further complexity to the land security question, the legislative context of land ownership around Kano remains far from simple, and is an amalgam of indigenous Hausa systems of land tenure, and elements of external legal systems originating both from Islam and the British colonial period. In an attempt to clarify inconsistencies between systems, the 1978 Land-use Decree gave the Federal Government control of all urban land, with powers allocated to the State Governor to grant customary rights of occupancy. The right of the government to instantly appropriate privately held land has, understandably, increased feelings of insecurity, even among those who legally own their plots. It is possible that such feelings may have encouraged some peri-urban actors to manage the land unsustainably, and in some cases have driven individuals to act in ways that they would normally not do. For example, one farmer who was interviewed admitted that the only reason he had sold his plot to an urban developer was because he feared that the government would confiscate it. He also confessed that immediately before selling his plot, he completely deforested the property so that he could earn some additional income from selling his trees as firewood. Such feelings of land insecurity, perpetuated by

suspicions of the government's motives, are by no means unique, and are widely shared by many peri-urban residents. As one respondent explains:

> Government officials have come to measure the land here, and some of the land has been confiscated. Now there are land rules which allow the government to take away our land and much of our farmland that in the past has been inherited by our fathers, has been taken over. When we were growing up, we saw our fathers and neighbours farming this land, but now the government has either sold this land or developed it. Rapid urbanization has changed the way the land is used (Maikano, pers. com., 2002).

In a recent paper by Lynch, *et al.*, (2001), empirical evidence collected in a longitudinal study undertaken in Kano, also suggests that peri-urban activities and livelihoods are presently being threatened by acute problems of tenure insecurity and encroaching land development. In-depth interviews with peri-urban farmers were conducted over a five-year period to elucidate the key factors relating to the tenure situation. The study revealed that peri-urban livelihood activities, especially the production of food, tended to develop in areas that had precarious tenure status, and it was common for many cultivators to farm land in areas over which they had no formal rights. Above all, Lynch *et al.* (2001) argue strongly that the wide range of land-use activities that take place in the peri-urban interface should be appreciated holistically, particularly in terms of how they fit in with urban structure, urban problems and the lifestyles and livelihoods of individual actors and communities.

Economic factors

In recent years, as economic conditions in Nigeria have greatly deteriorated, life has become increasingly challenging for those living in Kano's CSZ. The consequences of difficult economic times have had dramatic implications for rural livelihoods and farmers' capabilities of caring for the soil. For example, earlier in the chapter it was noted that economic pressures have currently made it much more difficult to gain access to *taki*. In the past, many actors have relied on strong networks to gain access to scarce resources and to cope in difficult times. However, in Kano and its hinterland, survival has become much more difficult as the 'rebound effects' of external forces such as SAPs have eroded the coping mechanisms that so many have depended on in previous years. Devaluation and the elimination of agricultural subsidies have had a major impact on the cost ratios of inputs and outputs, dramatically affecting nutrient management practices. Mustapha and Meagher (2000) report that by 1985 farmers in Kano state faced production and reproduction costs that were rising faster than the price of their produce. As we have noted, many households were forced into non-farm occupations to meet rising costs, and the use of fertilizers decreased significantly. A study by Ariyo *et al.* (2001) indicates that a significant decline in fertilizer use took place between 1992–99, putting increased demand on *taki* as a nutrient replacement substitute. Breman *et al.* (2001) suggest that farmers have few incentives to improve output, and therefore a more enabling environment must be created for farmers to invest in their soils.

Conclusion

This chapter, in exploring soil conditions as an indicator of land degradation in the Kano Close-Settled Zone, has also highlighted some of the methodological complexities of assessing soil 'sustainability'. 'Scientific' interpretations of the soil should not be viewed in isolation from local soil knowledge and management practices: an understanding of how local actors perceive their life-worlds and the forces that shape them is integral to any meaningful study of environmental change.

While many previous investigations of dryland soil conditions have exaggerated degradation by using inappropriate baselines or inaccurately extrapolating micro-level results to wider situations, in the case of Kano and its CSZ, numerous studies have suggested that soil conditions in the region are very 'sustainable'. In this chapter, the 'scientific' soil data explored demonstrate that 'natural' soil conditions at the study sites are not intrinsically fertile, but the nutrient balance study suggests that broadly speaking, land managers are not 'mining' the soil. It would appear that although fertility replacement may be becoming increasingly challenging, the majority of farmers are still able to maintain the soil nutrient economy at sustainable levels. However, according to the voices of local actors themselves, the founding conditions on which much of the 'sustainability thesis' is based are currently under great stress. We must therefore ask the question, why is it that farmers consistently maintain that the fertility of their soils is rapidly diminishing, if this is not the case?

On one level, local people quite rightly warn that increased pressures in Kano's urban hinterlands have intensified contests amongst various actors, have made access to resources much more difficult, and have made traditional smallholder mechanisms of adaptation and resilience increasingly challenging. However, on another level, focus group discussions also revealed that perceptions of the soil were greatly influenced by broader socio-economic concerns and perceptions of declining levels of well being. There is no doubt that the size of Kano has grown considerably in recent decades, but it is also likely the case that as those living in the urban hinterlands have become increasingly exposed to city lifestyles, both their material expectations and aspirations of prosperity have risen. Bryceson (1997) points out that many of the economic liberalization and 'democratization' policies that have been adopted by African governments in recent years have been implemented with great promises of improved standards of living for the general populace. She (1997: 242) argues:

> Many African youth, in particular, have thrown themselves wholeheartedly into the spirit of western consumerism. The acquisition of fashionable clothes and consumer durables has become a major preoccupation, which people enjoy all the more given their still vivid memories of the pre-SAP years of consumer goods scarcity experienced in so many countries. Western consumerism is antithetical to many of the traditional values that are lodged in African rural areas. Thus urban residence is a part of this lifestyle quest.

Following this line of thinking, it is quite plausible that those who continue to farm in the urban periphery feel that they are not achieving the standard of living that they should be, when they compare themselves to those living more affluent lifestyles

in the city. Many farmers may blame their 'stagnation' on an unsatisfactory home environment, and in turn perceive their resource base to be much more impoverished than it actually is.

Understanding soil fertility change, and soil degradation more broadly, thus remains a complex process and there are certainly many factors that have bearing on a land manager's ability to care for the soil. Although farmers often adopt creative and ingenious mechanisms for coping in increasingly difficult situations, it remains essential to appreciate that both local perceptions and behaviour are to some extent determined by broader contexts. This chapter illustrates very clearly that a number of important forces that shape the landscape and influence management decisions are a function of proximity to the city. In the next chapter, the discussion is framed around a different degradation theme, where tree management and perceptions of vegetation cover are explored. As will become apparent, there is much interlinkage between local perceptions of the soil and its relationship to tree cover, and many of the forces that shape soil fertility practices also play a role in determining how different actors manage trees.

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Chapter 6

Urban Pressure and Woodland Degradation: Perceptions of Tree Cover Change in the Kano Close-Settled Zone

Introduction

Inextricably linked to the concept of land degradation, and the central focus of this chapter, is the notion of vegetation change. As was reviewed in Chapter 4, the protection of many useful plant species and the incorporation of economic trees into food production systems has for centuries been an important part of livelihood strategies in the Kano CSZ (Mortimore and Adams, 1999). However, current discussions with a wide range of actors across the research transect reveal that there is presently considerable concern for a perceived decrease in many tree species. If local perceptions of environmental change are, in fact, representative of what is actually being played out on the landscape, such a reduction in vegetation cover could have a significant impact on livelihoods in the CSZ, since a broad range of plants, grasses and tree products are reported as being vital resources to the household economy. Moreover, the vast majority of households interviewed in this study also demonstrated an awareness that changes in vegetation cover had critical implications for the sustainability of other environmental resources, such as soil and water. Since there appears to be much interlinkage between the various types and manifestations of land degradation, local assessments of vegetative change may provide a useful indicator for assessments of other biotic resources as well. As Stocking and Murnaghan (2001: 7) point out, 'a reduction in vegetation cover through deforestation will almost always be accompanied by soil erosion, sedimentation of lower slopes and increased surface runoff'.

Although to a certain degree, vegetation change has always been apparent in the West African drylands, in recent decades, growing numbers of researchers have noted that human activity is increasingly playing a major role in causing it (LeHouérou, 1997). The discussion in this chapter contributes to the debate by exploring how local actors in the Kano CSZ currently perceive the relationship between people and woodland resources. More specifically, an attempt is made to elucidate the relationship between these perceptions and the issue of land degradation, taking into account some of the most recent pressures that are associated with urban expansion. For the purpose of this chapter, the analysis focuses on the 'degradation' of vegetation resources, rather than the more encompassing process of 'deforestation'. While 'deforestation' is broadly a term that is used to convey the total clearance of forest land for agriculture or other purposes, the concept of 'woodland degradation'

is used to convey lesser anthropogenic changes in tree cover that do not imply a total clearance (Grainger, 1999). The discussion is constructed around evidence obtained from the following three main sources:

1. Ninety household questionnaires administered at the six sites across the research transect.
2. Thirty focus group sessions undertaken with key informants selected for their particular knowledge of vegetation change. Five different 'actor groups' were identified at each of the six sites to take part in these discussions. The five actor groups were: young farmers, those who had received Western education, elders, Fulani herders and women.[1]
3. One hundred questionnaire surveys designed to explore peri-urban energy consumption patterns, administered at Hotoro Arewa and Zangon Gabas, the two most peri-urban sites.[2]

As has already been noted in previous chapters, local perceptions of land and society remain important considerations in any study of land degradation. Local actors base their land management decisions on how they perceive the environment to be, not necessarily on how it is in real terms. While this chapter does not attempt to quantify changes in tree cover *per se*, or even to claim that overall tree cover is declining in real terms, it does offer important insight into local perceptions of vegetation change. More specifically, the discussion reveals that perceptions vary considerably between actor groups, both temporally and spatially over the transect. This not only appears to affect the way that different social actors understand their environments, but it may also play a role in conditioning their differential behaviour within their surroundings. Thus, as new pressures on environment and society continue to 'ratchet up' stress in the Kano CSZ, livelihood patterns continue to adapt, and natural resources begin to take on new meanings for different individuals. As Warren (2002) points out, new social arrangements, such as community-based management systems, also become more challenging, since they may be associated with radically different appraisals of the resource base and of its degradation. Ultimately, it would therefore seem that an appreciation of the dynamic and variable perceptions that local people hold of the vegetation base must be a central consideration in formulating future environmental policies in and around Kano. Such an understanding must include the livelihood needs of all social actors if these policies are to have a realistic chance of success.

In this study, it is worth noting that at some of the research sites, the issue of woodland degradation was not perceived to be a crucial problem. However, at other localities, degradation was recognized as being a more serious threat to the

1 Local modesty considerations preclude a male researcher from interviewing women directly; they could therefore not participate in any mixed groups. A women-only group was thus established and interviewed by a female research assistant.

2 The questionnaire survey initially administered in ninety households across the research transect, identified a number of issues concerning peri-urban fuelwood use which required further investigation. Accordingly, to shed light on some of these issues, an additional survey was designed and administered to one hundred households in Hotoro Arewa and Zangon Gabas, the two most peri-urban sites.

environment and the sustainability of livelihoods. Similar observations concerning how perceptions of the localized contours of vegetation cover change spatially and temporally were revealed by Boerma (1999) in her long-term historical study into deforestation in the central highlands of Eritrea. Perhaps much like the pattern of vegetation change in Kano's CSZ, she concluded that change in tree cover is not a uniform or unilinear process, but rather, 'a kaleidoscope of different processes both in time and space, with both loss and gain in tree cover being experienced at different points in…recent history' (1999: i). As such, it may well be the reality that in the Kano CSZ, there are 'pockets' of pressure where stress on the vegetation resource base is particularly great at any one point in time. If this is the case, it would be clearly unwise to extrapolate any localized incidents of change to include the entire CSZ. Such a deduction would almost certainly paint an unrepresentative picture of the present situation concerning vegetation cover, and could undoubtedly contribute to reinforcing many of the strongly held 'deforestation myths' that have been so apparent in the past.

Related to this observation and reflecting the importance of specific species of trees and grasses to livelihood portfolios in the Kano CSZ, local actors identified certain vegetation resources that were increasingly perceived to be under threat, but suggested that other species had not suffered a decline in prevalence. At this micro-level, it appeared that there were some very situation-specific trends in the observations that emerged and understandably, local actors demonstrated a detailed knowledge of the vegetation species that had a direct bearing on their livelihoods. However, the interpretation of these observations from individual situations to the wider landscape should again be undertaken with an air of caution. Once again, as was discussed in Chapter 2, the issue of scale – both temporal and spatial – comes into play, particularly in research that explores the sustainability of resource management strategies in an unstable and fluctuating environment, such as that of the Kano CSZ. As Sullivan (1999) correctly notes:

> Clearly, information derived at the small-scale and in the short-term needs to be situated within an understanding of the range of dynamics that a system may display under different spatial and temporal conditions before degradation labels, and the attribution of blame associated with these, can be made with any degree of certainty (1999: 272).

As such, in the process of exploring local-level perceptions of vegetation cover in the Kano CSZ, the subsequent discussion in this chapter highlights some of the potential dangers in extrapolating degradation assumptions from small 'sacrificial areas' (Perkins and Thomas, 1993) to landscapes over much greater spatial scales (Warren and Agnew, 1988; Dahlberg, 1994). The chapter begins with a brief exploration of the variable and sometimes contested perceptions of vegetation held in the Kano CSZ, by drawing on 'local knowledge' and understandings of indigenous plants, trees and shrubs. In the process of this discussion, the complex and interacting factors that influence an individual's decisions to manage the vegetation base are revealed. Many of the observations in this chapter pair closely with the conceptual arguments presented in Chapter 2, where it was suggested that because people perceive the resource base in entirely different ways, the notion of land degradation is largely a

social construct. The chapter then goes on to explore more specifically the question of whether or not local actors actually perceive woodland degradation to be occurring in the Kano CSZ. In some cases, it is shown that a reduction in the prevalence of certain species does not necessarily equate with a perception of degradation. In the second half of the chapter, some of the main forces that local actors believe are currently driving vegetation change are investigated in detail. Particular attention is focused on a number of drivers which may be strongly influenced by proximity to the city and the implications that these changes have on livelihoods and sustainability are then considered.

Exploring local knowledge

In carrying out the research upon which this chapter is based, it immediately became apparent that local people hold an intricate knowledge of the plants, grasses and trees in their environment. Indeed, these resources are vital to livelihoods and those who live and work in the CSZ are well aware of any vegetation changes that may be occurring. Other studies in West Africa confirm this observation, have demonstrated that local knowledge can be a rich source of information, and have shown that local people often possess a detailed and reliable understanding of vegetation changes (Wezel and Haigis, 2000; Amanor, 1994; Kinlund, 1996). This is perhaps not at all surprising, since for hundreds of years most farmers have recognized the value of many tree species for food, fibre, fodder, medicine, fuel and building materials.[3] For example, many edible fruits and leaves become especially important during the dry season, when individuals rely on these resources to supplement an otherwise poor diet, to feed to livestock or to sell to generate much needed income. As was described in Chapter 4, the local value attached to such trees and shrubs has given rise to the typical Kano CSZ landscape which is often referred to as 'farmed parkland' (Pullan, 1974), and is characterized by a sustainable agro-forestry strategy in which a wide range of tree species are protected and integrated into food production systems. As has also been well noted in other research, any degradation of the woody vegetation cover in dryland environments, such as the Kano region, can have direct and profound impacts on the lives of local people (Lykke, *et al*., 1999).

In this study, local informants spoke eloquently and at length about the many uses of tree products and it quickly became evident that various tree species are valued very differently, depending on their specific usefulness to diverse livelihood portfolios. For example, as one old farmer from Zangon Gabas explained, there are certain farm trees that are more beneficial and better integrated into cropping systems than others:

> Some trees are better to have on your plot than others. The *Kuka* is excellent because it doesn't have too many leaves. But the *Tsamiya* has very broad leaves and it will make too

3 As was noted in Chapter 4, in an inventory of the major useful trees and plants conducted by Yusuf (1996) in Gamji Tara, local informants reported that there were over 43 useful tree species, more than 20 important domestic shrubs, and over 100 different species of useful annual grasses.

> much shade on the plot, so it is not as good for the crops. The *Gawo* tree produces fruits that animals love. So under the *Gawo*, you will see lots of animals, and they will drop their *taki* and make the soil rich. When you see the *Marke* tree, you know the land is not rich. The land around this tree becomes very hot and dry, even in the rainy season (Ibrahim, pers. com., 15 March, 2002).

Such an intricate knowledge of trees is, of course, not unique to land managers of the Kano CSZ. In recent years, there has been much interest in the value of IK in livelihood strategies and production systems elsewhere in Africa and indeed more widely in the developing world (see Richards, 1985; Chambers *et al*., 1989; Scoones and Thompson, 1994). For example, in his study of farmers' responses to land degradation in Ghana, Amanor (1994) has demonstrated that land managers often value and protect certain trees over others, as some species are believed to contribute more to site productivity. As the above quotation from the farmer at Zangon Gabas illustrates, this would also appear to be the case in the Kano region. However, in addition to having a preference for specific tree species, discussions with local cultivators around Kano also revealed that certain weeds and grasses were considered to be 'good' by land managers and were encouraged to grow, while other species were recognized as harmful and were suppressed. According to one respondent from Maisar Tudu:

> If you want a rich plot, there is a kind of grass called *Rai-rai*, which means long life. At all times of the year, that grass will remain green, and its presence is a good sign. There are many types of grasses that are good, like *Kiri-kiri*, *Yadiya*, *Dodandawa*, *Tofa*, *Tsidau*, and *Yawo*. If you see these grasses growing, the soil must be strong and fertile (Y. Abdulwahab, pers. com., 20 February, 2002).

Alternatively, however, other respondents pointed out that there were also certain species of grasses that were considered to be harmful and in fact served as a visual indicator of land degradation. In the words of a young farmer from Kadewa:

> Some grasses are bad, like *Komaiya*,[4] *Daburun Saniya*, or *Gasaya*. If you see them, it signifies that the place is not good and it is degraded. Also, where there is too much *Gogamasu* it indicates that the land is bad and crops will not grow well. *Gogamasu* is a kind of grass that has an irritating effect on your skin. If you see *Burruku* and *Duman Rafi* growing, it means that the land is too sandy and not good for crops. Wherever you see those grasses, the land is infertile because those grasses like a cold, waterlogged environment. Under that grass, there is water only a few metres down (Nasiru, pers. com., 05 March 2002).

Thus it became evident in discussions concerning the relationship between vegetation and land degradation, that it was not merely a loss of vegetation cover that was alarming to local land managers. Rather, many respondents associated a degraded landscape with specific changes in vegetation species (particularly shrubs

4 Many farmers believed that *Komaiya* (*Eragrostis tremula*) was a particularly 'wicked' grass, as is suggested by the well known Hausa proverb, '*Komaiya koma wata*', which roughly translates to: 'if there is Komaiya growing on your land, it is time to change to a new plot.'

and grasses),[5] as well as a perceived decline in the prevalence of many valuable indigenous tree species such as *Dorawa* (*Parkia biglobosa*), *Rimi* (*Ceiba pentandra*) and *Kuka* (*Adansonia digitata*).

Those respondents in the study who believed that tree cover was either stable or increasing in Kano's hinterlands, largely believed this to be so because of the plentiful number of exotic species, particularly *neem* trees (*Azadirachta indica*), that had been planted in recent years. The highly valued *neem* tree, a species originally indigenous to India, was first introduced to the Kano region during the colonial era and since then has been widely planted throughout the CSZ. Indeed, as was noted in Chapter 1 in our review of past and present attitudes to Kano's environment, when forester E.P. Stebbing visited the region in 1934, he believed the progressive degradation of the Savanna forest to be a major threat. His solution to the problem was to plant vast numbers of trees. When international awareness of 'desertification' burgeoned following the 1972–74 Sahelian drought, governments in the northern Nigerian states again became obsessed with shelterbelts and tree-planting schemes. Ever since colonial times, when tree-planting projects were first initiated, many of the young trees supplied by the government to afforestation programmes have been *neem* seedlings, due to their ability to grow quickly and withstand the harsh environment.

Although most respondents demonstrated a common belief that trees were generally valuable for farm conservation, many individuals complained that they could not gain access to government seedlings due to their erratic availability, the difficulty of transporting them to their farms or their high cost. Consequently, for a great many farmers in the Kano CSZ, new trees are usually added to farm plots simply by encouraging coppicing from lopped tree stumps, or by protecting seedlings which germinate naturally in a process referred to locally as *sassabe*. In Gamji Tara, it was reported that some trees, such as *Dorawa* (*Parkia biglobosa*), *Mangwaro* (*Mangifera indica*), *Dabino* (*Phoenix dactylifera*) or *Rimi* (*Ceiba pentandra*), needed to be protected with fences in the dry season in order to protect them from free-grazing livestock (Yusuf, 1996). Farmers also noted that many of the indigenous species of tree seedlings which they had protected around their plots and were encouraging to regenerate, grew very slowly and it would take a long time before they would reach maturity.

Since many individuals recognized that there was a positive relationship between trees and the soil, and that the indigenous tree species that they were encouraging to grow would take years to mature, some respondents described alternative land and soil conservation techniques that they had also adopted. Some of the practices mentioned

5 In a related observation, Stocking (1996: 145) points out that although the majority of research supports the belief that vegetative cover is one of the most important factors in controlling soil erosion in tropical environments, it is not necessarily the case that vegetation always has a positive influence on the landscape in which it grows. He notes that in a series of laboratory experiments carried out by de Ploey (1981), two troughs of soil – one that was planted with bunch grass and one that was left bare – were exposed to conditions of simulated rainfall. After observing increased sediment loads under the trough planted with grass in comparison to the one that was bare, de Ploey concluded that vegetation was an 'ambivalent factor' in soil conservation strategies.

included: building low-lying mud walls to slow down soil erosion, referred to as *ganuwa* in Hausa, or planting various indigenous species of grasses, such as *Jemma* (*Urelytrum giganteum*), *Gamba* (*Andropogon gayanus*), *Tsintsiya* (*Eragrostis sp*.) or *Kiri-kiri* (*Cynodon dactylon*), around the boundaries of farm plots. Once again, informants demonstrated a detailed knowledge of many different species of grasses that they believed were useful and could be beneficially integrated into farming systems. It was also apparent that different grasses were used in different situations depending on the severity of conditions, as is evident in the following statement by one young farmer from Gamji Tara:

> *Jemma* is one of the strongest of the grasses. It has the strongest roots and has the greatest perseverance for withstanding fast currents of water. *Gamba* seems to be one of the weaker grasses, and *Tsintsiya* is somewhere in the middle in terms of strength. *Jemma* can be submerged in water for an entire month and it won't die. *Kiri-kiri*, or carpet grass, is an interwoven grass that is the strongest of all grasses. It is a flat grass that doesn't grow shoots (Alkasim, pers. com., 27 February, 2002).

Understanding local perceptions of the relationship between trees and soil

Focus group discussions at all six sites along the research transect confirmed that many informants recognized that changes in the vegetation base had direct implications for the sustainability of other environmental resources. For example, a significant number of individuals realized that the leaf litter from most farm trees played a significant role in improving soil fertility, although they could not explain why this was so. Alternatively, other informants made a positive connection between tree cover and soil conservation. When one woman from Zangon Gabas was asked if the number of trees on her land had an effect on the quality of the soil, she responded:

> Yes, it has great effect, and we can see that the time when the quality of the land began decreasing coincides with the time when the trees really began disappearing. When there were no longer strong roots to hold the soil together, the wind began to blow the soil and there was much more sand. Also, there were no leaves to block the rain when it fell, or break the speed of the wind, so this was very hard on the land (Shemawa, pers. Com., 15 May, 2002).

When further attention was focused on exploring local knowledge of the relationship between trees and the soil, it became evident that there was a complex matrix of factors that influenced management decisions. At each site, many people indicated that vegetation could play a key role in controlling erosion, maintaining soil structure, enhancing fertility, or moderating microclimates. As is apparent in Table 6.1, when specifically asked if changes in tree cover affected soil conditions, there was a high level of agreement among households that a correlation existed between the two.

Further focus group discussions at each site elucidated many of the responses given in the household surveys. Farmers frequently spoke of how the colour of soil under trees changed to a 'richer shade of black', and if crops were planted in a location where a tree had been cut down, the land would be more fertile and yields would be higher for three agricultural seasons. For unknown reasons, there was a

Table 6.1 Do changes in tree cover affect soil conditions?

Site	Yes		No	
	Number	%	Number	%
Hotoro Arewa	12	80	3	20
Zangon Gabas	10	66.7	5	33.3
Kadewa	13	86.7	2	13.3
Maisar Tudu	11	73.3	4	26.6
Gamji Tara	14	93.3	1	6.7
Magama	11	73.3	4	26.7
Total sample (N=90)	71	78.9	19	21.1

(N=15 at each site)

Source: Author's fieldwork

strikingly high level of consensus that crop yields and soil fertility levels would return to normal levels after three years. The household questionnaire surveys also revealed that at all six sites, there were a number of other common perceptions concerning the relationship between trees and the soil. When asked to describe the effects that a reduction in the number of trees had on the soil, there were four overwhelmingly common responses, which are summarized in Table 6.2.

Table 6.2 Effects of tree cover change on soil conditions

Stated effect of fewer trees on soil conditions	**Mentioned by**	
	Number	**Total % of sample (N=90)**
Makes soil more sandy	19	21.1
Reduces amount of shade which dries out soil	17	18.9
Reduces amount of leaf litter which makes soil less fertile	16	17.8
Exposes soil to wind and rain which increases erosion	16	17.8
Other effects mentioned	3	3.3

Source: Author's fieldwork

In summary, local actors appeared to demonstrate a strong awareness that levels of vegetation were connected to site fertility, soil conservation and the safe-guarding of other environmental resources. However, while farmers reported that they did make conscious management decisions concerning trees and grasses based on this local knowledge, it was also quite evident that other structural factors often influenced their decision-making abilities and shaped local practices. Thus as we have already noted with the assessment of other environmental resources, the dynamics of vegetation change must also be situated in a broader livelihood context, where the factors that mediate people-environment relationships are determined at varying scales, from the

micro-level to the macro-level. Later in this chapter, further attention will be focused on how specific livelihood factors drive local decisions in tree management practices, especially those factors that are shaped by the process of urbanization. But first, in the next section, the discussion will turn briefly to consider how perceptions of tree cover change are allied more broadly to the complex concept of land degradation.

Perceptions of vegetation change: is woodland degradation occurring?

For over a century, deeply held apocalyptic visions of deforestation in the West African drylands have captured the imaginations of a wide array of observers, ranging from colonial administrators and government officials to development workers and environmentalists (Ribot, 1999). All too often, as an increasing number of studies have pointed out, previous research concerning the relationship between people and trees has erroneously been premised on neo-Malthusian assumptions (Fairhead and Leach, 1996). The prevailing orthodoxy has suggested that widespread deforestation has been driven by 'exploding' populations and their increasing poverty, which is causing irreversible environmental degradation (Myers, 1991). However, there is now a vast literature which recognizes that many of these fears have been unfounded, and have unjustly supported highly inappropriate and draconian environmental policies that have often been damaging to local people (Cline-Cole, 2000; Fairhead and Leach, 1998; Tchamie, 1994).

One of the principal shortcomings of many previous studies of environmental change that have endeavoured to explore tree cover loss, is undoubtedly that they have been frequently constructed around inaccurate baseline information and exaggerated forestry statistics (Fairhead and Leach, 1998). Since longitudinal environmental data are often difficult to obtain, many assessments of forest degradation are, in fact, based on observations of present situations, or comparisons between short time-series of data (Fairhead, 1998). However, even studies which attempt to assess the extent of tree cover change based on data which span one or two decades can be problematic, since observed changes may be the result of several processes operating at various time scales (Rasmussen, 1999).

As has already been made clear, this chapter does not propose to make long-term comparisons of tree cover change, but rather concentrates on the perceptual aspects of environmental change in the short-term. By focusing on the normative nature of woodland degradation, a number of key questions can be explored which may help to shed light on why tree managers often behave in such different ways. For example, we might ask, how do perceptions of tree change vary with distance from Kano? What are the main factors that condition these perceptions? And although it is apparent that many people believe that there are presently less trees than in the past, why is it that they do not always equate this with a perception of degradation? Questions such as these remain imperative if we are to truly understand how local people understand their environments and prioritize their tree management decisions.

When questioned about changes in tree cover, a high percentage of respondents in this study perceived that there were now fewer trees than in the past, even though they acknowledged that there were presently conservation laws in place to regulate

the felling of trees on farmland. According to the questionnaire survey, over 82 per cent of the households sampled reported that they now had fewer trees on their land than they did 20 years ago. Moreover, as is apparent in Table 6.3, although the perception that tree cover is currently diminishing was high at all six sites, households sampled at the three communities in closest proximity to Kano – Hotoro Arewa, Zangon Gabas, and Kadewa – demonstrated a very strong belief that tree numbers were presently on the decline.

Table 6.3 Are there less trees on your land today than 20 years ago?

Site	Yes		No	
	Number (N=15)	%	Number (N=15)	%
Hotoro Arewa	13	86.7	2	13.3
Zangon Gabas	13	86.7	2	13.3
Kadewa	13	86.7	2	13.3
Gamji Tara	12	80	3	20
Maisar Tudu	11	73.3	4	26.7
Magama	12	80	3	20
Total sample (N=90)	74	82.2	16	17.8

Source: Author's fieldwork

In the past, respondents explained that customary laws regulating the use of trees and other common resources were regarded as an essential mechanism for securing equitable access to resources. In addition, however, such laws undoubtedly played an important function in ensuring the most efficient use of the natural resource base between different actors, particularly in an environment with such a low and unpredictable amount of rainfall. Although it should not be assumed that the absence of customary laws necessarily causes land managers to behave irrationally or opportunistically, Boerma (1999) suggests that in the past, such regulations may have helped to clarify people's rights, to improve their ability to manage their resources effectively and to help avoid disputes about entitlement to various resources. However, in this study, discussions revealed that for all intents and purposes, most of the customary laws concerning the felling of trees had all but disappeared in a significant number of the communities in Kano's hinterlands. In their place, it was reported that many local governments have introduced new policies to regulate the exploitation of trees. For example, various respondents spoke of a recently enacted law, whereby those who wished to 'lop' a tree or cut it down completely, were subject to pay a fine of 100 naira or 200 naira respectively (circa £0.52 and £1.04 in April 2002). A number of respondents added, however, that these laws and their attendant penalties did not seem to prevent people from cutting down trees because they were not effectively monitored or enforced.

Although an overwhelming majority of respondents in the study articulated that there had been a notable reduction in vegetation cover in recent years, the reasons

given for this perception varied greatly and fell into four main categories. First, individuals believed that the most significant pressure causing stress on the vegetation base related to an increased domestic demand for fuelwood, especially at the sites in closest proximity to the city. Second, it was suggested that difficult economic times and an increased demand for cash income had forced many people to rely on their natural capital stocks, such as trees, to make ends meet. Third, it was believed that increased pressure on the land and the accompanying changes in land-use patterns that had developed, had led to many more trees being cut down. And fourth, many land managers, especially elderly farmers, associated a perception of increasingly harsh climatic conditions with the natural death of trees, particularly many of the more cherished indigenous species. Broadly speaking, the majority of descriptions of vegetation change given in this study fit into one of these four main categories. In the next sections of the chapter, each of these perceived reasons for change will be addressed individually and greater attention will be focused on the livelihood factors that drive local management decisions.

Fuelwood demand

In many parts of the West African drylands, urban demand for fuelwood has long been assumed to be a major contributing force to the permanent deforestation of wooded Savannas. Main (1995) notes that wood accounts for as much as three-quarters of total energy consumption in sub-Saharan Africa, while estimates of fuelwood dependency in the Sahelian countries suggest that consumption rates are even higher.[6] At the heart of the dependency–deforestation narrative is the assumption that rising urban demand for wood drives traders to deplete rural tree stocks on the edge of the city, and then the cycle becomes circular and reinforcing as poor urban and peri-urban dwellers become vulnerable to rising woodfuel prices that they can no longer afford. As fuelwood becomes more scarce and urban prices continue to escalate, it becomes more feasible for wood traders to travel even further afield to harvest fuelwood supplies, driving prices still higher and extending the ring of deforestation to greater distances.

During the 1970s and early 1980s, this narrative appears to have been a major theme in many studies concerning fuelwood supply and demand in West Africa and came to be popularly referred to as the 'Woodfuel Gap' theory. The main premise of this theory was formulated on the notion that increasing deforestation rates were best interpreted as a problem of a growing gap between population-driven demand and diminishing resources, usually radiating out from centres of habitation in increasingly wider and wider circles. By the mid-1980s, however, the idea of a fuelwood gap and the assumptions upon which it was based, had largely been discredited. Revised

6 An increased concern for energy issues in Africa immediately took hold following the dramatic global rise in fossil fuel prices during the early 1970s. As attention became focused on the fact that wood was the primary source of energy used by households in Africa, many spoke of the fuelwood crisis as being the 'real' energy crisis (Eckholm, 1975). By the end of the 1970s, one study carried out by Club du Sahel (1978) estimated that on average, in Sahelian countries firewood represented 82.12 per cent of household energy consumption.

assessments of the fuelwood supply situation in Africa revealed that there was less of a problem than had initially been predicted and consequently many of the fuelwood-focused programmes initiated during the 1970s were scaled back (Arnold, *et al*., 2006). However, throughout the 1990s, many studies continued to be influenced by 'gap' reasoning. For example, Kabré's (1998) fuelwood study in Burkina Faso at the end of the 1990s illustrated the idea of a supply-demand gap by estimating the ever-increasing distances travelled by fuelwood lorries supplying Ouagadougou markets. According to his calculations, he noted that, 'during the 1950's, the distance to travel was 25 km compared to 85 km in 1985; with 1.7 km rate of increase a year this distance is 105 km in 1997 and will reach 111 km in 2000' (1998: 44). Ultimately, his study concluded that the overexploitation of timber stands would undoubtedly continue to rise in the short term and would become increasingly catastrophic as Ouagadougou's ecological footprint expanded, unless new sources of domestic fuels could be found.

Alternatively, Benjaminsen's (1998) two detailed case studies from Mali, carried out in the Gourma region and the Diéli sub-region in the southern cotton zone, were much more critical of narratives framed around Woodfuel Gap theory. His studies argued that such fuelwood orthodoxies unfairly blamed local people for causing natural resource degradation. However, although Benjaminsen's research concluded that locally induced deforestation caused by fuelwood consumption did not appear to be an immediate environmental threat in his two case study areas, the investigation did suggest that the commercial exploitation of wood destined for urban markets was currently putting stress on fuelwood supplies. Specifically, his studies pointed out that there was an unusually high external pressure on the woody vegetation in the Diéli region due to the proximity of a major road linking two urban centres, and about half the quantity of wood being exploited from the area was being removed by fuelwood traders coming from outside to supply urban areas with wood (Benjaminsen, 1998: 36).

As was noted in Chapter 1, the situation in the Kano CSZ appears to be radically different. Mortimore's (1975) detailed research relating to fuelwood interaction between Kano and its hinterlands has suggested that regions in the urban periphery have benefited from the close social and economic links that they have long shared with the nearby city. Further studies into fuelwood consumption and tree management in the 'inner' and 'outer' CSZ by Cline-Cole *et al*. (1990a; 1990b), have provided a powerful counter-narrative to deforestation orthodoxies and suggest that the maturity and density of trees actually increase in areas that are in closer proximity to urban centres where there are greater population densities. Until the 1960s, it has been argued, most of Kano's demand for fuelwood was satisfied by trees harvested within 26 km of the city limits, within the so-called 'inner' CSZ, an area that is now generally considered to be peri-urban in nature (Mortimore, 1998; Cline-Cole, 2000). However, by the early 1990s, Cline-Cole *et al.* (1990a) have suggested that growing urban populations were responsible for driving fuelwood traders to distances of more than 300 km away in search of wood, and it became more cost effective for traders to purchase truck loads of wood from outside the CSZ.

While previous studies into Kano's fuelwood trade, such as those carried out by Cline-Cole *et al*. and Mortimore, have provided important counter-narratives to fuelwood orthodoxies, the question remains as to why the majority of informants interviewed in this study appeared to have a radically different perception of their environment. As was noted in Chapter 1, it is of course worth noting that the studies carried out by Cline-Cole *et al*. (1990a; 1990b) were based on field research undertaken in the late 1980s. Moreover, Mortimore's pioneering research on the fuelwood trade was conducted as long ago as the late 1960s and early 1970s. Could it be the case that in more recent decades, the introduction of powerful new external pressures has eroded the resilience of sustainable tree management systems? Indeed, since the earliest tree studies were first carried out in the CSZ, the ecological footprint of metropolitan Kano has grown significantly in size and the far-reaching changes set in motion by the forces of globalization have penetrated even the remotest of villages. The extension of the market system to even the most far-removed regions of the CSZ has increased both the demand and opportunity for cash incomes and the desire of many individuals to seek out off-farm income generating strategies. We must therefore ask ourselves, have the abilities of local land managers to make sustainable tree management decisions been able to keep pace with the radical changes that have taken place during this period?

Although increased urban pressure has almost certainly put greater stress on tree stocks in Kano's urban hinterlands, Main (1995) notes that undoubtedly some reports of deforestation have been grossly over-exaggerated in the past. For example, one well-known study by Eckholm *et al*. (1984: 28) carried out within a 40 km radius of Kano, describes the presence of 'severe deforestation and the collapse of a sustainable agricultural system.' In the research carried out for this study, there were no observations made to uncover any evidence of 'severe' deforestation caused by fuelwood exploitation. However, respondents in focus group discussions did raise a number of key concerns concerning the sustainability of the fuelwood supply in the immediate future. According to local voices, urban demand for wood has greatly influenced the way that many individuals manage their farm trees and it would now seem that there is a pressing need to reconsider some of the issues concerning trees in the Kano CSZ.

Focus group discussions and the fuelwood questionnaire survey administered at Hotoro Arewa and Zangon Gabas suggested that a rising peri-urban demand for wood was the result of a number of factors. Specifically, in addition to an increase in the domestic use of trees for house building, it was commonly believed that there was a heightened demand for wood for cooking and heating water. This belief was not just based on the perception that a growing population was consuming more resources, but also on the awareness that the rising cost and unreliable availability of kerosene had increased the demand for wood as the main source of fuel. For example, according to one individual at Hotoro Arewa:

> Your fuel choice will firstly be determined by economic factors. If you use firewood, it is the cheapest way. When women try cooking for a large family on a kerosene stove, the food will not be cooked well and it will take too much time. The price of kerosene is very high today and the cost is increasing with every day. When the kerosene is not available,

> it becomes very costly and many cannot afford to buy it. With the hiking of petrol prices, it has made kerosene even more expensive and many who used to use kerosene have stopped and switched to wood (Hamza, pers. com., 23 March, 2002).

Some respondents suggested that the demand for wood was further being driven by a combination of high profit margins in the fuelwood business, coupled with the effects of the government's recent domestic energy pricing policies which left people with a lack of viable energy alternatives. In agreement with the findings of this study, Odihi's (2003) recent research into deforestation in Yobe and Borno States notes that both the high cost and erratic availability of alternative energy sources has played a major role in strengthening fuelwood dependencies. Prior to the introduction of SAPs in Nigeria in 1986, he points out that alternative forms of domestic energy, including kerosene and cooking gas (liquefied natural gas), were both affordable and available. At that time, Odihi suggests, a 12 kg cylinder of cooking gas that cost less than 3 naira would last an average family for one month and was cheaper than kerosene and even fuelwood. By 1988, however, the situation was very different:

> The affordability index of fuelwood between 1988 and 1996 was between 7 and 9 for low-income households and 9 for both middle and high income ones. Kerosene availability declined from the favourable condition of index 6 in 1988 to 0 in 1994 and climbed back to 4 in 1996 for low-income households. The affordability index of gas was 0 in 1994 (i.e. it was not affordable) for over 70 per cent of middle income households that were formerly using it (Odihi, 2003: 244).

In this study, liquefied natural gas was not mentioned by any of the households surveyed as a current source of domestic fuel.[7] Table 6.4 summarizes the main types of household fuel being used in peri-urban areas, according to 100 households randomly surveyed in Hotoro Arewa and Zangon Gabas.

Table 6.4 Primary fuel sources in Hotoro Arewa and Zangon Gabas

Main type of household fuel used	% of households (N=100)
Wood	38
Kerosene	31
Wood and Kerosene	26
Millet/sorghum stalks and wood	2
Millet/sorghum stalks	1
Ayafa (refuse from plastics factories)	1
Charcoal	1

Source: Author's fieldwork

7 Odihi (2003: 242) notes that for both natural gas and kerosene, the supply and reliability of these energy sources has been greatly reduced by a variety of factors including: price fixing, tampering with metres and containers to reduce their capacity, adulteration and a strong illegal trans-border trade.

In addition to cost and availability factors, it was also suggested by many households that wood was preferred as the main source of fuel for a number of cultural reasons. For example, for families that have the financial means, it is a traditional Hausa custom for women to cook very large quantities of food every day, so that it can be shared with extended family or those in need at a moments notice. Such substantial portions of *tuwo*, the staple food, can only be cooked in large pots on wood fires. Many respondents suggested that only those who had small families, or did not want to share their food with others, chose to cook on kerosene stoves.

Moreover, it was apparent that many households avoided kerosene altogether because they either believed that the stoves were too complicated or they thought that the kerosene affected the taste of the food. As one respondent from Hotoro Arewa suggested:

> The people here avoid buying kerosene if possible. They want firewood. Any food cooked on kerosene does not taste as good as if it is cooked on firewood. The *tuwo* tastes much better when it is cooked on wood and in some villages, old men will not eat food cooked on kerosene (Usaini, pers. com., April 06, 2002).

Several respondents also made a direct connection between a perceived increase in birth rates and an increase in fuelwood consumption. Such a perception can be attributed to the common Hausa cultural practice known as *wankan jego*, where newly delivered mothers bathe twice daily for 40 days in scalding hot water. This tradition obviously requires a large volume of fuelwood to heat the water and it is frequently possible to identify new mothers from the large piles of fuelwood outside their houses (see Plate 6.1). Table 6.5 summarizes the main factors determining the choice of household fuel utilized, as revealed by the fuelwood questionnaire.

Table 6.5 Reasons for household fuel choice

Fuel type	Reason for choice of household fuel	% of households (N=100)
wood	Wood is the cheapest	25
wood	Family is large, so wood is more economical	18
wood	Food tastes better cooked on wood	4
wood	Cannot cook some foods with kerosene, so wood must be used	2
wood	Wood is more available	3
wood	Cannot afford to buy kerosene stove	1
kerosene	Family is small, so kerosene is easier and cost effective	19
kerosene	Kerosene is easier to use than wood	9
kerosene	Kerosene is cheaper than wood	8
kerosene	Do not like the smoke from wood	6
kerosene	Kerosene is more easily available than wood	4
kerosene	Kerosene is better for the environment	1

Source: Author's fieldwork

Plate 6.1 Fuelwood outside compound for wankan jego, Gamji Tara

Economic factors

Focus group discussions revealed that many informants associated difficult economic times and a rising demand for cash income with increased pressure on natural capital stocks, such as trees. According to the West African Long Term Perspective Study (WALTPS) carried out by Club du Sahel (1995), the non-farm share of rural household income in West Africa may be as high as 40 per cent of total income. Such a growing dependency on non-agrarian income-generating activites, Bryceson (1997) adds, is largely being driven by a combination of three main forces: economic pressures undermining small scale agriculture, environmental degradation and new economic and political opportunities which may have opened up markets in recent years. Smallholders in northern Nigeria do not appear to be exempt from these forces and in the Kano CSZ, the process of de-agrarianization is very apparent. In fact, in recent years, cash needs have become even greater for most people and have been driven by the rising costs of manufactured goods and food products, and a poor economic climate in Nigeria more broadly. Meagher and Mustapha (1997) suggest that in Nigeria, as is the case in other sub-Saharan countries, the onset of SAPs has been one of the most dramatic influences on the rising cost of food and agricultural inputs.

As non-agrarian income has become a 'lifeline' for poor grassroots actors in many parts of sub-Saharan Africa, off-farm activities have increasingly been pursued with greater vigour and often at the expense of the natural resource base (Bryceson,

Plate 6.2 Fuelwood sellers at Magama loading a lorry destined for Kano

1997). For example, El Bashir (1997) describes how desperately poor rural people in Darfur, Sudan, have become dependent on fuelwood and grass sales to make ends meet, but in the process have accelerated environmental degradation. Likewise, Meagher and Mustapha (1997) argue that in the northern Nigerian context, there is also a danger that off-farm activities could extract too much natural capital from the resource base and threaten the sustainability of production systems. It would appear that these concerns have great bearing on the discussion at hand concerning vegetation, since the sale of fuelwood, economic tree products and even grasses and shrubs, is becoming an increasingly common method of generating income. Rapidly growing urban markets for forest products provide new opportunities for smallholders, especially those who live in peri-urban areas. As has been noted by Cline-Cole (1995):

> Dependence on non-agricultural income increases with harvest failure, livestock mortality, population density, farming intensity, land scarcity, and proximity to large urban centres…. The collection, processing and sale of sylvan products from both agricultural and non-agricultural land make important contributions to non-agricultural income, with fuelwood being, arguably, the most important of these (1995: 174).

In focus group discussions in this study, a number of individuals admitted that economic desperation had driven them to harvest the trees on their property and sell them for fuelwood. In fact, even in Gamji Tara, a community that Harris once described in her 1995 study as being 'away from the bias of the city…[where] farmers were not in frequent contact with Kano businesses and trade' (1995: 49), residents reported that fuelwood lorries from Kano now make regular visits to the village to

buy trees from anyone who wishes to sell.[8] Likewise, at Magama, the furthest site from Kano (Plate 6.2), one resident commented:

> Here we don't have many ways of earning money, especially in the dry season, so some people cut down their trees to sell as firewood. We can sell our wood to the people from Kano city, who come here to buy it. There are lorries from Kano that drive out here and we can sell our wood for 15 or even 20 naira per bundle (circa £0.08 and £0.10 respectively in April 2002). In Magama, we use wood as our main fuel source, but even in the city people will now buy wood because kerosene is very costly and many people are no longer using stoves (Dibi, pers. com., 19 February, 2002).

Harvesting and trading fuelwood are important and well documented strategies for bridging seasonal gaps in income generation, and they are vital activities for raising the large amounts of start-up capital needed at the beginning of a new agricultural or trading year (Leach and Fairhead, 1994). Most often, however, it was reported that the greatest financial strain occurred during the so-called 'hungry season' immediately preceding the harvesting of crops or during cultural occasions that required gift-giving, such as weddings or naming ceremonies. With respect to the latter, Bryceson (1997) has noted that economic stress has in many ways broken down well-established channels of familial exchange. She suggests that although it may be the case that households still possess a sense of filial duty, economic crisis has left them with little disposable cash or time to spend on gift-giving to relations beyond their nuclear families. In this study, many respondents remarked that the cost of their economic responsibilities has risen dramatically in recent years. Overall, respondents indicated that their major financial commitments included hiring farm labour, purchasing food, buying clothes and meeting the costs associated with household items consumed on a daily basis, such as soap, kerosene and soup ingredients. Although many of the households surveyed admitted that they sometimes had to purchase their fuelwood, this was not revealed as being a major household expense in the questionnaire survey. In fact, due to the rising costs of other household expenses, domestic energy expenditures were reported as being minimal. Many respondents admitted that in recent years, they had resorted to collecting fuelwood themselves or burning the sorghum or millet stalks from their farms.

To return briefly to the discussion concerning the 'capitals school' that was outlined in Chapter 2, it was suggested that at any specific time, a household may possess up to five different types of 'capital assets' in its livelihood portfolio. To review, the five most common categories of capital are: natural, economic, human, physical, and social. According to the 'Sustainable Livelihoods' approach, households in effect 'juggle' combinations of these different types of capital, and if one category of capital is lacking at any given time, one form can be freely converted into another. As livelihood portfolios are dynamic and subject to change over time and space, it can thus be concluded that the responses and capabilities of various households are also constantly in flux, as local circumstances change. As Warren *et al*. (2001)

8 During focus group sessions in Gamji Tara, informants reported that during the dry season, fuelwood lorries from Kano came to Gamji Tara as many as three times per week to collect wood.

note, it would appear that some households may have a greater capacity to convert assets than others, depending on a variety of factors such as wealth, power, status or household demography.

In desperate times, when individuals may not be able to readily rely on the 'social capital' or family networks that were once more accessible in the past, an over-reliance on the natural capital base may be the response of some households. Indeed, many of those interviewed in this study equated their perception of a reduction in tree cover with the economic stress that had been building over the past two decades. These sentiments are well summarized by one woman interviewed at Kadewa:

> The number of trees here has been drastically reduced. Numbers started to decline about 15 years ago and as population has increased, tree numbers have continued to diminish. Today, we are in serious financial trouble and it is common for people to cut down the trees, either on the farmland or in the compound, and sell them for firewood either in Jogana or Kano. As the number of people continues to increase, more wood is in demand for both *wankan jego*, and for fuelwood to cook. We have mainly cut down trees like *Dorawa*, *Rimi*, and *Kuka*, and now there are few. Cooking gas is too expensive for most people, so we buy wood from the city, but it is also expensive, so we try to burn our millet stalks. In the past, some of us used kerosene stoves, because kerosene was very cheap then. Only the rich can afford to use kerosene or gas cookers today (Zakari, pers. com., 2002).

Thus for many respondents, current pressures on tree numbers were perceived to be related to a specific episode of economic stress, rather than merely population growth in general. The reasons given for a decline in tree cover frequently concerned conflicting land-use patterns that were being driven by increased urban pressures and greater economic stress. As such, it was revealed that not only do many people now rely much more heavily on the natural resource base to generate cash income, but as will be explored in the upcoming section, land hunger and the pressing need to increase yields on each plot may also have implications for the number of trees that farmers choose to integrate into the farming system.

Conflicting land-use patterns

It has already been noted that for many years now, there has been an intense demand for agricultural land in the Kano CSZ. More recently however, beginning with the major changes in the Nigerian political economy that were set in motion during the oil boom years, increasing urban and peri-urban population densities, land fragmentation and periods of climatic uncertainty have put much more strain on smallholder production systems. As such, Mortimore *et al*. (1999) suggest that in the West African drylands, the major force presently driving the process of deforestation is the expansion of small-scale farming. Ribot's (1999) extensive studies into local forest management in Burkina Faso appear to confirm this belief. His research suggests that most of the recent peri-urban vegetation clearing that has taken place around the city of Ouagadougou has not been to meet urban fuelwood shortages, as has most frequently been claimed (see, for example, Kabré (1998)), but has rather

been an attempt to create more agricultural land. Arnold *et al*. (2006) add that the peri-urban regions where fuelwood collection is likely to be the most prevalent, especially during the early stages of urbanization, are also likely to be the areas that are most under pressure from land clearance for agriculture. In other words, they note that these patterns of tree loss can be attributed just as much to local needs for more farm land as to needs for fuelwood. Other researchers, in fact, have shown that the fuelwood supplies destined for many urban markets frequently come from land that has been cleared for agriculture, rather than from forest areas (Townson, 1995). Land clearance for agriculture has thus been identified as a significant cause of forest depletion (Leach and Mearns, 1988) and in the Kano CSZ, one of the main contributing factors to local perceptions of tree cover decline may also be the high demand for agricultural land.

In the northern Nigerian dry belt, Odihi (2003) believes that recent government policies and a downturn in socio-economic conditions have favoured agricultural expansion for many desperate people living on urban fringes. Based on research conducted in eight local government areas in Yobe and Borno states, he argues that 'unfavourable socio-economic conditions such as mass retrenchment of workers, mass unemployment, increasing social burdens in circumstances of low wages, irregular or non-payment of salaries and soaring food prices have turned many people into farmers' (2003: 229). Although it is certainly the case that the political and economic climate of Kano state is in a similar poor predicament to that of its northern neighbour states and there is an equally strong desire for local farmers to increase output, the possibility for local actors to expand farming activities is somewhat more challenging. All available farmland is under permanent cultivation and the practice of fallowing rarely occurs, except under circumstances that are very out of the ordinary (Harris, 1996). Consequently, as the following statement of one respondent illustrates, there is in fact very little possibility for creating further agricultural land or rangeland for grazing animals:

> We use all the available places around here for grazing our animals, but the grazing land has disappeared because of the city. We have to spend a lot of money on animal feed now. We buy the feed simply because the *burtali* and *makiyaya* we have now are few. There is no forest reserve. There is land hunger now and people are desperately looking for farm plots. If you have enough food, you can do whatever you like (Baba, pers. com., March 10, 2002.)

Although it was widely believed that many trees were considered to be beneficial for soil conservation and were a key economic asset in livelihood portfolios, it was almost unanimously mentioned that too much shade was considered to be bad for crops and further reduced the amount of land that could be planted. Several informants mentioned that during the 1980s and early 1990s, there had been a short-stemmed variety of sorghum called *zauna inuwa* that grew very well in the shade, but it was no longer possible to obtain these seeds. Since local residents no longer had access to the seeds which made cultivation in the shade possible, and it was extremely difficult to obtain additional farm land to plant more crops, many individuals reported that they had cleared all the trees from their plots to increase the cultivable area and allow more sunlight to reach their crops.

During focus group discussions, it also became apparent that the incidence of land hunger was not only affecting farmers, but also pastoralists who were in dire need of rangeland to graze their animals. Indeed, several recent studies have highlighted the apparent emergence of pastoralist-farmer conflict and the subsequent breakdown of a supposed state of symbiosis which once existed between the two groups (Williams *et al*. 1997; Milligan, 2002). Several respondents in this study admitted that in recent years, trees had been the cause of land-use conflicts between Fulani pastoralists and local cultivators. Of specific concern to many individuals was the diminishing prevalence of the *Gawo* (or *Gao*) (*Faidherbia albida*) tree. The *Gawo*, a highly valued indigenous species, has been referred to as 'the dry season floral wonder of the Sahel' (Odihi, 2003) because it has the unique ability to remain green and produce fruit during the long dry season, at a time when most other trees are leafless. As such, the *Gawo* tree is an important source of fodder for pastoralists at a time when animal feed is scarce. To discourage pastoralists from bringing cattle onto their agricultural land, local farmers remarked that they frequently chopped down all *Gawo* trees, whose branches are traditionally used by the Fulani for cattle fodder.[9] The problem is illustrated by the following concerns of one young farmer:

> Some trees are good for the land, but some are bad. The *Gawo* tree causes problems for us because of the *Udawa* (Fulani who come to Nigeria from the Republic of Niger). They come and cut the branches, and often there are thorns which spread all around my plot and hurt me when I am working. Sometimes, the *Udawa* bring their animals onto my plot after the crops have already germinated and they damage the plants. So for this reason, to keep the *Udawa* off my land, I have cut down my Gawo trees. Afterwards, I used the wood as fuel for cooking (Yakubu, pers. com., 2002).

Such reports of conflict between cultivators and pastoralists in the Kano CSZ are undoubtedly increasing and in recent years greater contest for key resources has often led to violent clashes. Similar findings are reported by Odihi (2003) in his extensive study of deforestation-related activities and problems carried out in Yobe and Borno States between 1991 and 2000. In fact, Odihi (2003: 238–239) goes as far as to suggest that '[t]he increasing popularity of animal rearing by urban residents, soaring price of fodder (*harawa*), mutual hostility between herders and crop farmers which practically ended the long existing symbiotic relationship between crop and animal production in the zone seem to be at the expense of [the] gao tree.' In this study, many of those interviewed also expressed great concern for the manner in which the *Gawo* tree had intensified levels of tension between local communities and the transitory *Udawa*, as is evident in the following statement of one farmer from Maisar Tudu:

> The *Udawa* do come here, and sometimes they stay for one or two months. The relationship we have with them is not cordial. Four years ago, one of the *Udawa* climbed up one of our trees to lop the branches. We told him to get down, but he refused. Because of this a big fight started. Many people were wounded (Garba, pers. com. 25 February, 2002).

9 Consequently, the decision by many farmers to cut down the Gawo trees on their plots may have also played a role in reducing the amount of taki available from Fulani cattle.

Most concern for farmer-herder relations was evident at the transect sites that were furthest in proximity from Kano, where the *Udawa* still regularly transit during the dry season. In comparison, at Hotoro Arewa and Zangon Gabas, the two closest sites to Kano, focus group informants suggested that as the number of *Gawo* trees had been considerably reduced in recent years and the landscape had become progressively more 'urban' in character, pastoralists now rarely used peri-urban areas to graze their animals. At all of the transect sites, however, it was pointed out that because local authorities were often reluctant to enforce the trespassing laws that concerned seasonal visits from the Fulani, most farmers in the region had stopped nursing young *Gawo* saplings on their plots altogether. Deteriorating relationships between farmers and the *Udawa*, and the tension between them created by the *Gawo* tree, illustrates the significant implications that land-use conflict can have on tree-growing decisions. As was noted earlier in the chapter, many individuals in the study spoke of a positive relationship between trees and the soil and consequently several farmers conceded that the absence of trees such as the *Gawo* could have contributed to recent perceptions of deteriorating peri-urban soil conditions.

Climatic factors

It must finally be noted that although most respondents in this study associated their perceptions of woodland degradation with anthropogenic factors, many individuals believed that certain vegetation species were diminishing as a consequence of declining amounts of rainfall. Research based on longitudinal time-series analysis of satellite data has confirmed the dynamic and highly variable nature of the regional environment and its climate, but these studies have not resulted in a consensus on the direction of environmental change or its underlying causes (Herrmann *et al*., 2005). However, contrary to the belief of many individuals interviewed, evidence also suggests that northern Nigeria has not experienced a sharp decline in rainfall in recent years. Even so, it was apparent that many respondents in this study believed that climatic conditions were now harsher than in previous years and this was having a significant impact on the ability of many indigenous tree species to regenerate. Some individuals suggested that because many African tree species are 'slow growers' and were not being replanted to the same extent as exotic species such as the *neem* tree, they were quickly declining in number. This perception is well-illustrated by one Fulani man at Gamji Tara:

> The indigenous trees such as *Dorawa* and *Gawo* are quickly disappearing. *Gawo* is becoming extinct because of the *Udawa*, and there are few seeds left to replant the *Dorawa*. When the *Dorawa* gets old, it stops producing seeds and dies. And we have not replanted *Dorawa* seeds previously because we have been using them for many things, like cooking *kunu* (gruel). So there are not many new *Dorawa* trees. We practice *sassabe* with the *Dorawa*, but it has a short period of seed production in its lifetime. *Dorawa* cannot withstand harsh environments like many other trees can. It is not as strong and now there have been changes in the environment. The climate has become more harsh and there is less rainfall. The roots of the *Dorawa* cannot travel deep into the soil to get enough water (Jibrin, pers. com., 26 February, 2002).

Even if it was the case that low and variable amounts of rainfall were playing a role in retarding the growth of certain tree species, it is probably not the case that this factor alone is responsible for any significant reduction in their numbers. Indeed, most of the trees found in the Kano CSZ are extremely hardy and resilient, and for thousands of years have been withstanding extreme environmental conditions. However, perceptions of an increasingly harsh environment have undoubtedly placed greater stress on local livelihoods and may have accelerated the tendency for some individuals to exploit their natural capital base in times of intense pressure. For example, many respondents noted that in recent years there had been an increase in the activities of traditional herbalists who strip the bark from certain indigenous trees for medicine, in a practice known locally as *sassaka*. It was reported that in many localities, the bark was being removed at unsustainable rates and was causing a large number of trees to die.

In a recent study by Herrmann *et al.* (2005), the temporal and spatial patterns of vegetation greenness and rainfall variability in the Sahel are investigated using a combination of remotely sensed indicators (the Normalized Difference Vegetation Index (NDVI)) and gridded satellite rainfall estimates for the period 1982–2003. Although rainfall remains the dominant causative factor for an increase in vegetation greenness, they argue that human factors, or what they refer to as the 'human signal', can also either trigger or inhibit vegetation greenness. While their study demonstrates that throughout the Sahel, there is no real recent evidence of large-scale anthropogenic land degradation, they argue that this does not mean that 'pockets' of degraded areas do not exist at local scales. From their data, they note: 'Only parts of northern Nigeria and Sudan show areas where human impact hypothetically inhibited a greening trend in the order of magnitude expected from the positive trend in rainfall conditions' (2005: 400). It remains unclear as to why vegetation greening has fallen behind what would be expected from the increase in rainfall in northern Nigeria, but Herrmann *et al.* (2005: 400) suggest that one hypothetical explanation might be, 'the neglect of good land use practices due to civil strife and conflict.' They conclude that more detailed field work is needed at the local level with the analysis of finer spatial satellite data, such as LANDSAT and MODIS imagery. As was argued in Chapter 5, broader concerns for the climate may also be influencing perceptions of land degradation and may have convinced some individuals that the widespread depletion of environmental resources is occurring (Dahlberg and Blaikie, 1999; Elias and Scoones, 1999). As is possibly the case with perceptions of soil fertility, it should not be ruled out that local perceptions of tree cover change are also being framed by broader concerns, such as increased stress on livelihoods or negative changes in levels of well-being.

Conclusion

Although in recent years, a number of influential studies examining woodland degradation in West Africa have been guided by more optimistic hypotheses concerning the relationship between people and physical resources (Fairhead and Leach, 1998; 1996), in this study, local perceptions suggest that in some locations

within the CSZ, there may currently be some cause for concern. However, it was also revealed that livelihood circumstances and management strategies vary greatly both spatially and temporally, and extrapolating micro-level findings to wider scales thus remains problematic. Although it may be the case that 'pockets' of environmental pressure do exist, it would also be incorrect to assume that the widespread degradation of all woodlands was occurring.

As Cline-Cole and Madge (2000: 5) suggest, in the Kano CSZ dryland forestry is essentially, 'the product of the dynamic interplay between dominant and subordinate forces, between heterogeneous populations and varied interests'. Tree management decisions are embedded in a complex political economy, involving the conflicting resource management interests of a wide range of actors. This chapter has demonstrated that perceptions of tree cover and the management decisions they drive vary greatly across the research transect. Although there are many practical and theoretical challenges to consider when integrating spatial scales and extrapolating from the micro-level to the macro-scale, in agreement with Marcussen and Reenberg (1999), micro-level studies still remain the best analytical point of departure for investigations of environmental change. Although it may be the case that different social actors hold radically different appraisals of their resource base and of its degradation, such an understanding of the dynamic and variable perceptions that local people hold of the natural resource base must be a central consideration in formulating meaningful environmental policies for the years to come.

Chapter 7

Water Quality, Urban Waste and Sustainability

Introduction

Throughout the discussion in this book, a picture of the environmental and ecological uncertainty of Kano and its CSZ has emerged, and the risks and constraints under which local land-users must operate have become all too apparent. This became particularly clear in Chapter 4, where our examination focused on the unpredictable nature of climatic and hydrological conditions that are characteristic of the region. Indeed, each year there is a serious water deficiency in the Kano vicinity which can last for up to seven months. The development of a series of major dams in Kano State during the 1970s has led to a proliferation of irrigated agriculture projects, which has helped to extend the agricultural growing season for many farmers. However, research by Main (1990) suggests that many of these capital intensive rural development projects have also been responsible for fostering accumulation and proletarianization, with the real beneficiaries being commercial farmers and businessmen. Other studies suggest that dam projects have not been without their serious environmental and social consequences (Adams, 1991). On a smaller scale, however, Essiet and Ajayi (2000) note that in more recent years, the Kano State Agricultural and Rural Development Authority (KNARDA) has embarked on drilling a large number of shallow boreholes (ranging in depth from 5–25 metres) to assist smallholders in *fadama* cultivation. It has been estimated that there are over 1,200 shallow boreholes in Kano State, and statistics from the late 1980s suggest that more than 11,000 hectares of *fadama* lands are under small-scale irrigation agriculture in Kano and Jigawa States (KNARDA, 1989).

For many farmers, it is certainly the case that the widespread implementation of irrigation projects in Kano State has likely played an important role in spreading some of the risks associated with rainfed cultivation in a highly unpredictable environment. However, in peri-urban localities, where communities are under the direct social and economic influence of Kano, the competition for scarce land and resources has become intense. The dual combination of climatic uncertainty and increasing resource pressure means that those engaging in peri-urban farming often find themselves doubly constrained in their food production activities. Nevertheless, even within city limits, many individuals have successfully managed to extend the annual growing season by relying on irrigated agriculture to cultivate vegetables throughout the year. Consequently, evidence suggests that many poor households have been able to overcome food deficits and produce valuable food surpluses for income generation in urban Kano, which serves as an important market for much

of the food and resources produced in the peri-urban zone. In fact, based on data collected in three field surveys undertaken in 1996, 1998, and 2000 (see Binns and Fereday, 1996; Binns and Lynch, 1998; Olofin *et al.*, 1997), previous research on the significance of agriculture in urban and peri-urban Kano has concluded that urban farms make very significant contributions to city nutrition, household food security, employment and environment. Although there does not presently appear to be official recognition of urban and peri-urban agriculture (UPA) in Kano, city farming is widespread and is tolerated as an important response to the economic and social conditions faced by many poor individuals.

This chapter examines some of the critical environmental issues associated with irrigated agriculture, urban waste recycling and water quality in peri-urban Kano, and is the third and final degradation 'theme' to be explored in this book. Despite the widespread recognition that irrigation schemes can play an increasingly important role in boosting food production in dryland environments, in recent years a number of major ecological concerns have been identified with UPA in and around Kano. Of course it must be recognized that many of the processes that affect environmental conditions at irrigation sites may be considered to be 'natural' occurrences. Much previous academic attention has focused on these 'naturally' occurring problems and processes, particularly in situations where soil conditions have been affected. For example, considerable research has been carried out on a number of common environmental issues that frequently occur at irrigation sites, such as the physical and chemical deterioration of soils due to continuous cultivation (Essiet, 1990), alkalinity and salinity problems (Maurya, 1982), and high water conditions resulting in the water-logging of plots (Bichi, 2000). However, as will become clear in this chapter, there are other environmental problems associated with UPA that may be regarded as being more 'human induced', or 'human-assisted' than others. In some cases, degradation problems which are frequently considered to be naturally occurring processes may be exacerbated by farmers or other actors, and can ultimately become human-assisted ones.

For example, as was noted in Chapter 5, the soils of the Kano CSZ are naturally light and sandy with low water-holding and cation exchange capacities, and they are generally susceptible to a build-up of sodium. Salinization, or the build up of salts in the soil, can occur under natural conditions in a dryland environment, but problems with salinization are most commonly associated with excessive water application. Moreover, as Essiet (1986) notes, not all sources of water are suitable for irrigation and water that has been contaminated by effluents from industries or impurities from fertilizers may speed up soil salinity over time. It would appear that poor quality irrigation water not only plays a key role in exacerbating salinity, but it may also determine the extent of many other environmental problems at agricultural sites as well (Essiet and Ajayi, 2000).

According to focus group discussions with local actors, there presently appears to be great cause for concern with respect to many environmental and health related issues associated with UPA in Kano. Since the city is located in a semi-arid zone and receives very little annual rainfall, dry season agriculture is only possible in low-lying *fadama* depressions where the water table is close to the surface. There is intense competition for peri-urban plots where such irrigated cultivation is possible.

The combination of Kano's low and unreliable rainfall, its burgeoning population, and industrial pollution from abattoirs, tanneries and factories seriously threatens the quantity and quality of local water resources. Further compounding the problem is the inadequate sewerage provision leading to the discharge of effluents into rivers and drains. As Lewcock (1995) warns, contamination of water sources is a major threat, especially in the absence of adequate rainfall, which might serve to dilute and flush out toxic elements.

Water analysis and selection of irrigation sites

Focus group discussions were conducted at each of the six sites on the distance-decay transect and it became immediately apparent that in the Kano region, concerns for water quality varied spatially with distance from the urban centre. Actors at the four sites furthest from Kano – Kadewa, Maisar Tudu, Gamji Tara and Magama – were generally not worried about issues to do with surface and ground water quality, although as was to be expected, there were some concerns regarding access to sufficient quantities of water at certain times of the year. However, respondents at Hotoro Arewa and Zangon Gabas, the two sites which were in closest proximity and under the strongest influence of metropolitan Kano, suggested that local water supplies had been severely compromised by a variety of factors, many of which had resulted from the shifting of urban environmental burdens onto the hinterlands.

In this chapter, the discussion revolves around empirical evidence obtained at three food production sites located in peri-urban Kano (Kwarin-Dankukuru, Jakara and Kofar Ruwa), where a significant number of respondents believed that wastewater disposal was contributing to environmental degradation. Some of the respondents at Hotoro Arewa and Zangon Gabas were actually engaging in vegetable production at these sites as part of their livelihood strategies, particularly Kwarin-Dankukuru, which is located directly adjacent to Zangon Gabas. Figure 7.1 locates the sites in relation to the distance-decay transect.

Water samples were taken at various points from the Getsi Stream and Jakara River, the two main sources of irrigation water at all three of the sites (see Figure 7.1). An attempt was made to examine water quality both temporally and spatially, and sample sites were selected on a transect, moving away from the urban centre into the peri-urban zone. The Kofar Ruwa site and Jakara site off Airport Road were chosen because they are situated close to the city centre in areas of high population density, while the Kwarin-Dankukuru site, which is located at the urban periphery, serves as a good comparison of how water quality varies spatially over the urban and peri-urban zones. At Kwarin-Dankukuru, water was sampled from both an irrigation channel and a washbore (6–8 metres deep), so that comparisons could be made between the two sources. Water samples were also taken from the Getsi Stream in the nearby Bompai Industrial Estate, since this is the main source of industrial pollution at Kwarin-Dankukuru.

Within the three agricultural sites, five sample locations were selected and three main catagories of (waste) water were identified:

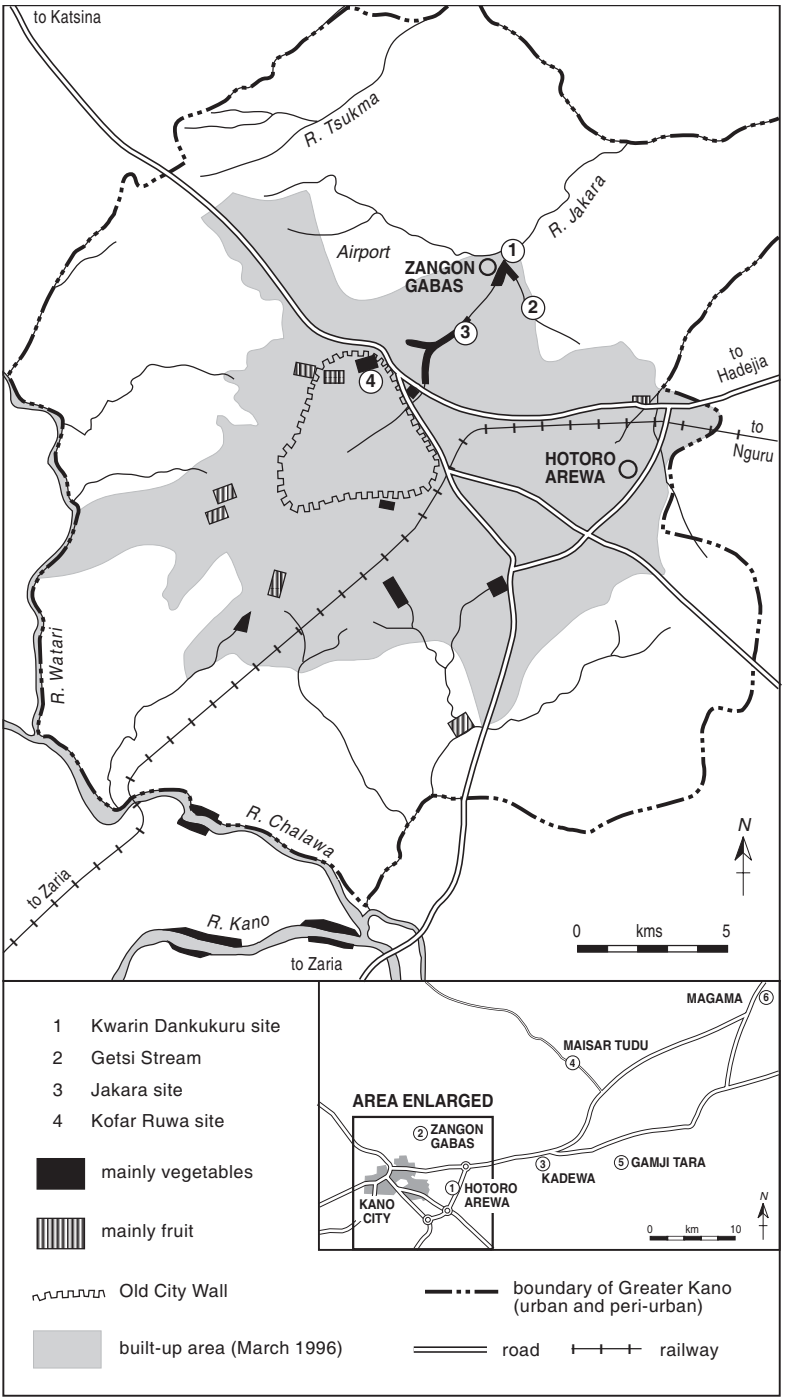

Figure 7.1 Irrigation sites sampled in peri-urban Kano

1. Industrial wastewater was found at the sample sites at Getsi Stream (within the Bompai industrial estate) and the irrigation channel at Kwarin-Dankukuru.
2. Domestic wastewater was identified at the sites at Kofar Ruwa and within the Jakara Channel (near Airport Road bridge).
3. Ground water was sampled from a washbore at Kwarin-Dankukuru irrigation site.

Following preliminary discussions and on-site transect walks with local farmers at all three sites, it became apparent that almost all channel irrigation for agriculture was carried out during the long dry season, roughly between the months of September and May. During the 'wet' months of June, July and August, farmers rely on rainfed irrigation, and due to the high cost of petrol and diesel fuel, they will only use their motor-driven pumps in situations when it is abnormally dry during this period (Plate 7.1). As such, the majority of sampling for the study was carried out during the month of April at the end of the long dry season, since this was the critical period when farmers were irrigating on a daily basis and there were no natural water flows to dilute toxins in the channels. However, a set of samples was also taken during August, the wettest month, in order to compare between water quality in the wet and dry seasons.

Plate 7.1 A farmer uses a motor-driven pump to irrigate with polluted water at Kwarin-Dankukuru

During the month of April, samples were collected on the same day of the week for three consecutive weeks. Water specimens were taken both in the early morning and in the afternoon, as it was noted that local factories release pollutants into water

courses at different times during the day, causing daily temporal variations in water quality. Laboratory analysis was undertaken by the Central Laboratories at Bayero University, Kano (BUK) and, in addition to pH and electrical conductivity, standard spectrophotometric procedures were followed for the analyses of cobalt (Co), iron (Fe), nickel (Ni), manganese (Mn), copper (Cu), sodium (Na), potassium (K), lead (Pb), chromium (Cr), mercury (Hg) and cadmium (Cd). Titrometric methods were used to analyse magnesium (Mg) and calcium (Ca). Although a wide range of parameters could have been potentially selected for analysis, the choice of elements tested was limited to some of the trace elements which are typically associated with discharges from tanneries and textile mills – two of the major polluters in the Kano industrial estates. Previous studies in the Bompai and Sharada industrial estates have already indicated that water contamination from heavy metals, such as lead, mercury, chromium and cadmium, is rife (see for example, Tanko 2002; Ahmed and Tanko, 2000; Tanko, 1997a). However, it should be noted that this study did not examine levels of pathogens associated with faecal contamination, but it is already generally accepted that sewage wastewater pollution is a significant problem in Kano (Tanko, 1997b). Previous research from other countries, such as the study by Shuval *et al.* (1986), reveals that exposure to raw sewage wastewater significantly increases the risk of contracting cholera, as well as infection by *Ancylostoma* (hookworm) and *Ascaris* (nematode).

Following a brief review of some of the environmental concerns associated with UPA in Kano, the discussion in this chapter focuses more specifically on these three agricultural sites, perceptions of water quality are explored in detail, and the implications of environmental degradation are assessed for the sustainability of food production systems in peri-urban Kano. The main focus of the investigation is not concerned with the 'natural' degradation processes which may be developing at sites, but rather critical attention is given to the deterioration of environmental conditions which may be resulting as a consequence of human-induced activities, particularly the use of poor quality irrigation water and toxic waste on farm plots.

Feeding a growing city or degrading the urban hinterland? Some environmental concerns with UPA in Kano

As we noted in Chapter 1, Nigeria is 'the giant of Africa' and currently has more cities with over a million people than any other nation on the continent. In recent years, rapid and generally unplanned urban growth has led to a heightened awareness of the problems that Nigeria's 'exploding' cities face and has spurred an increased academic interest in the challenges posed to sustainable urbanization. In particular, the role that UPA can play in improving livelihoods has been well documented, and many researchers have suggested that such intensive cultivation may indeed be the panacea for the urban food supply deficit faced by many burgeoning Nigerian cities (Binns and Lynch, 1998).

Overwhelmingly, the work published on UPA has highlighted the positive aspects of such activities. Previous studies carried out in a variety of Third World cities have pointed out that UPA increases urban food security (Atkinson, 1995), serves as an

important coping mechanism in the informal economy (Lourenço-Lindell, 1995; Gefu, 1992), is an important income-generating activity (Freidberg, 1996), may help in reducing urban malnutrition (Egziabher *et al*, 1994; von Braun et al 1993), and can even play a role in the advancement of women in African cities (Freeman, 1993). On the other hand, but perhaps to a lesser extent, there has been limited academic interest in exploring some of the negative consequences associated with UPA. For example, Mvena *et al*. (1991) conclude that water shortages, the threat of waste contamination and conflicting land-use activities can make the promotion of urban farming difficult in many situations. Lynch *et al*. (2001), who identify the issues of security of tenure and the use of heavily polluted water as major constraints for peri-urban farmers in Kano, suggest that the promotion of an 'enabling environment' in which UPA is encouraged and supported remains crucial. This is especially vital in terms of how agricultural activities fit in with urban structure, urban problems and the greatly varying lifestyles and livelihoods of individual actors in the peri-urban interface. It was perhaps not until 1992 at the UNCED Earth Summit in Rio that the environmental debate was finally broadened to focus international attention on the so-called 'brown agenda', dealing with pollution problems, environmental hazards and poverty. In particular, as will be elucidated in the discussion in this chapter, peri-urban zones serve as both resource extraction sites and depositories for urban waste, and there are growing concerns regarding the sustainability of expanding crop, livestock and natural resource production in these areas. As land pressures and the competition for key resources have mounted in peri-urban localities, an increase in the incidence of land degradation has been identified as a significant environmental problem in the hinterlands surrounding many of Nigeria's expanding cities. Whilst there is much variability in both the level and nature of understanding of land degradation, a concept which in any case is socially constructed, according to discussions with key informants in this study, it is apparent that there are some shared concerns regarding the current state of Kano's peri-urban environment.

Although there are many ecological concerns associated with UPA in Kano, the incidence of wastewater discharge is possibly the biggest threat to city farming and has been identified as a major environmental hazard in the region (Tanko, 2002; Bichi, 2000). Located within the city's three industrial estates – Bompai, Challawa and Sharada – a large number of rubber, plastics, food, metallurgical and manufacturing industries generate highly polluted effluents which are discharged in an untreated form into adjacent water courses. According to the Ministry of Commerce and Industry, within these estates which encircle the city and utilize its limited water resources, there are 43 food processing industries, 63 aluminium, metal and wood factories, 50 plastic rubber and tyre factories, and over 32 chemical and cosmetic industries (cited in Bichi, 2000: 306).

It is perhaps the tannery and textile industries, however, using the largest quantities of water and producing the greatest amounts of waste water, that constitute the main sources of pollution. Kano is the centre of Nigeria's tanning industry, and is home to 70 per cent of the country's tanneries (World Bank, 1995b). The waste bi-products from these tanneries have high concentrations of the heavy metals chromium and cadmium, and a 1989 study, which monitored the activities of 15 tanneries in Kano, found that in all cases permissible limits for effluent discharge were violated (World

Bank, 1995b). According to Osae-Addo (1992), not only do down-stream fish and crops become heavily contaminated by heavy metals as a result, but human health is further threatened in urban and peri-urban Kano because over 60 per cent of local people depend on rivers and groundwater aquifers in the area for water.

Food production requires access to land, water and fertilizer, all of which are in scarce supply in a peri-urban environment. As a result, out of desperation, waste bi-products and contaminated water are often used as inputs in the areas farmed on the outskirts of Kano. An in-depth review of peri-urban natural resource-linked health issues carried out by Birley and Lock (1997) highlights the numerous ways that peri-urban surface water is polluted (also see Birley and Lock 1998). For example, domestic contamination from people washing, bathing, defecating and urinating is commonplace, and inadequate sewerage facilities or the presence of landfill sites further complicates the problem. Moreover, agricultural chemicals and industrial effluent frequently pollute groundwater and soils and since major roadways often traverse peri-urban areas, heavy metals associated with traffic pollution may also cause further contamination of crops (see Mage and Zali, 1992 or Alloway 1995 for further discussion). While studies in Nigeria have revealed high levels of lead in the dust from unpaved roads (Birley and Lock, 1998), other research examining dry season *Harmattan* dust deposition in Kano has found traces of lead in samples, which is also probably due to automobile exhaust emissions (Wilke, *et al*., 1984). Barrow (1991) adds that such airborne heavy metal pollutants are very slow to break down and can easily contaminate water sources and damage the soil. Ultimately, he cautions, the rehabilitation of soils degraded by heavy metals is extremely difficult and they must either be removed and buried below an uncontaminated layer, or treated chemically to neutralize or leach out the contaminants (Barrow, 1991: 235).

In peri-urban Kano, there is an immediate environmental threat posed by the presence of a large number of tanneries which discharge substantial quantities of chromium salts and numerous other toxins into water sources (Birley and Lock, 1998). Many water courses have, in fact, become so contaminated that their ecology has been disrupted and their ability to function as water supplies has been grossly compromised (Showers, 2002). In addition to the health hazards associated with contaminated peri-urban water sources, there has also been a great deal of concern that stagnant water channels may increase the abundance of mosquito breeding sites and hence the risk of malaria and other vector-borne diseases (Lindsay *et al.*, 1990; Trape *et al*., 1992; Trape and Zoulani, 1987).

The indiscriminate disposal of solid waste into water bodies has also been flagged as a growing problem in peri-urban Kano and is now recognized as a significant environmental threat. To mention but one example, the decomposition of refuse from the food industry has been reported to have contaminated virtually all of the boreholes in Kano's Bompai industrial estate in the eastern part of the city (Egboka *et al*.,1989). Moreover, the increased use of urban solid waste as fertilizer may cause additional health hazards. As was previously discussed in Chapter 4, rural-urban interaction between Kano and its hinterland has been well documented by Mortimore (1975) in his account of the donkey-load exchange between urban waste and manure, and rural fuelwood. The transfer of urban waste products to the hinterland still exists today, but on a much larger scale where lorries now mainly transport the refuse

rather than donkeys. Presently, the most common way for a peri-urban farmer to gain access to urban refuse, or *shara*, is to pay one of the lorry drivers of the Kano State waste disposal service (KASEPPA) to actually bring the material to the plot. According to Lewcock (1995), local farmers are willing to pay substantial sums of money for waste delivery, which extends to a radius of 10–15 km around the city. As was revealed in Chapter 6, discussions with local lorry drivers confirm this observation, and the cost of *shara* delivery becomes increasingly expensive with distance from the city (Binns *et al.*, 2003).

However, once again, it is possible to claim that this much-documented symbiotic relationship between city and hinterland is currently under stress from a variety of new pressures that have been introduced into the system and in peri-urban Kano, sustainable methods of waste disposal presently prove to be more challenging. To mention but a few of the problems concerning solid waste management in Kano, Lewcock (1995) points out that there is a chronic shortage of operational disposal lorries due to the under-funding of maintenance and equipment purchase, there is a severe shortage of technical training, and there appears to be a prolonged uncertainty as to whether it is the responsibility of local, state, or federal government to manage disposal services. However, many farmers do continue to recycle waste products and use them on their plots. Although composting organic wastes has positive effects in improving the fertility of the soil, and some pathogens may be destroyed if composting temperatures are high enough, Birley and Lock (1998) point out that there is a still a great danger of introducing heavy metals into the food cycle. In addition, both sludge from factories and untreated raw sewage from toilets are often applied directly onto peri-urban farm plots and can carry viruses and high levels of faecal coliforms. The use of unsorted urban waste as fertilizer has also caused polythene bags to accumulate on many farm plots, and this has now become a major environmental hazard throughout Nigeria and indeed in many other African countries. In the case of Kano, farmers have even been known to directly apply solid waste from tanneries and abattoirs to their plots, which not only emits miasmal odours, but is an excellent breeding ground for disease vectors. The situation is recounted by one young farmer from Zangon Gabas:

> Without some kind of fertilizer on our plots, nothing will grow. People are forced [to use wastes on their plots] because of difficult circumstances. Some people even use the wastes from tanneries. Before an animal hide can be tanned, strong chemicals are used to remove the hair from the skin. If you apply that waste to your plot, it will last in the soil for two or three years. This waste is not very abundant today, but if people see it for sale, they will definitely buy it. The one that is blue in colour is very effective, but the chemicals are very heavy. After a long time, it accumulates and kills the soil, just like a car battery. It can act like an acid, but people don't know. They just use it because it is effective and cheap (Liman, pers. com., 15 March, 2002)

Lewcock (1995: 228) notes that farmers also reported tannery waste to be 'extremely hot' and consequently, it needed to be mixed with large volumes of household waste and water before it could be utilized. Laboratory analysis of these waste bi-products suggests that over time, their long-term effects will damage the soil due to their high chromium content (Tanko, 2002).

Water, pollution and peri-urban food production in Kano

Although patterns of urbanization and their effects on aquatic systems most certainly vary from city to city (Baer and Pringle, 2000), many urban environments in Africa are linked by water to their larger surrounding landscapes (Showers, 2002). Peri-urban environments serve as a buffer zone between urban and rural landscapes and as untreated wastewater is released into this interface, the effects are long-lasting and cumulative. As is the case with 53 per cent of the surface of the African continent, Kano has no discharge to the sea. As a consequence, concentrations of contaminants in soil and water can reach dangerously high levels, since they are not diluted by maritime influences (UN 1973, cited in Showers, 2002). Although these problems are well recognized, in Nigeria there have been few comprehensive studies concerning the present state of surface and groundwater resources (NEST, 1991). This dearth of accurate and up to date information is a major limitation to planning (Salau, 1990) and most frequently, it is the peri-urban poor who suffer the worst consequences.

In this section of the chapter, the quality of Kano's peri-urban water is examined both temporally and spatially, and the results of laboratory analysis of water samples taken from various points of the Getsi Stream and Jakara River are presented and discussed. Both of these water ways are major sources of irrigation water for peri-urban farmers. For each sample, standard procedures were followed for the analysis of a wide range of parameters, as identified in the second section of the chapter.

Table 7.1 Phytotoxic threshold levels of selected trace elements for crop production

Element	Recommended maximum concentration in mg/l
Co (cobalt)	0.05
Cu (copper)	0.2
Fe (iron)	5.0
Mn (manganese)	0.2
Ni (nickel)	0.2
Hg (mercury)	n/a
Cr (chromium)	0.10
Cd (cadmium)	0.01
Pb (lead)	5.0

Source: Pescod (1992: 17)

An irregular level of pH, the measure of acidity or alkalinity of water, is rarely a problem in itself, but normal levels of samples should be between 6.5 and 8.9, and values outside this range indicate that there are severe abnormalities in water quality (Pescod, 1992). Quite clearly, referring to Table 7.2, pp. 146–147 it is immediately apparent that several pH levels, particularly those measured from the Getsi Stream during the dry season, are abnormally high. Electrical conductivity, another standard measurement in irrigation water assessment, is used to determine

the ionized constituents of water which are generally closely correlated with total salt concentration. Plant growth, crop yield and the quality of agricultural produce are all affected by the salinity of the soil, which is often determined by the salt concentration of irrigation water. The optimum EC level for irrigation water is 2 millimho/cm, whilst values which exceed this level will reduce the water osmotic potential, or the rate of water entry into the crops (Tanko, 2002). For this study, the selected elements, cobalt, copper, iron, manganese, nickel, lead, chromium, mercury, cadmium, magnesium and calcium, were tested and Table 7.1 indicates the phytotoxic threshold levels of these elements for crop production. Abnormal levels of these elements will lower the nutritional nature of the irrigation water and may have inhibitory effects on plant growth.

The results of the analysis, as summarized in Table 7.2, are discussed under the appropriate site sub-heading according to site location. In addition to the quantitative data collected, extensive interviews were conducted with producers at each site, and their concerns about water quality further suggest that there is an urgent need to ameliorate the considerable health and environmental hazards associated with agriculture in urban and peri-urban Kano (also see Binns *et al*., 2003).

The Kwarin-Dankukuru Site

Contaminated irrigation water originating from the Bompai industrial estate is used extensively in many parts of peri-urban Kano, particularly at the agriculture site at Kwarin-Dankukuru. This site, located furthest from the urban centre, exhibits the most 'rural' characteristics of the sites examined in this study. Whilst Kwarin-Dankukuru does not display the mosaic of different land-uses that the other sites do, and is primarily defined by agricultural use, the effects of industrial wastewater do extend to this area, as is reflected in the results of the water samples analysed. At this site, irrigation water was sampled at the confluence of the Jakara River (which carries mainly residential effluents) and the Getsi Stream, and high levels of toxins were revealed in the analysis. Sampling was also carried out slightly upstream from this site in the Getsi portion of the water system within the Bompai industrial estate (see Figure 7.1), which seems to be the main source of pollution at Kwarin-Dankukuru. Farmers commented that a number of years ago, even in the dry season, there used to be large volumes of water from residential areas flowing through the Jakara, which would dilute the industrial pollution in the Getsi. More recently, however, increased water scarcity in Kano has forced residents to use less water domestically and consequently, there is less residential runoff. However, this does not appear to dissuade local growers from using the water and many farmers continue to irrigate even though toxicity levels are now much higher. One morning, a farmer remarked that he could see that the water quality was not very good at that moment and his vegetables might get 'sick' if he irrigated his plot. However, he admitted that he had no choice but to use the water because if he did not, his vegetables would certainly die.

Wastewater from the Bompai industrial estate is released, without any form of treatment, into the Getsi Stream. A significant proportion of the factories in

Table 7.2 Concentrations of chemical pollutants at three peri-urban agriculture sites in Kano

S/ No.	Date	Time	Site	PH	EC	Co	Fe	Ni	Mn	Cu	Na	K	Hg	Cr	Cd	Pb	Mg	Ca
1	09/04/02	7:30am	Kwarin Dankukuru (irrigation)	7.5	0.47	0	38.5	0	3	0.7	35.6	15.1	17.4	46.7	27.2	39	27	21.4
2	09/04/02	6:00pm	Kwarin Dankukuru (irrigation)	8.2	0.52	2.5	35.4	271.7	8.6	0.7	20.3	8.5	14.3	36.3	20.1	31.2	18.6	19.8
3	09/04/02	7:45am	Kwarin Dankukuru (washbore)	5.6	0.09	19	17.7	75.3	0.7	0.5	10.2	2.8	0	0	0	0	15.6	23.1
4	09/04/02	6:15pm	Kwarin Dankukuru (washbore)	6.2	0.09	5.8	27.7	115	0	2.1	20.3	30.2	0	0	0	0	13.5	22.5
5	09/04/02	8:30am	Getsi Stream (within Bompai)	8.6	1.28	1.4	1	0	2.6	2.6	61	12.3	18.6	48	28.5	40	18.5	16.4
6	09/04/02	5:30pm	Getsi Stream (within Bompai)	9.5	1.38	5.8	34.6	0	2.5	2.1	190.7	119.8	15.5	40.1	21.5	34	16.7	15.4
7	09/04/02	9:30am	Kofar Ruwa (irrigation)	6.6	0.16	17	42.3	45	3	3.1	28	9.4	0	0	0	0	6.3	8.8
8	09/04/02	4:45pm	Kofar Ruwa (irrigation)	6.9	0.18	4	28.5	60	3.7	2.8	105.9	231.1	0	0	0	0	4.5	7.2
9	09/04/02	9:00am	Jakara Channel (Airport Rd.)	7.1	0.46	2.6	15.4	75	0.5	1.1	22	21.7	0.1	0	0	0	5.2	7.4
10	09/04/02	5:00pm	Jakara Channel (Airport Rd.)	7.5	0.55	7.4	34.6	38.3	0.4	2	30.5	51.7	0.1	0	0	0	3	8.7
11	16/04/02	7:40am	Kwarin Dankukuru (irrigation)	8.2	0.65	1.1	34.6	63.3	1.4	1.9	96.6	16	18.6	45	28.1	41.2	28.2	20
12	16/04/02	5:15pm	Kwarin Dankukuru (irrigation)	10	0.76	0.9	33.9	128.3	3	3.2	81.4	14.2	15.3	32.5	21.2	31.8	19.5	14.2
13	16/04/02	7:55am	Kwarin Dankukuru (washbore)	6.4	0.09	5.8	45.4	115	3.7	2.7	20.3	23.6	0	0	0	0	16.7	18.6
14	16/04/02	5:45pm	Kwarin Dankukuru (washbore)	7.1	0.09	5.6	43.9	63.3	6.1	2.2	8.5	2.8	0	0	0	0	11.7	15.6
15	16/04/02	7:15am	Getsi Stream (within Bompai)	10.5	1.43	4.4	28.5	0	2.1	0.9	61.9	15.1	18	47.5	28.9	46.2	16.2	16.2
16	16/04/02	4:50pm	Getsi Stream (within Bompai)	10.5	1.28	6.3	21.5	66.7	0	1.6	189.8	201.9	15.5	38	22	37.4	17.7	15.2
17	16/04/02	8:53am	Kofar Ruwa (irrigation)	7.5	0.16	2.8	17.7	23.3	3	2.6	12.7	9.4	0	0	0	0	7.2	8.4
18	16/04/02	4:15pm	Kofar Ruwa (irrigation)	7.2	0.19	0.7	36.9	160	3.5	2.5	28.8	109.4	0	0	0	0	5.8	8
19	16/04/02	8:30am	Jakara Channel (Airport Rd.)	8.3	0.39	3.4	20.3	17.8	2.6	1.7	33.2	20.1	1.6	0	0	0	5.3	11.5
20	16/04/02	4:35pm	Jakara Channel (Airport Rd.)	7.5	0.43	3.2	29.2	22	3.7	2.7	54.2	26.1	0	0	0	0	4.6	10.6

21	23/04/02	7:40am	Kwarin Dankukuru (irrigation)	7.9	0.48	4.7	23.6	96.7	7	3	78	250	16.8	48.8	26.2	41.8	27.4	18
22	23/04/02	5:35pm	Kwarin Dankukuru (irrigation)	8.2	0.75	0	39.2	0	4.4	2.5	106.8	14.2	14.6	36.7	20	36.2	20	17.2
23	23/04/02	7:50am	Kwarin Dankukuru (washbore)	7.5	0.1	3.9	37.7	75	0	2.1	20.3	3.8	0	0	0	0	12.4	24.5
24	23/04/02	5:42pm	Kwarin Dankukuru (washbore)	7.7	0.12	8	40	0	3.3	2.1	24.6	2.8	0	0	0	0	16.4	24
25	23/04/02	7:10am	Getsi Stream (within Bompai)	10.6	0.67	9.8	18.5	190	0.7	1.2	111	7.6	18.6	49	28.6	46.2	18.6	17
26	23/04/02	6:15pm	Getsi Stream (within Bompai)	8.8	1.43	2.6	30.8	158.3	0	1.9	189.8	11.3	16.4	46	21.8	38.2	17.2	16.3
27	23/04/02	8:47am	Kofar Ruwa (irrigation channel)	8.1	0.23	2.1	23.9	206.7	2.6	2	37.3	12.3	0	0	0	0	6.2	8.7
28	23/04/02	4:30pm	Kofar Ruwa (irrigation channel)	8	0.23	9.3	34	153.3	2.8	2.2	36.4	12.3	0	0	0	0	6	8.6
29	23/04/02	8:25am	Jakara Channel (Airport Rd.)	8.8	0.38	7.9	36.9	118.3	2.8	2.2	51.7	13.2	0	0	0	0	4.8	11.6
30	23/04/02	4:55pm	Jakara Channel (Airport Rd.)	8.4	0.44	9.3	34.6	118.3	3.5	1.5	56	16	0	0	0	0	5.6	7.6
31	04/08/02	8:30am	Kwarin Dankukuru (irrigation)	7.5	0.28	20	36.9	86.7	4	2.2	22	4.7	14.4	26	17.2	27.2	18.1	14.3
32	04/08/02	5:00pm	Kwarin Dankukuru (irrigation)	7.3	0.14	23	33.1	46.7	2.6	1.7	28.8	25.3	10	12	10.8	15	10.2	10.1
33	04/08/02	8:45am	Kwarin Dankukuru (washbore)	6.5	0.08	0.7	35.4	171.7	8.6	0.7	26.7	13.2	0	0	0	0	17.6	23
34	04/08/02	4:45pm	Kwarin Dankukuru (washbore)	6.5	0.08	2.1	30.1	160	7.8	2.1	25.3	12.6	0	0	0	0	15	16.3
35	04/08/02	7:45am	Getsi Stream (within Bompai)	7.15	0.15	0	34.6	55	0.5	2.8	9.3	28.3	14.6	26	18.4	27.4	18.4	17.3
36	04/08/02	4:30pm	Getsi Stream(within Bompai)	7.45	0.16	5.6	30.5	86.3	2	1.8	110	22.2	9.5	10	10.5	17	10.6	14.6
37	04/08/02	10:15am	Kofar Ruwa (irrigation)	7.2	0.21	3.5	39.2	140	3.3	3.5	20.3	10.4	0	0	0	0	6.5	8.3
38	04/08/02	6:30pm	Kofar Ruwa (irrigation)	7.2	0.15	2.8	39.2	165	0.4	1.7	16.1	8.5	0	0	0	0	5.2	5.3
39	04/08/02	9:45am	Jakara Channel (Airport Rd.)	7.4	0.27	1.1	30.8	81.7	4	1.9	17	15.1	0	0	0	0	7.6	6.8
40	04/08/02	6:00pm	Jakara Channel (Airport Rd.)	7.3	0.15	2.1	2.5	80.5	3.2	2	17	18.2	0	0	0	0	6.5	6.5

EC–measured in µ/s

Co, Fe, Ni, Mn, Cu, Na, K, Hg, Cr, Cd, Pb, Mg, Ca –measured in mg/l

Source: Author's survey, 2002.

operation at the industrial estate are tanneries and textile mills and samples of water show high levels of contamination from their discharges (see Table 7.2). Pollutants such as mercury, chromium, lead and cadmium were found to be in excess of the recommended permissible levels for releases both by industries (Federal Environmental Protection Agency, 1990) and also for irrigation (FAO, 1976). While research undertaken in Kano's second industrial estate at Sharada shows similar characteristics (Tanko, 2002), another study has established that the pollutants have begun to affect the quality of water in shallow hand-dug wells around the Bompai residential areas (Tanko, 1997b).[1] Whilst some contaminants were found to be present in water sampled from a washbore at Kwarin-Dankukuru, the water was free of heavy metals (Table 7.1). Although previous research has revealed traces of these metals in shallow hand-dug wells around the Bompai settlement (Tanko, 1997b), no evidence of such contamination was found in the current study. This suggests that deep ground water sources may be a good alternative for farmers in urban and peri-urban Kano when they irrigate their crops.

All the farmers interviewed at Kwarin-Dankukuru expressed great concern about the current environmental state of the site. Since the livelihoods of farmers depend on their crop production at the site, both in terms of home consumption and income generated from the sales of produce, it is perhaps no surprise that most cultivators possess a great deal of environmental knowledge and are well aware of the conditions that constrain them. For example, farmers can distinguish water toxicity levels by colour and can provide detailed descriptions of the temporal variations in water quality. According to one respondent:

> There are three bad colours [of water] that come at different times. The oily red one and the green one will kill the crops, and when we see these colours in the channel, we turn off our pumps immediately. The bluish water is corrosive and causes a red rash when it comes in contact with the skin. We always wash our hands after we come in contact with the blue water (Sadanu, pers. com., 2002).

Another farmer commented that he had recently noticed a very serious increase in the amount of red water being released into the channel. He explained that the colour had become much more intense, almost to the point where it was now black, and he added:

> If you put your hand in this water, it will stain your skin. This water burns the soil, and there are patches now that won't yield anything anymore (Nuhu, pers. com., 2002).

Many farmers were able to make a connection between these poor quality waters and the degradation of the soil. One cultivator pointed out that because of the water

1 Field observations during this study also revealed that PVC pipes used underground for supplies of domestic potable water in the settlements surrounding Bompai, pass across the Getsi Stream. Breakages in these pipes provide inlets for chemical contamination, especially when the water pressure within the pipes is low. In this respect, local residents face a serious risk of ingesting heavy metals associated with industry, through contaminated drinking water. Gradual accumulation of these toxins is quite obviously a serious threat and could lead to severe health problems (see Nash, 1993).

quality, the soil on his plot had developed a dark, blotchy stained look on the surface and the soil texture had become oily. He demonstrated that when he irrigated his plot, the water would no longer penetrate the soil, but instead floated on the surface and then ran off, causing the crops to 'starve'. The process being described is referred to by soil scientists as 'deflocculation', and occurs as a result of high levels of sodium salt and a deficiency of calcium and magnesium. Although the farmers do not understand the chemical process whereby the soil loses its structure, they are keenly aware that using toxic water has exacerbated the situation.

Referring to Table 7.2, it is apparent that the levels of both calcium and magnesium have shown lower relative values in relation to sodium. The calculated Sodium-Adsorption Ratio (SAR) for the water at the irrigation site shows a value of 4.34. Whilst this is an acceptable value for irrigation (FAO, 1976), it clearly shows potential for 'sodicity' development, a situation where there is an increase of sodium cations on the soil particles, and therefore concurs with what the farmers indicated. Perhaps of greater concern, however, is that other pollutants in the effluents, such as the heavy metals lead, mercury, manganese and cobalt, have specific ion toxicity effects on the crops. This may explain why the plants cannot germinate on many of the plots at the site, a common remark made by respondents. Where crops do germinate, there still remains a fear that chemical toxins may be absorbed through plant root systems, and later ingested by humans through the food chain, as described by Ahmed and Tanko (2000). While detailed exploration of the effects of wastewater contaminants on plant samples is beyond the scope of this chapter, many cultivators at the site commented on the detrimental impacts that irrigation water had on plants. For example, one farmer gave the following account:

> When I was young, I heard from the elders that the productivity of this land used to be very good. But before, the water was clear. Today, the water is polluted by tanneries and textile companies who flush their pollutants into the stream at the Bompai industrial estate and the soil is being destroyed by very heavy chemicals. When you look at the farmers' crops that are planted on this land today, it looks like they are burning. The leaves start to curl up. The water is very bad and it spoils the *tudu* (low lying) land (Sani, pers. com., 2002).

Observations such as this suggest that there is clearly a pressing need for further research to explore how crop growth is affected by high concentrations of industrial waste. As Blaikie and Brookfield (1987) point out, some aspects of environmental change are very difficult to detect, as soil and plant productivity may not be affected until a critical threshold is reached. Moreover, it may take considerable time to determine the health hazards associated with the consumption of affected crops. As contaminated crops are consumed over an extended period and the concentrations of toxins accumulate in local communities, the health impacts on urban and peri-urban populations will eventually become apparent. Longitudinal studies are urgently needed to clarify such health issues.

The other main soil problem reported by farmers at Kwarin-Dankukuru was that irrigated plots often developed a crust on their surface and would not allow water or air to infiltrate. The processes of 'sodicity' and 'salinization' were both apparent at the site and were probably caused by excessive levels of sodium in the water.

This condition is easily recognizable, as chalky white salt deposits can be seen on the soil surface. Salinity, a type of soil degradation caused by an increase in the soil water solution, is usually more severe in arid and semi-arid environments such as Kano. However, such problems can often occur in conjunction with poor irrigation management and can be intensified by polluted water.

A final concern that was universally shared by all farmers interviewed at the site involved the seriousness of the polythene bag pollution problem. At Kwarin-Dankukuru, plastic bags are not only transported to the site amongst piles of urban waste, or *shara*, to be used as fertilizer, but bags are also deposited on plots by way of the irrigation channels (Plate 7.2). Huge volumes of bags arrive at the site during the rainy season when water levels are higher and currents can transport debris more readily. Not only do the bags clog drains, but stagnant pools form, encouraging the spread of diseases such as typhoid and malaria. Although some farmers have tried to dispose of the bags by gathering them together and burning them in large piles, it is reported that it remains very difficult to eliminate their presence completely. During the dry season, large numbers of bags can be seen blowing about on farm plots. Lewcock's (1995) study into farmers' use of urban waste in Kano also confirms that the prevalence of plastic bags has increased in recent years, and has become a significant health hazard for livestock who eat the bags but cannot digest them.

Plate 7.2 Polythene bag hazard during the wet season at Kwarin-Dankukuru

Jakara Site (off Airport Road)

Domestic waste water released from the residential areas of Kano's ancient walled city, Sabon Gari, and Gwagwarwa all drain into the Jakara channel, which flows into the Jakara River. Unlike the water in the Getsi, the Jakara water shows no evidence

of pollution by heavy metals. While a number of small-scale tanneries are located in certain parts of the old city, field visits confirm that no metals are used in the tanning process. However, referring to Table 7.2, it can be seen that other pollutants, including cobalt, manganese, and iron, have been found in high concentrations. These may pose toxicity problems to crops, since most crops lack the complex, internally balanced homeostatic mechanisms that regulate body function and adaptation that are found in animals.

Plate 7.3 Vegetable production at the Jakara site

A significant amount of vegetable production takes place using the polluted water near the Airport Road bridge where crops are irrigated by water from the Jakara channel (Plate 7.3). Farmers report observing colour differences in effluents at different times during the day, indicating that there are also temporal variations in water quality in the Jakara. This observation is reflected in the values of the tested parameters, taken in the morning hours and afternoon hours (see Table 7.2). As Figure 7.1 illustrates, the Jakara joins the Getsi, and thus the water in the Jakara helps to dilute toxins originating from the tanneries and textile mills in the downstream portion of the Getsi system.

The Jakara site is located near Airport Road bridge in a high-density residential area. Substantial vegetable production takes place on the south west side of the road, and crops are irrigated by water from the Jakara channel, which flows through the Birni (old city), Fagge, Sabon Gari and Gwagwarwa, and serves as the main drain for built-up areas along the way. Since most of the water entering the irrigation channel comes from residential sources, this helps to dilute toxins originating from the tanneries and textile mills. However, according to one respondent, there is presently less water of acceptable quality entering local water courses:

> By the time the water reaches our farms, it has usually been diluted. Sometimes though, we see green water, which is very bad because it will burn the crops. The green water has only just started this year. Many factories that used to pump clean water into the channel have closed down in recent years, so now the bad water is not as diluted. Because of this, we have started to see the green water this year (Amadu, pers. com., 2002).

Of further concern, pathogenic viruses, bacteria, protozoa and helminths are often present in municipal wastewater released into the Jakara and pose an additional health hazard to local people (Pescod, 1992: 33). However, there is some evidence to suggest that liquid waste from sewage could be a valuable commodity in UPA if recycled properly, since it contains many useful elements such as nitrogen, potassium and phosphorus.[2] As Pescod (1992) suggests, if local authorities were able to harness the beneficial characteristics of domestic wastewater, not only would surface water pollution problems be mitigated, but valuable water resources would be conserved and dependence on commercial fertilizers might be lessened.

Kofar Ruwa Site

The Kofar Ruwa production site is located in a low-lying *fadama* depression adjacent to the north-eastern part of the old city wall and it covers an area of approximately 350x250 m² (Lynch *et al*., 2001). The site is situated in the floodplain of a small tributary of the Jakara River, which serves as a drain for urban wastewater in the built-up area immediately to the north of the city wall. The construction of a sewage treatment scheme was initially started in the late 1960s to treat waste water from the Gwammaja housing estate and Dala Orthopaedic Hospital, but the project has long been abandoned. Like other UPA sites in and around Kano, sources that supply irrigation water are heavily polluted and have been flagged as a major environmental and health concern.

Previous interviews at the Kofar Ruwa site conducted by Lynch *et al*. (2001) over a four-year period, reveal that perhaps the major constraint faced by farmers in the area is that of insecurity of tenure. However, more recent interviews conducted for this study suggest that concern for the quality of available water was also a significant issue for many farmers. According to one cultivator, both the odour and colour of water sources change periodically at Kofar Ruwa, especially during the dry season. Sometimes, it was reported that the poor quality of irrigation water was responsible for 'burning' the lettuce and causing it to 'dry up'. As Table 7.2 indicates, although no traces of heavy metals were detected in the samples taken at the Kofar Ruwa site, toxicities of some of the domestic contaminants, especially manganese, were detected and this would explain the 'drying up' of crops. Farmers also reported that soils were of poor quality and that crop yields were typically low. Of particular concern, however, are the high salinity and sodicity indices. Sodium has a mean

2 See Brook and Dávila (2000) for a discussion of how the high nutrient load in sewage can reduce the needs for fertilizer inputs in peri-urban agriculture, as revealed in their study in Hubli-Dharward, India. In another peri-urban context, see Mukherjee (2006) who looks at the positive aspects of recycling wastewater for aquaculture in peri-urban Kolkata, India.

value of 38.5mg/l, and the water has a calculated Sodium-Adsorption Ratio (SAR) of 16.8 which is high enough to cause the loss of soil structure and deflocculation.

In addition to concerns about water quality, a number of respondents at Kofar Ruwa admitted that the general lack of water in the dry season was also a problem and sometimes farmers were forced to use poor quality water on their plots. In fact, in the survey conducted by Lynch *et al.* (2001), respondents revealed that the majority of the water used for irrigation at the site was waste water, and the amount available largely depended on levels of consumption by households in the surrounding built-up areas. Unlike Kwarin-Dankukuru or Jakara site, cultivators did not generally use motor-driven pumps to irrigate, but rather relied on gravity fed irrigation or buckets to transport water. Some plots had better access to water than others and crop choice was largely determined by water availability. The prolonged use of this polluted water had caused the soil to 'die', according to one farmer. In the past, admitted a second farmer, the authorities had warned the public not to consume vegetables which were grown at Kofar Ruwa, especially at times when cholera was a threat.

The need for an integrated management approach

Of the many environmental concerns that need to be urgently addressed in urban and peri-urban Kano, increased levels of pollution in local water sources are at the top of the agenda and deserve immediate attention. According to one World Bank report, advisors warn that water contamination has the second highest potential for future negative impacts on GDP. In Nigeria alone, increased incidences of water-related diseases cost the country an estimated US $1 billion annually through increased health costs and lost productivity, and put 40 million people at risk (World Bank, 1990). In practice, there are laws in place requiring the treatment of industrial waste before disposal (Egborge, 1998). However, in greater Kano, water treatment and even water supply facilities are virtually non-existent, such that poor people, including those who engage in urban and peri-urban farming practices in order to make ends meet, cannot afford defensive sanitary practices. Local surface water is of vital importance and the shallow ground water supplies found in *fadama* depressions where much of the peri-urban agriculture takes place, are highly polluted with urban and industrial contaminants.

At Kano's three industrial estates – Bompai, Challawa, and Sharada – industrial sludge and liquid waste are routinely deposited in open drains, sewer systems and water courses without treatment. The waste treatment facilities that do exist are either inadequate or not functioning, and very little enforcement takes place. Poor zoning and enforcement by-laws in the industrial areas seem to exacerbate problems, as landowners continue to sell their property to housing developers, since few new manufacturing facilities are being established in Kano at the present time. As long as such practices continue, housing encroachment and urban agriculture will continue alongside industry, pollution rates will continue to rise at an alarming rate and the health of the local population will remain in jeopardy.

It should also be noted that in Kano, and indeed other Nigerian cities, penalties for violating industrial standards are very lax or in some cases non-existent. Market-

based incentives to reduce pollution, such as the 'polluter pays' principle, or grants, subsidies and tax credits for environmentally friendly behaviour, either do not exist or are ineffective. Further compounding these problems, responsibility for pollution control enforcement is not clearly defined and both state and federal governments seem to disagree on who should be liable. Coordination among environmental agencies is weak and a new integrated approach to peri-urban pollution problems is urgently needed, so as to stimulate cooperation between different levels of governance in a region where administrative boundaries have become more or less irrelevant.

Thus recognizing the role that both local industry and the state play in driving environmental change in Kano remains vitally important. In the case of Kano, technical and financial barriers most certainly constrain the ability of many businesses to mitigate environmental practices. However, following Bryant and Bailey (1997), we must also acknowledge the possibility that local industry may wield sufficient power in relation to other actors, so as to minimize or avoid the environmental costs associated with the manufacturing process. Indeed, as Korten (1995: 30) points out, 'waste disposal practices reveal with particular clarity the relationship between power and the allocation of environmental costs.' In short, in many poor African countries, the continued quest for economic growth and industrialization has led to what Korten refers to as a 'race to the bottom', where local governmental authorities disregard or ignore pollution regulations in an attempt to attract industry. More often than not, as is the case in peri-urban Kano, it is clearly the marginalized grassroots actors who are the most vulnerable to the ecological crisis and environmental deterioration caused by industry. As Bryant and Bailey (1997: 40) point out, 'the link between...[environmental] costs (e.g. land degradation) and weaker actors is merely the flip-side of the connection between powerful actors and environmental benefits acquired through privileged access to environmental resources.'

Conclusion

In the process of exploring the issues of water quality and land degradation, this chapter has raised some important environmental concerns that appear to be having an impact upon UPA in and around Kano. Many of these concerns have further implications for health. The discussion has suggested that if UPA is to be encouraged and fully incorporated into Kano's urban planning strategies, then there is a pressing need for further research. As Lynch *et al*. (2001: 170) point out, perhaps one of the main problems with much research on UPA has been that it identifies the advantages of growing food in the city from a relatively restricted perspective and fails to engage with a greater understanding of such activities in relation to specific issues, such as land tenure, health and environmental concerns. In this light, in considering some of the issues that have been raised about UPA in Kano, the empirical evidence presented in this chapter suggests that there are many areas where joint research between urban planners, agricultural scientists and health specialists must be carried out in the immediate future. However, whilst the focus of the enquiry has been on just one city, in reality these findings are by no means situation specific, but may

have much wider relevance for other large cities in Africa. It seems that a number of key issues require urgent attention in Africa's rapidly growing cities;

- The scarcity and prohibitive cost of irrigation water and chemical fertilizer have forced many local actors to seek unsustainable alternatives which are currently jeopardizing both health and environment in urban and peri-urban areas. Improving access to safer water resources should be a top priority.
- Industrial pollution management capabilities are severely constrained at institutional levels, both financially and technically, and there is a lack of effective implementation of environmental management laws. Substantial investment and community action are needed in urban and peri-urban waste management.
- There are many linkages between environment, health and UPA, such that a holistic understanding is urgently needed. In order for improved management techniques to be implemented, a condition that is crucial for food security, environmental and health impact assessments must be conducted in order to identify these linkages and to evaluate the relative seriousness of different situations. Only after such assessments are undertaken can sustainable solutions be proposed and then implemented.
- Levels of pollution in urban and peri-urban water sources vary both temporally and spatially, and there may be safer times and locations where agriculture can be encouraged by authorities. There is an urgent need, therefore, for UPA practices to be carefully monitored both spatially and temporally.

The benefits of UPA are far-reaching in terms of providing employment, food security and income generation and these have been well documented in the literature. It is evident that the food production sites examined in this chapter provide a valuable resource for meeting the challenges of a rapidly growing city, and many Kano residents now rely heavily on food grown on urban and peri-urban plots in order to make ends meet. However, at the same time, as the competition for scarce resources continues in and around Kano, it seems that financially strained governments at municipal, state and federal levels, are no longer effectively managing the environment. Indeed, there is much cause for concern and the resolution of many problems concerned with environment and development in urban and peri-urban areas will undoubtedly be determined by the quality of governance at various levels, a key issue identified in the recently published *World Water Development Report* (UNESCO, 2003).

Despite a considerable body of literature that has examined urban health issues, there have been relatively few studies that have explored the complex interrelation between the environment, health and UPA, and there is a pressing need for further research in this context. In particular, comparative longitudinal studies are needed to evaluate the different short-, medium- and long-term impacts of pollutants on crops, the environment and human well being. As Kano, and indeed other African cities continue to expand at alarming rates, the proliferation of UPA seems likely to continue unabated and it is essential that such activities become both safer and more sustainable.

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Chapter 8

Sustainability Challenged? Seeing beyond Kano's 'Political-Ecological Footprint'

Introduction

This final chapter seeks to identify and draw out a number of key themes that have recurred throughout the individual chapters in the book. Although the discussion cannot claim to provide a comprehensive review of all the chapters, the main findings that emerge from the study are highlighted. More importantly, however, the discussion attempts to locate these context-specific micro-level findings within a broader research agenda for further work into the dynamics of peri-urban environmental change. The chapter begins with a brief review of the main motivations for the research. Of particular concern to this study has been the need to adopt an integrated approach that seeks to reorient the direction of enquiry towards a more holistic focus on livelihoods and natural resource management in Kano's urban hinterlands. Following McGregor *et al*. (2006: 320), the significant consequence of pursuing such an integrated approach in practical research terms is, 'to shift attention away from studying or verifying peri-urban natural resources management and livelihood strategies as somehow distinct (or unique), and towards a more nuanced and holistic understanding of peri-urban resource use and management as part of the livelihoods/survival strategies, and the perceptions and priorities, of peri-urban residents.' Indeed, although the research on which the book is based has set out to reconsider the relationship between people and environment in the Kano region by focusing specifically on the complex issue of land degradation, there are certainly lessons here which are applicable to natural resource management issues on a much wider scale. Following a discussion of the key findings of the study, the chapter then endeavours to contextualize local voices and place micro-level findings within a wider research agenda. As this concluding chapter will seek to demonstrate, appreciating human–environment interaction in its broader context remains essential if a more complete understanding of environmental change is to emerge in Kano's CSZ and beyond.

Land degradation beyond the rural-urban divide: Moving towards a more comprehensive picture of environmental change

In the introductory chapter of the book, the motivation for this study was set out and attention was focused on several important considerations that have set this

investigation apart from other studies of environmental change. First and foremost, it was noted that to date there has not been an in-depth actor-oriented study that has explored the effects of urban growth on land degradation, nor has there been a meaningful critical evaluation of how the knowledge, understanding and perceptions of local actors have affected their land-use decisions in the rural-urban interface. Bryant and Bailey (1997) note that although there is a growing body of literature that addresses land degradation and management in an urban context, most studies do not adequately locate urban environmental change in the hierarchy of inter-related social, political and economic forces which operate at greater scales. Thus, they suggest that one novel way of looking at peri-urban environmental change and conflict might be to build on Rees's notion of the 'ecological footprint', adding a 'political' dimension to the enquiry and developing the idea of a 'political-ecological footprint'. By placing micro-level actors within their 'situated contexts' (Long, 1992) and appreciating that the way people perceive their environment and make land-use decisions is often highly political, it is hoped that this book has taken a first step in shedding new light on studies of urban and peri-urban environmental change in semi-arid areas and indeed more broadly.

As has been argued throughout this book, in the past our knowledge and understanding of degradation issues has often rested on specialized research carried out within a single research discipline. This investigation has highlighted the importance of conducting interdisciplinary research into land degradation, arguing that an approach is required that combines analytical tools from both the natural and social sciences. It has been suggested that the marriage of the two research fields is necessary to effectively address the complex relationship between land managers and their environment. As such, following the principle of triangulation, the fieldwork for this study has drawn on a wide range of sources, allowing for an exploration of the issues from multiple viewpoints. In the process of working across the divide between the physical and social sciences, some of the methodological complexities of assessing land degradation have been revealed. This became particularly apparent in the discussion concerning soil fertility levels in Chapter 5, where it became clear that positivist interpretations of land degradation must not be viewed in isolation of local knowledge of the environment, livelihood diversity and change. The analysis demonstrated that 'scientific' assessments of soil fertility, such as the calculation of nutrient balances, do not always accord with farmers' perceptions of the soil. It should be noted that the point being made here is not that one type of knowledge is inherently wrong, or even that one form of knowledge is necessarily superior to the other. Clearly, both 'scientific' and local level 'indigenous' perspectives have positive aspects and shortcomings to their approaches. What does remain crucial, however, is that a more encompassing view of environmental change is demanded; one that encourages an interdisciplinary outlook from a variety of different disciplines, perspectives and scales.

As such, while this book has stressed the need for more people-driven approaches in investigations of environmental change, this is not to say, however, that 'hard' data sources, such as the laboratory analysis of soil samples or the wide range of remotely sensed data that are now readily available to social scientists, cannot also be useful in studies of land degradation. Indeed the selective and critical use of such data can offer

valuable insight to researchers by enhancing their overall picture of environmental change. Yet as Marcussen and Reenberg (1999: 10) note, remotely sensed data on their own 'cannot claim to fully meet the demand for a comprehensive, hierarchical land use model, a 'mental model' which also incorporates the socially constructed environment.'

Although in this study, remotely sensed data, satellite imagery or aerial photography were not employed in the analysis, it is acknowledged that such information sources could be very useful for mapping present-day rates of land-use and land cover change in peri-urban Kano. If an accurate and up to date baseline resource could be created for Kano and its hinterlands, then many of the current pressures on environmental resources could be identified and the consequences of urbanization, resource degradation or pollution could potentially be quantified. In particular, as McGregor *et al.* (2006) point out, the impacts of these pressures on water and other ecological resources require careful monitoring and having access to baseline data on biophysical information could assist in planning for the sustainable use of natural resources. For example, in Chapter 6, the discussion of the research undertaken by Herrmann *et al*. (2005), who carried out a broad-scale analysis of remotely sensed and satellite data over time in the Sahel, revealed how the use of these advanced tools can be beneficial in studies of land degradation. Moreover, the use of Geographical Information Systems (GIS) analysis has also been successfully adopted by a number of other researchers in peri-urban contexts, which has helped to clarify observations and provide a framework for decision-making and future planning (Diaz-Chavez, 2006). The usefulness of GIS in peri-urban studies has recently been acknowledged by the UK Department for International Development (DfID), who have adopted its use in their Natural Resource Systems Programme (NRSP) in Kumasi, Ghana (see McGregor *et al*., 2002).

Although data collection methods that focus on the broad picture of land degradation remain important tools for understanding environmental change, it has been widely argued that many inappropriate development strategies have stemmed from research methodologies that fail to appreciate the 'whole picture' in communities, and in particular ignore local people's perceptions, needs and understandings (Binns *et al*., 1997). All too often in the past, simplistic answers to perceived environmental problems have been the product of single or narrow-minded perspectives. Indeed, one of the major limitations of many investigations into people–environment interaction has been that they have not adequately taken local people's views on board. Many studies have adopted centrally driven, top-down approaches which have failed to appreciate the complexities of socio-economic and cultural contexts in which livelihood and food production systems function. Fortunately, however, many researchers now have a much stronger recognition that local actors possess a detailed and sensitive understanding of their environments. Such environmental knowledge has become vital, as local actors continue to adapt their livelihood portfolios to cope with increasingly uncertain environmental conditions.

The embracing of more participatory methods of data collection represents a significant step forward in understanding and interpreting people-environment relationships and in particular, studies of land degradation. Although, as Stocking and Murnaghan (2001) point out, RRA and PRA methodologies have tended to be

dominated by social or economic enquiry, studies which look at change in natural resource quality can also benefit from the use of more participatory approaches. In short, the utilization of techniques that bridge the natural and social sciences is absolutely vital in obtaining a more accurate and robust picture of land degradation that is inclusive of all land-users. Of key significance to this study, is that the local-level findings considered in the three empirical chapters have supported the understanding that land degradation is a social construction and has different meanings for different individuals. With this in mind, the study has adopted an approach that embraces multiple perspectives and attempts to make sense of their differences and commonalities.

Key findings and lessons emerging from the study

As we have seen, over the years, Kano and its region have attracted much attention from researchers, and a number of influential land–society studies have surmised that sustainable intensification will continue well into the future, even in light of increasing levels of resource competition. Although many of these studies have been instrumental in challenging the degradation 'myths' and environmental orthodoxies that have been so uncritically adhered to in the past, much of this research, however, does not adequately engage with a series of new pressures which may currently be challenging the symbiotic relationship between people and their environment.

Indeed, the evidence presented in Chapters 5, 6 and 7 suggests that there are some significant challenges which are being faced, as urban expansion continues to exert a strong influence on the livelihood resilience of individuals, households and communities in the CSZ. There is no doubt that Kano, like many other burgeoning sub-Saharan cities, has grown significantly in physical size over the last four decades and in the process, its urban fringe has steadily become a zone of contested terrain. It also remains clear that intense competition for resources in the rural-urban interface has put increasing pressure on the peri-urban environment. Many previous land–society studies have been founded on a strong dichotomy between the urban and rural sectors, but the arguments in this book have challenged this assumption and the investigation has revolved around the increasingly widespread interaction between Kano and its hinterland, a feature which has been present for centuries.

Over time, the width, nature and boundaries of the rural-urban interface have changed as they have been shaped by the varying pace of urban growth and its related processes (McGregor *et al*., 2006). As such, although this study has presented a 'snap-shot' picture of land and society in the Kano CSZ, it has tried to relate this image to both historical processes and wider structures of change. Throughout this book, the discussion has stressed that in the process of exploring environmental change, the changing nature of the interconnections between urban and rural issues over time and space must not be forgotten.

Today in the Kano CSZ, rural-urban linkages (including the flow of people, wastes, *taki*, fuelwood, and other environmental resources) and strong sectoral interactions (such as urban and peri-urban agriculture) are a vital component of livelihood portfolios. Studies which appreciate the significance of these backward

and forward linkages and acknowledge that rural and urban livelihoods are becoming progressively intertwined, can play a key role in informing natural resource policies and projects, ensuring that they may have more relevance to the needs of local people. In an attempt to bridge the rural-urban divide, this investigation has adopted a spatial framework and has endeavoured to present a comparative picture of how management abilities, access to resources and livelihood portfolios may change along the so-called rural-urban continuum.

In some instances, as was clearly the situation with many of the soil parameters investigated, it remains uncertain as to whether a clear spatial relationship actually exists between processes of urbanization and the specific environmental changes that are currently taking place in the surrounding countryside. As Main (1995) points out, the complex manner in which urbanization and many other associated development processes are interwoven, frequently makes it difficult to discern a clear and accurate picture of what is happening. In other instances, however, the relationship is less uncertain and there appears to be a strong connection between the influence of the city and the ensuing environmental change. Although those individuals who engage in peri-urban agriculture often benefit significantly from their close proximity to urban markets and may be more readily able to gain access to certain nutrient inputs for agriculture, such as *shara*, it is also evident that there are some very serious environmental trade-offs associated with farming in the urban shadow.

As was discussed in detail in Chapter 5, peri-urban farmers are often threatened by acute land tenure insecurity and may face grave problems associated with the encroachment of urban development. Inadequate regulatory controls for access to peri-urban land invariably leads to land accumulation by the wealthy and land alienation and marginalization for the poor. Moreover, as the materials for manufacturing concrete building blocks for urban development continue to be sourced in close proximity to the city, peri-urban farmers must often face the significant environmental burdens caused by sand collectors. As we saw in Chapter 2, sand extraction has not only accelerated soil erosion in many peri-urban communities, but has also been responsible for creating hazardous water filled quarries which provide breeding sites for mosquitos. Furthermore, in Chapter 7, the discussion revealed that high concentrations of urban and industrial waste are most definitely a function of proximity to the city. For the foreseeable future, the build-up of both domestic and industrial toxins will have a serious impact on water sources in the rural-urban interface, which will undoubtedly have considerable knock-on effects for the sustainability of other natural resources in the peri-urban environment. This will most certainly have alarming consequences for the livelihoods of local people who rely on urban agriculture for providing employment and income and supplementing levels of household nutrition.

Although it is the case that certain discrepancies were apparent between competing types of knowledge in this study, when the local-level findings of the research are situated in a comparative perspective, it becomes evident that the seemingly different concerns of individual actors are not always mutually exclusive. Although different actors are susceptible to different problems, and indeed perceive the environment and the issue of 'degradation' in entirely different ways, it is vital to understand that scale, environmental problems and actors are all inter-connected up and down the

chain. By taking a more holistic approach to land degradation, the systemic effects of how the elements of one system might impact elsewhere, can be appreciated. Whether the enquiry focuses on the individual, the household or the community, it is often only at this local level that the real complexity of the decision-making process can be fully appreciated. Thus an understanding of these micro-perceptions remains paramount since they often determine how and why local actors behave in the way they do. In short, although this study is one of locality and focuses almost exclusively on micro-level analysis, there are a number of significant lessons that are relevant to other burgeoning sub-Saharan cities that are facing similar pressures as Kano and its CSZ. The main conclusions that can be drawn from the study are summarized as follows:

- While there may not always be a strong spatial relationship between urban pressure and the degradation of resources, evidence from the Kano CSZ suggests that 'pockets' of environmental pressure do exist, especially in the 'inner' peri-urban regions where competition for land and resources is often the most intense.
- Although many farmers often adopt creative and ingenious strategies for coping in increasingly difficult and variable non-equilibrium situations, recent increases in the competition for resource use between local actors point to mounting evidence that the sustainability of a once apparently resilient system is being challenged like never before.
- As the competition for scarce resources intensifies and pressures associated with urban growth continue to shape land and society in dramatically new ways, it remains unclear as to whether livelihood strategies will retain the resilience that they have shown in previous times.
- Differences in the capabilities, opportunities and constraints of individual actors play a significant role in shaping their management abilities, and it remains imperative to explore the role that politics plays in formulating land-use decisions and determining access to resources.
- Perceptions of the environment and land degradation vary both spatially and temporally, and urban pressures play a defining role in how different actors imagine and construct their landscapes.
- Indigenous perceptions of environment and resources are often framed by broader livelihood concerns, which come to influence the way in which different actors view and respond to their environments.
- There appears to be much interlinkage between the various types and manifestations of land degradation, and therefore local assessments of specific resources (such as soil fertility levels, the extent of tree-cover or water quality) may also prove a useful indicator for assessments of other biotic resources.
- Policies that attempt to regulate land management in the CSZ need to be flexible, and must accommodate a wide range of actors and their diverse livelihood strategies.
- In-depth studies into indigenous and community-based 'institutions' are urgently sought, and the question of how institutional arrangements mediate access to resources in a 'politicised environment' are of critical significance.

- Explorations of the effectiveness of community-based institutions, how they have come to be challenged in recent years, and how they might operate more effectively in future, are issues of key importance and demand further study.

Ultimately, a better understanding of the relationships between people and environment in and around Africa's growing cities is vital for both successful and sustainable development planning in the future. The many urgent issues that confront environmental planning and management in the peri-urban interface pose a great challenge for both researchers and policy makers. A more critical evaluation of how the knowledge, understanding and perceptions of local actors drive behaviour and affect land-use decisions at the local-level is essential if viable and sustainable environmental policies for the future are to be initiated.

Charting a way forward

So what lies ahead for the sustainability of the Kano CSZ? Should we be concerned about the resilience of a system that has previously been so widely heralded as one of Africa's great success stories in sustainable management? What of the adaptability and flexibility of management systems that have been so extensively documented in the past? If it is the case that indigenous coping mechanisms, or the so-called 'moral economy', will continue to be challenged, how will this be 'played out' in relation to the linkages between land and society? And how will urban pressures continue to affect peri-urban land-use patterns? All of these far-reaching questions beg complex answers and quite clearly, further research is needed to gain a more robust understanding of the nature and dynamics of what lies ahead for Kano and its CSZ.

In short, there is every reason to believe that the findings of a number of the pioneering studies carried out in the Kano region, particularly the work conducted some years ago in the early 1960s, need to be revisited. Although it may well be the case that the adaptive capabilities of dryland households are perhaps their greatest resource, it has been clearly pointed out by the influential *West Africa Long Term Perspective Study* (1995) that many regions of West Africa are currently undergoing substantial and profound socio-economic transformation. Although local actors do continue to adapt and demonstrate a great degree of flexibility in their livelihood systems, it is increasingly becoming evident that the choices they are faced with are becoming less and less attractive. This was perhaps most clearly illustrated in Chapter 7, where the discussion highlighted how peri-urban farmers are faced with the choice between a number of undesirable options when irrigating their plots – they must decide whether they will irrigate their crops with the red water, the green water or the blue water, none of which is likely to present them with a sustainable situation.

The actors in this study have generally demonstrated a wealth of environmental knowledge and have shown great skill in manipulating a range of environmental features to secure a livelihood for their families. However, as the competition for scarce resources intensifies, and pressures associated with urban growth continue to

shape land and society in dramatically new ways, it remains unclear as to whether it will be possible for livelihood strategies to demonstrate the resilience that they have in previous times. While the identification of the role that indigenous knowledge can play in land management strategies will certainly be a major element in ensuring the sustainability of livelihoods in the Kano CSZ, there remains a danger of over-romanticizing the role that local knowledge can effectively play in a rapidly changing world, where it appears that constraints and pressures from all fronts are challenging traditional systems. In such a changing scenario, we must exercise caution in being drawn in by what some have referred to as the 'Merrie Africa' syndrome, where all that is traditional is considered to be good and all that is modern is considered to be bad (Binns, 1995).

In light of the many serious issues that have been highlighted in this book, one of the central questions that must be considered is, how can the positive links between the city and countryside be strengthened, and how can the detrimental linkages be ameliorated? Interventions aimed at alleviating many of the problems that have been the subject of this study will involve a shift away from approaches that concentrate on the physical scarcity of resources, and a move towards an appreciation of the underlying reasons why people's ability to secure effective command over environmental goods and services may be denied. Since the beginning of the 1990s, there has been a growing recognition of the importance that 'institutions' play in the development process, and attention is increasingly being given to how institutional constraints shape the way in which individuals and groups gain access to and utilize resources (Mearns, 1995; Leach *et al*., 1997). A wide range of institutional arrangements may be relevant for understanding how different actors gain legitimate command over environmental goods and services, and why others are excluded. Such institutional dimensions may include both formal and informal rules of land and tree tenure, family and kinship systems, the way that communities are organized or local government administration. In the case of Kano and its CSZ, further research into indigenous institutions and coping mechanisms could provide some vital answers to many of the questions which remain unanswered. In-depth studies are needed to explore how the effectiveness of community-based institutions has become challenged in recent years, and how they might operate more effectively in the years to come.

Indeed, if it is in fact the case that traditional land management strategies have come under increasing pressure in recent years, it would appear that they have not been effectively replaced by other mechanisms. One key issue that remains of vital significance to land management strategies in peri-urban zones throughout the developing world, is that there is clearly a lack of effective government planning or interventionist policy. As McGregor *et al.* (2006) point out, one of the major problems with many public environmental policies is that they are designed to be applied exclusively to either urban locations or rural areas. Since the peri-urban interface is neither solely urban nor rural in nature, specific peri-urban issues are rarely adequately addressed. Growth and development in peri-urban regions essentially remain informal, and many individuals take advantage of the fact that government regulatory capacity in these dynamic and constantly shifting areas is weak. For example, the proliferation of sand miners who are presently operating in

peri-urban Kano without any regulation whatsoever, or the increased incidence of highly toxic industrial effluents which are discharged into peri-urban water courses, are cases in point. However, while Dávila (2006) acknowledges that a peri-urban policy vacuum may have accelerated the degradation of the peri-urban resource base, he believes that the creation of specific policies designed for peri-urban zones may not necessarily be the way forward. Instead, he argues that what is truly needed is 'a greater awareness of the effects of sectoral policies on spatially localized groups, particularly those who are more vulnerable or disadvantaged economically, socially and environmentally' (2006: 53).

In response to the short-comings of centralized approaches to service delivery and resource management in the rural-urban interface, a number of recent studies have stressed the potential benefits of adopting more decentralized approaches to management, which are considered to be more appropriate for peri-urban areas (Parkinson and Tayler, 2003). The concept of decentralization is currently at the heart of development and governance debates, raising questions about interactions between local government and community institutions, and their roles in resource management, poverty eradication and the strengthening of livelihoods at the grassroots level. Dávila (2006) believes that centralized decision-making bodies are less likely to be responsive to the high temporal dynamism and the rapid pace of change that is characteristic of the peri-urban interface. Since decentralization is often motivated by the idea of bringing government closer to the people to ensure better representation, responsiveness and accountability, Dávila argues that more localized governance structures which favour 'co-production' arrangements between state agencies and organized groups of citizens, are more likely to generate sustainable outcomes in peri-urban regions.

However, it has also been suggested that in certain situations, the devolution of power to the local level may result in unintended negative consequences in the context of rapid urban growth. For instance, local authorities may lack the capacity to face the additional burdens associated with increased environmental pressures, which may actually exacerbate existing tensions between peri-urban communities and those living in the urban core (Dávila, 2006). There are, of course, numerous problems associated with the recent decentralization experiments of many African governments, none of which will be rehearsed in detail here.[1] However, the role that the decentralization of natural resource management can play in the sustainability of peri-urban regions needs to be further explored. Bringing decision-making abilities back into local hands would seem an essential first step in redressing many of the critical peri-urban environmental problems highlighted in this book, and in recent years there has been much interest in the decentralization of regional development planning. Moreover, the role that small and intermediate-sized towns can play in the development process, by serving as bulking points and reducing some of the stress currently building in the regions that surround growing cities, has also been noted (Pedersen, 1997). According to Tacoli (1998: 153), 'What is needed is [a] real decentralization of decision-making, with investment and resource-raising at the

1 See Ribot (2004) for an extensive review of decentralization initiatives involving natural resource management in Africa.

local level which will allow the articulation of local needs and priorities and which will stimulate both rural and urban development.'

Although a meaningful shift from the central to the local level may foster a more flexible approach to regional planning, in the long run, substantial investment and community action will be needed in urban and peri-urban management. Above all, policy makers must demonstrate some of the 'adaptability' and 'flexibility' that smallholders in Kano's CSZ have become so famous for in the past. In order for local people to continue coping in increasingly difficult circumstances, the policies that attempt to regulate land management in Kano's peri-urban zone and the surrounding CSZ, need to be flexible and must accommodate a wide range of actors and their diverse livelihood strategies.

Conclusion

In the near future, all signposts appear to suggest that the competition for scarce resources in Kano's CSZ will undoubtedly continue, the sustainability of systems once considered to be 'closed' will further be challenged, and actors at all levels will find it increasingly difficult to manage their environments. At the grassroots level, many individuals in need will no longer be able to rely on the traditional safety nets and coping mechanisms that have served them so well in the past, while at an institutional and governmental level, environmental management capabilities will be severely constrained both financially and technically. Although presently, regulations governing land and society supposedly do exist, they are not effectively monitored or enforced, and of paramount relevance to this study is the fact that there appears to be a lack of effective implementation of planned environmental management strategies.

In short, substantial investment and community action are urgently sought in the management of Kano's peri-urban zone if future livelihood and environmental sustainability are to be ensured. Coordination among communities, environmental agencies and government bodies is presently weak and a new concerted programme of action is vital to stimulate effective strategies for the management of the peri-urban environment. Although local actors may be both powerless and marginalized, they frequently possess the most accurate understandings of people–environment interactions and are generally in the best position to evaluate and safeguard their resource base. Acknowledging the perceptions and knowledge of a wide range of peri-urban actors and determining how they fit into the macro-level forces that currently shape Nigeria's development trajectory, will undoubtedly be a key component in ensuring the sustainability of livelihood systems in Kano and its hinterlands. Such a shift in understanding, it is argued, remains an essential first step in re-framing environmental problems and their solutions in the Kano CSZ.

Future research must identify the positive roles that the state can play in supporting local resource management initiatives in the Kano CSZ, taking into account the interests of grassroots actors. However, as Leach and Mearns (1996) point out, 'more and better research' will not necessarily translate into the formulation of more appropriate and effective policy. There is a need for better understandings

of how mutual support between institutions at different levels and scales can be fostered, particularly in times when fewer resources are available and environmental management has become increasingly difficult.

At the UN Millennium Summit in September 2000, member states unanimously adopted the now well-known set of eight Millennium Development Goals (MDGs), which presently serve as a benchmark for global human development. This bold new set of goals, and their accompanying eighteen development targets, call for a dramatic reduction in poverty, marked improvements in the health of the poor and a measurable improvement in quality of life. In recent years, there has been much discussion and debate about how the MDGs can be met in urban and peri-urban areas (Hasan *et al*., 2005). Of the eight MDGs, goal number seven – 'to ensure environmental sustainability' – has particular relevance to this study. Since it is widely recognized that 'the environment' provides goods and services that sustain human development, and better natural resource management increases both income and nutrition levels of the poor, it would appear that achieving 'environmental sustainability' could contribute to reaching many of the other seven MDGs as well. Future studies into sustainable environmental management in peri-urban zones thus remain crucial for securing livelihoods and improving the quality of life in sub-Saharan Africa, particularly since it is the world's poorest and least developed continent, and where urban growth rates are among the fastest in the world. It is also the one region of the world that is least expected to meet the MDGs by the target date of 2015. It is likely that many of the issues explored in this book are also being replicated in other large sub-Saharan cities. Ultimately, this in-depth study has revealed a range of patterns, processes and problems which have much wider relevance in sub-Saharan Africa and beyond.

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