

A dryland case study of local natural resource management in the Maradi-Kano region of Niger and Nigeria¹

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1 Introduction: purpose and approach

The need for a holistic approach to ecosystem management has emerged with renewed force since the signing of the Convention on Biodiversity (CBD). From the local to the global scale, multiple stakeholders in conservation are now recognised, and research is revealing complex interactions in every landscape, subject as always to the forms of management intervention imposed by individuals, communities, peoples, institutions and corporations. Under most development scenarios, these people will continue to be responsible for the everyday decisions that collectively determine the sustainability of vast landscapes, such as the semi-arid drylands of Africa.

The poverty reduction agenda of the Millennium Development Goals calls for interventions in which equity among beneficiaries is a prime consideration - a priority to which many conservation projects in the past paid scant regard. The balance now sought between sustainable ecosystem management and enhanced livelihood security for the poor requires both a theory and a strategy. The Ecosystem Approach developed by the CBD represents a learning strategy that brings together local with scientifically based knowledge.

1.1 A Dryland Case Study

Drylands – typically – are very extensive and tend to cross national borders. While many have little relief, they are environmentally heterogeneous and multiple scales are required to understand them. Different users perceive and exploit them in a variety of ways (Kowal and Kassam, 1978). Variability from year to year (especially in rainfall) and rapid economic, political or demographic change in the longer term necessitate flexibility, adaptability and innovativeness on the part of their inhabitants. These capacities, rather than any ‘carrying capacity’ of natural resources, determine the numbers who can live there and the substance of their livelihoods (Mortimore, 1989, 1998). Drylands do not exist in isolation: economic symbiosis with more humid regions, towns and overseas migrant destinations, always important, has become quite critical for sustainable livelihoods. This characterisation is based on the Sahelian region in particular (Raynaut, 1997); however, it is believed to be representative of tropical drylands in poor countries.

Research in the drylands has not adequately informed policy. It is now generally agreed that environmental planning and management should be decentralised, but appropriate institutions are often lacking at the local level. New thinking about integrated ecosystem management must therefore be translated into effective, accountable and democratic planning, negotiating processes, and decision making.

The purpose of the case study is to capitalize on the lessons learnt from the application of the EA as a means to the end of managing dryland ecosystems sustainably, and ensuring the livelihoods of the people and the conservation of the natural resources.

People and their use of landscape and biodiversity are at the centre of ecosystem management, and no other users’ interests (including those of external agencies

such as donors and conservation organisations) should automatically be privileged. However, conservation, productivity and sustainability (outside protected areas, where the focus of conservation efforts is now shifting) all depend on decisions made by local managers, a majority of whom are poor and small-scale farmers or livestock producers. The institutional framework governing access to natural resources, and the distribution of benefits from their use, is thus intimately linked *in situ* with the ecosystem itself. Both have evolved together, modified during several millennia of occupation and exploitation.

1.2 Selection of the study area

The Niger-Nigeria border region has attracted attention since colonial times as an area of alleged natural resource degradation, potential desertification, and economic marginalisation. There have been numerous development projects on both sides of the border (e.g., the *Projet du Développement Rural de Maradi*, in Niger, 1978-1984; the *North-East Arid Zone Development Programme*, 1990s, and the *Katsina Afforestation Programme*, 1990s, in Nigeria). A new proposal for a major, long-term (8 years) programme (*Integrated Ecosystem Management in Shared Catchments between Niger and Nigeria - SCNM*) has been approved for funding by the Global Environment Facility (GEF), and began to be implemented by UNEP through the Niger-Nigeria Joint Commission (NNJC) in 2006.

The Niger-Nigeria border region is characterised by extensive, flat drylands, in which transhumant livestock herders move several hundred km north and then south again each year, following the rains and the grazing; where sedentary farmers grow crops along a south-north gradient of diminishing rainfall and increasingly erratic distribution; and population density is increasing as a result of both natural increase and immigration from more densely settled areas in the south. The study focuses on rainfed dryland ecosystems, in which wetland ecosystems play a subsidiary role. The sites selected are representative of the trans-border region in which the 'shared catchments' of the NNJC project occur. To build on, and add value to earlier research, activities of the EA case study took place in the following villages and their local government areas:

- Maradi Region - formerly Department, Niger (listed from north to south, dry to less dry): Dan Kulu, Serken Hausa, and Magami.
- Jigawa and Kano States, Nigeria (listed from north-east to south-west, dry to less dry): Dagaceri and Tumbau (Mortimore and Adams, 1999)

The five villages together comprise a 400km transect from the desert margin (or northernmost limit of rainfed farming) through Sahelian environments of diminishing aridity and riskiness to the edge of the Sudanian biome, and from average annual rainfall of <400 mm to >600 mm.

Given the challenging realities of a dryland environment, the aims of developing an integrated Ecosystem Approach to research for development must include: sharing access to ecosystem goods and services; securing equitable benefits for livelihoods; conserving biodiversity and ecosystem integrity; maintaining or improving biological productivity; and building institutional sustainability.

1.3 Approach and methods

The primary methods used were structured group or individual discussions, supplemented by inventories of biodiversity (as defined by user groups), livelihood and technical options, and some participatory mapping of ecosystem resources or ecosystem areas. Evaluations of 'ecosystem health' based on local understanding

were integrated with science-based indicators. In Nigeria, main emphasis was placed on stakeholder focus groups and village meetings; in Niger, on key informants interviewed on their farms. Following the conclusion of field enquiries, a micro-project linked to biodiversity protection was identified and set up by the communities. The purpose of this exercise was to learn lessons relating to the mobilisation of institutional structures for a common purpose in ecosystem management.

2 Stakeholder interests in ecosystem resources

2.1 The nature of ecosystem management

The ecosystem in a natural world is most often conceived of as a discrete spatial and organisational unit, for example a river basin or catchment. The nesting of ecosystems appears to demand a matching hierarchy of institutions. Logic suggests that to mirror natural organisation in such a way offers the best possibility for

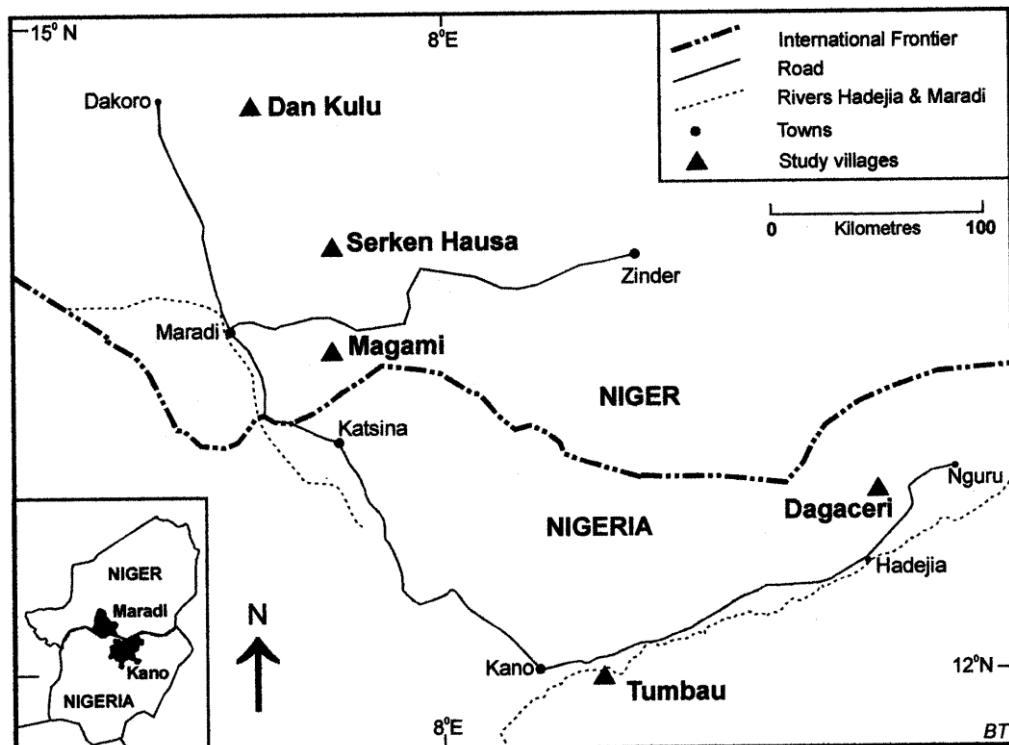


Figure 1: Location of the study villages in Niger and Nigeria

optimising management. However, contradictions arise between ecological, social, political and economic units. Stakeholder groups are not mutually exclusive but rather tend to overlap within the local community. As a result it is incorrect to assume that the summation of all interests in a given location necessarily equates with a 'community' in the sense of universally shared common interests which can together learn to manage 'the ecosystem' sustainably. The way to achieve sustainable ecosystem management is to be found closer to the ground – in understanding the complex and interactive behaviour of stakeholder groups, achieving consensus within

groups about ways and means for managing ecosystem services, and enabling negotiations between competing interests. Such an agenda cannot be imposed from outside, and the challenge for any conservation or development agency appears to lie in facilitation, empowerment and incentives.

2.2 Essentials of regional ecology

The essentials of the regional ecology for all five of the villages, from south to north - Tumbau and Dagaceri in the Kano region of Nigeria and Magami, Serken Hausa and Dan Kulu in Maradi Department, Niger - are summarized in Box 1.

Box 1: Essentials of regional ecology

- The temperature and rainfall distributions follow a seasonal pattern: October - April, May or June dry (relative humidities of <20%); July - September wet (relative humidities often >80%).
- Mean annual rainfall ranges from 200-400 mm in the north (Dan Kulu) to 600-800 in the south (Tumbau), with variations of around 30%.
- From the 1960s until the 1990s, average rainfall declined throughout the Sahel region by up to 33%.
- Perennial rivers are scarce, wetlands confined to the flood plains of rivers or inter-dune depressions. Water table is normally 20-40 m below the ground.
- Soils are derived from former dune sands - low inherent fertility, and scarce organic carbon. They are prone to lose their nutrients over time when cultivated unless replenished by long fallows or fertilization.
- The 'natural' vegetation is open savanna woodland (Sahelian or Sudanic): thorny tree species, regenerating shrubs and perennial or annual grasses and forbs. In natural depressions, river valleys and around seasonal ponds larger trees benefit from shallow groundwater and form small areas of dense woodland. The number of woodland and grassland species identified in the region is reported to be >400.
- Under extensive agriculture, woodland has been cleared over very wide areas and the land converted to fields and fallows. On these fields and fallows, trees are increasingly protected.
- Risk is endemic in production systems owing to the variability of the rainfall and its associated threats. Livestock keepers try to counter risk by moving herds seasonally or year-round; farmers try to store surpluses against crop failure and to find supplementary sources of income. All agriculturalists also invest in livestock.

The minute adaptations which have to be made between more and less dry areas is indicated in Box 2, which compares data from Tumbau and Dagaceri. Dagaceri lies about 100km north of Tumbau.

Box 2: Variations between Tumbau and Dagaceri primary stakeholders

	Primary Livelihood Resources		Secondary Livelihood Resources	
	Farming	Livestock	Ecosystem-based resources	Other
PRIMARY STAKEHOLDERS FARMING SPECIALISTS (to whom livestock are also vital for farming)				
TUMBAU Resources highly integrated: farming is impossible without livestock for - manure traction, ploughing.	Rainfed: Millet, sorghum, cowpeas Irrigated farming in low-lying fadama areas: Rainy season: rice and sugar cane. Dry season – some irrigable fields	Livestock type sheep and goats (manure for farm fertility); hens; better off also have milking cattle and work-bulls or donkeys for carts and ploughs. Overall, small flocks/herds. Grazing regime Animals compound-fed in growing season with cut grasses, weeds and browse supplemented with stored fodder. In dry season browse millet, sorghum and cowpea residues.	Resource availability: Many tree species, trees increasingly found on-farm; grasses rare; stover used for fencing, mud for walls, roofs; small animals found locally; monkey and gazelle in forest reserve. 2 wells. Resource use: blacksmithing; carving wooden tools; selling wood, wild fruits, leaves, thatch grass; herbalists; fishing; hunting bush-meat; mudbrick making; selling water	Trading; house construction; dry season migration; running Koran classes for children; offering prayer services
DAGA-CERI farming specialists - mainly indigenous Manga + immigrant Hausa	Similar to Tumbau but (i) rainfall is lower (ii) population density much lower (iii) the distance to major markets greater (iv) no fadama land (iv) growing season shorter: production of early millet critical to household food security. Sorghum chancy - depends on rainfall.	Same as Tumbau, Animals produce manure for soil fertility; but there is not enough of it - hence the continued importance of fallowing. Land can be cultivated annually with manuring, or for 3-5 years with fallowing. May be left longer to become shrub-grassland.	Resource availability: Some degraded secondary woodland. Trees increasing within the settlement and very slowly in open fields. Resource use: Same as Tumbau + weaving and making a variety of products using dum palm (<i>Hyphaene thebaica</i>) fronds; pottery.	trading, house construction, dry season migration and dress making
PRIMARY STAKEHOLDERS - LIVESTOCK SPECIALISTS				
	WHO	LIVESTOCK TYPE	GRAZING REGIME	
TUMBAU Settled	Fulani households in the village combine livestock with farming, but invest more in livestock)	Livestock type Cattle: herds of 20-50 corralled at night.	Grazing regime: Crop residues; fallows; grass strips on the edges of fadama land; cattle corridors between fields. In the dry season animals moved south to graze	
DAGA-CERI Settled	Settled Fulani combining farming with livestock rearing, keeping mostly cattle. Their farms are larger than those of local Manga farmers.	Livestock type: large herds of cattle and flocks of sheep and goats.	Grazing regime: use grain stovers and community grazing lands, grass on farmers' fallows (often purchased). Send herds away to dry season grazing 25 km south.	
TUMBAU Trans-humanant	Six groups of transhumant herders were camping within the village area at the time of the survey (rainy season). One group was interviewed.	Livestock type 62 cattle and 12 sheep.	Grazing regime: grass strips on the edges of fadama land. In the dry season animals should be moved south to avoid competition with resident livestock keepers. But some transhumants steal crop residues and cut browse from privately owned trees ⁱⁱ .	
DAGA-CERI Trans-humanant	Bororo Fulani from Niger pass through the area during the dry season in years when their home pastures are exhausted.	Livestock type: large herds of cattle and flocks of sheep and goats.	Grazing regime: They compete for farmers' unharvested residues and grasses on farmers' fallow fields, as well as for the use of community grazing lands and forest reserves.	

In the three Niger villages, further north again, individual interviews were held with about 10 key informants in each. Interesting points were made which confirmed and amplified the picture from the Nigeria side of the border.

The primary stakeholders in the Niger village Magami are perceived to be: the resident people, and the transhumant pastoralists. All have common interests in the vegetation, land, and water, and concerns for the sustainability of rainfall and woodcutting (for fuel and for construction). In pursuing their interests in ecosystem resources, these actors draw on a wide range of local knowledge. Stakeholders of course value their ecosystem primarily for its various use values, and they have been become more sharply aware of these as resources which used to have no cash value (such as grasses on field borders) have become scarce and have begun to enter the market.

Individuals noted that farm yields are better where there are more trees, partly because leaf litter contributes to soil fertility but also because trees reduce wind speed and soil erosion. Specialist woodcarvers noted the growing scarcity of the species best for carving and there was talk of beginning to plant them (though suitable indigenous species are very slow-growing). The importance of protecting *Hyphaene thebaica* was noted here as in Nigeria, and cutting permits are now required for this species.

Farmers discussed at length the results of population growth and the consequent increasing demand for cultivable land. Permanent cultivated fields have extended and fallowing is no longer practised in the fields near the village. Further away it continues because transport constraints prevent farmers from using manure. To protect the environment, more trees are needed on both types of land.

Interviewees in Dan Kulu, the most marginal of the five villages, explained their strategies for using ecosystem services to diversify livelihoods. Investing heavily in livestock is one. It is also important to encourage natural regeneration and protect valuable trees when clearing fields.

The inhabitants of both Serken Hausa and Dan Kulu drew field sketches of what they regarded as their immediate ecosystem. We produce that of Serken Hausa here, as an example (Figure 2).

3 The functioning and management of ecosystems

In this section we present evidence of ecosystem change, and consider whether such change is a threat to ecosystem function and sustainable management.

3.1 Changing land use

Unmodified natural vegetation is rare or non-existent, and anthropic factors omnipresent and persistent. Cultivation or short fallow grassland extends to >70% of the surface, throughout most of northern Nigeria and southern Niger, even where population densities are relatively low. This transformation has been accomplished relatively recently in areas remote from towns and political centres, and in the far north of Maradi Region; but in Nigeria, dense populations have been associated with intensively cultivated areas for many centuries and the Kano Close-Settled Zone has rural population densities in excess of 220/km² and ratios of annually cultivated land of >80%.

Tumbau. The land use pattern as mapped from air photographs shows 76% in permanent cultivated fields in 1950 rising to 88% in 1981, at which point cropland was stabilised. Remaining land consists of a few fallowed fields, patches of rangeland, cattle corridors and settlements. This area is characterised by a 'farmed parkland' of mature trees carefully protected and harvested by their owners, at 10-15 trees/ha, and found both on farmland and within settlements. They are systematically managed by lopping, pollarding and coppicing and are only felled when dead.

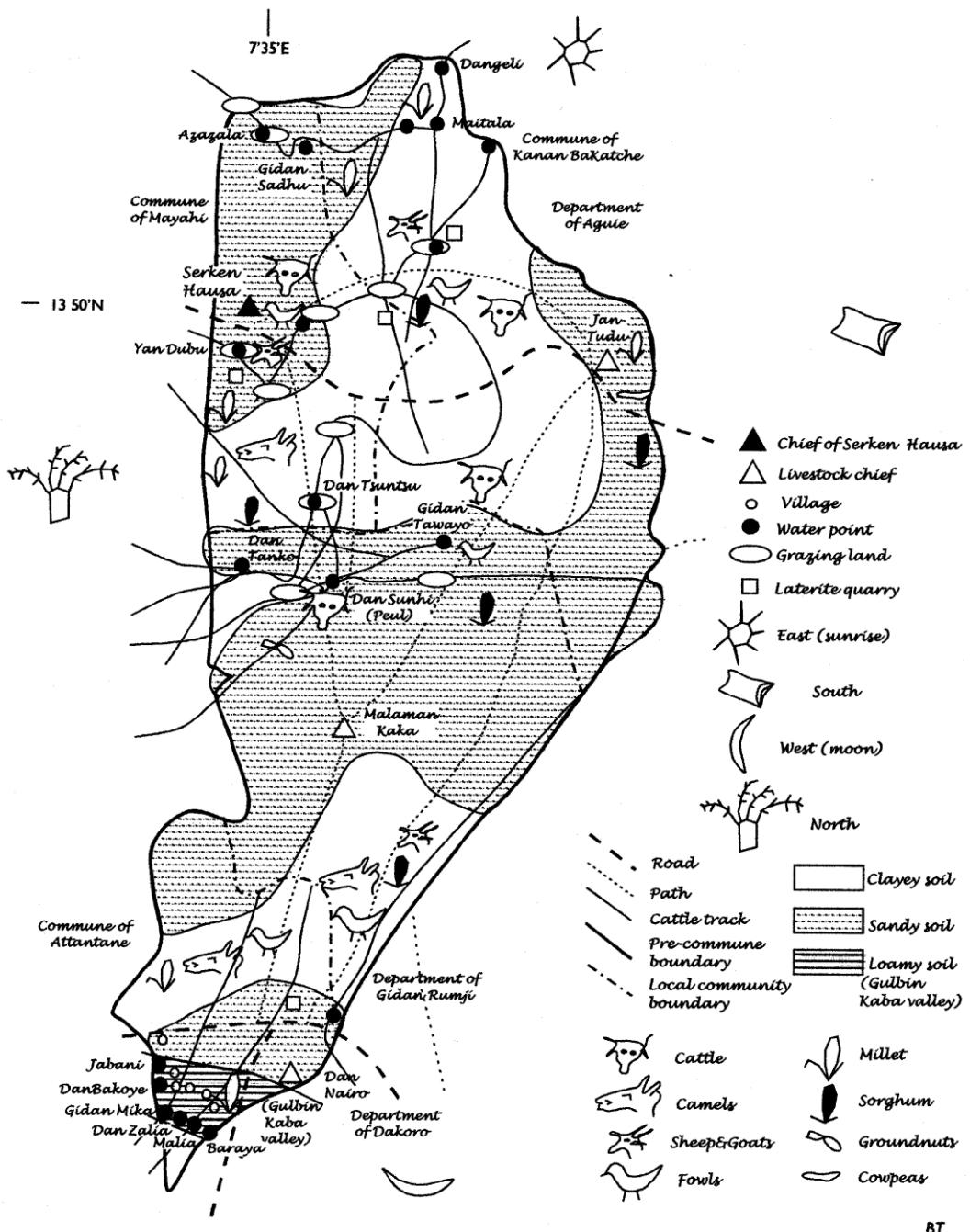


Figure 2: Pictorial field sketch of ecosystem resources: Serken Hausa. This sketch, a composite of field enquiries with local residents, gives a local view of the ecosystem with its differentiation of sites for crop and livestock based activities. It shows awareness of adjacent locations and points of the compass (N: baobab tree; E: rising sun; S: bag of groundnuts; W: the moon).

Dagaceri. The fraction of land under cultivation, including some short grass fallows, after rising rapidly before 1981, stabilised at 57%, owing to government reservation of community grazing areas for livestock keepers. Their vegetation is degraded woodland comprising widely spaced trees and shrubs and a discontinuous ground cover of grasses and herbs.

Magami, Serken Hausa, Dan Kulu. The key difference between the Kano and the Maradi ecosystems in terms of their vegetation is the greater instability of land use and vegetation as one proceeds northwards. By contrast with the old farmed parklands of Tumbau, a shorter history of cultivation (in some areas, <60 years), and the development of annual cultivation only recently, ensure fewer mature trees on farmers' fields, and degraded woodlands.

Land use data at village level are not available, but in the Region the cultivated fraction increased from 59% to 73% between 1975 and 1996 – at least as high as in Dagaceri.

Box 3 shows how tree species are typically spread across the 400km range under consideration. Some key species, especially those important for fruit, food and soil fertility are zealously maintained across the whole range.

Box 3: Tree species commonly found across the Nigerian and Niger sites			
Tree species	Tumbau 600-800mm rainfall	Dagaceri 500-600mm rainfall	Maradi 200-400mm rainfall
Trees typical of farmed parkland in Tumbau			
<i>Anogeissus leiocarpus</i>	x		
<i>Butyrospermum paradoxum</i>	x		
<i>Ceiba pentandra</i>	x		
<i>Parkia biglobosa</i>	x		
Important trees found right across the range of sites:			
<i>Acacia nilotica</i>	x	x	x
<i>Acacia seyal</i>	x	x	x
<i>Adansonia digitata</i>	x	x	x
<i>Balanites aegyptiaca</i>	x	x	x
<i>Faidherbia albida</i>	x	x	x
<i>Mangifera indica</i>	x	x	x
<i>Tamarindus indica</i>	x	x	x
<i>Citrus spp. (in damp depressions)</i>	x	x	x
Common in Dagaceri			
<i>Combretum spp</i>		x	
<i>Commiphora spp</i>		x	
<i>Euphorbia spp</i>		x	
<i>Ficus spp</i>		x	
<i>Moringa spp</i>		x	
<i>Sterculia spp</i>		x	
<i>Vitex spp (doniana?)</i>		x	
<i>Ximenia spp</i>		x	
Common in Dagaceri and in Maradi villages			
<i>Azadirachta indica</i>		x	x
<i>Bauhinia rufescens</i>		x	x
<i>Boscia senegalensis</i>		x	x
<i>Guiera senegalensis</i>		x	x
<i>Hyphaene thebaica</i>		x	x
<i>Maerua crassifolia</i>		x	x
<i>Ziziphus mauritiana</i>			x

There is evidence of recent reforestation in southern Niger as the value of tree products rises in markets, and as a result of the efforts of many environmental

projects (Larwanou et al., 2006). The practice of protecting naturally regenerating trees on farmland has become widely accepted in Magami and Serken Hausa. In Dan Kulu, the most marginal of the villages, many tree species and perennial grasses here reach or pass the northern limit of their distribution.

Farmers' capacity to have an impact on the effects of deforestation through conservation of trees on farms should not be under-valued (Mortimore and Turner, 2005). For the Sahel as a whole, recent analysis of earth satellite imagery between 1982 and 1999 shows statistically significant increases in the 'greenness index', from the Atlantic Ocean to the Red Sea (Eklundh and Olsson, 2003).

What this index cannot show, however, is that as competition for land and natural resources has increased, farmers have protected on-farm locations for trees more often, and allowed trees in open access areas to disappear: trees have been 'privatised' in short.

3.2 The management of soil fertility

Long fallows are now the exception. Under annual cultivation, nutrient stocks and the amount of soil organic matter in the surface layer diminish, and yields fall. Farmers try to obtain organic manure or purchase inorganic fertilizers for application in micro-doses. Success in fertilisation thus depends on economic resources (livestock or cash). The absolute level of soil fertility declines with the rainfall northwards, and actual yields are determined by rainfall in any given year.

Box 4: Farmer Strategies For Soil Fertility					
	Agric	Fertiliser	Livestock	Labour	Other
Tumbau 600-800 mm	Early and late millet + sorghum; cowpea, groundnut, benneseed + <i>Hibiscus</i>	Heavy applications of manure, dry compost and ash	Stall fed in rains; high on-farm densities kept - vital for farm fertility	High use of labour per ha	No grazing area designated
Dagaceri 500-600mm	early millet, sorghum, cow-peas, ground-nut + beniseed, <i>Hibiscus</i>	use of manure	Lower livestock densities	Less use of labour per ha	Designated grazing area exists
Magami + Serken Hausa 400-500 mm	early millet, sorghum, cow-peas + ground-nuts	manuring has begun in fields near settlement	Many farm livestock	Increasing weeding inputs = land-use intensification	No designated grazing areas
Dan Kulu 200-400 mm	early millet sorghum, cow-peas + ground-nuts. Frequent crop failure fr. pests/ drought.	Limited manure available for fertilisation	Low livestock densities	Extensive - little effort spent on weeding	Livelihoods have to be supplement-ed by out-migration

What these data suggest is that soil fertility, a key determinant of ecosystem health (Harris, 1998), is slowly being managed more intensively along the south-north continuum, and farmers struggle to the limits of their capacity to do this. Only in Dan Kulu is such management all but impossible.

3.3 Local knowledge

The term ‘local knowledge’ recognises the dynamism, experimentation, and adaptation that characterise local efforts to extend knowledge resource use, and which involve the combining of local with external knowledge. In managing ecosystem resources, stakeholders draw on collective and personal knowledge enhanced by science-based knowledge from government services or project activities. On this knowledge, future resource sustainability rests.

Knowledge is itself embedded in social and political institutions at the local level. Exercising it is linked with leadership roles, governance functions, social and family status, reputation and wealth as well as the functional needs of the individual in managing a production and livelihood system. Knowledge is a bridge between society and ecosystem management, and new knowledge therefore plays a role in social change. For effective ecosystem management, sharing of local and external sources of knowledge and experience is essential, and an institutional framework for such sharing is required.

In both Nigeria and Niger, the local chief has a complex, multi-purpose role touching on many aspects of ecosystem management, as well as some powers to intervene, whether executing mandates or directives from above or to satisfy local political interests. However, powers differ in Nigeria and in Niger owing to differences in implementing decentralisation policies.

4 Ecosystem resource appraisal

In this section, we apply local knowledge to an appraisal of ecosystem resources. Local knowledge is dynamic and evolving, a mosaic of perceptions gathered from local legacy, personal experience, exchanges with travellers or relatives in other villages, exposure to media (especially radio) and interaction with development practitioners, including training courses (Manvell, 2005).

4.1 Findings

The surveys in the five villages have shown that:

- Indigenous communities have a capacity to assess their ecosystem resources on the basis of an extensive and detailed knowledge of species, typologies and indicators.
- There is consensus that annual rainfall has been declining for at least 30 years, and the times of onset and cessation of rain have become less predictable.
- The second major threat is increasing human and livestock populations. An increase in livestock numbers would increase the supply of manure to sustain agriculture, among other benefits. But farmland cannot be converted into range land, and livestock are increasingly dependent on crop residues (especially in Tumbau).
- Soil fertility, as shown in crop yields, is assessed on the basis of several typologies reflecting colour, texture, depth, wetness, hardness or cultivability, and perceived health. The effects of and need for fertilisation are understood.
- There is a problem of maintaining soil fertility, but this is not perceived as a crisis: it can be corrected by treatments such as organic fertilisation, and soil fertility is not the prime determinant of crop yields – rainfall is.
- A large number of cereal, legume, and other cultivars are maintained from year to year within the community, from which seed is selected for planting.
- Diversity is valued and there is great interest in new introductions and in exchanging information and experience (Busso et al., 2000). Among the millets,

there has been a shift from late-maturing to early-maturing landraces, as a strategy for escaping drought. Sorghum varieties are selected to respond to soil conditions and residual moisture.

- Agro-diversity continues to characterise farming practice though there is a risk of loss if new improved varieties replace 'traditional' ones as main food providers. It is striking that in all four of the lower rainfall villages, the same quartet of key crops (early millet, sorghum, cowpea and groundnut), with popular minor crops such as Hibiscus, is found all the way to the desert margin of agriculture.
- Some plant species, including trees and herbs, are disappearing or threatened with disappearance. Biodiversity loss, however, is far from being a crisis. Some losses are attributed to drought, some to the expansion and intensification of agriculture.
- New practices recognise symbiotic relations between trees and crops and informants acknowledge the contribution of projects in helping to recover conservation values and methods.
- The practice of protecting naturally regenerating trees on farms is known to all farmers, and awareness of threatened species and the economic value of trees (and increasingly forage plants) is supporting the evolution of integrated, small-scale cropping and silvicultural systems.
- Given the severe aridity gradient from south to north among the five villages, the extent of biodiversity recorded in northern locations is greater than was expected, and awareness of its value, both economic and intangible, appear to ensure that it will not be significantly reduced in the foreseeable future. Some missing plants are still available a little further south on the rainfall gradient.

These findings suggest a scenario characterised by strongly held conservation values, and visible in an increasingly wooded landscape, good use of local knowledge in planning and an active search for more sustainable pathways in ecosystem management.

5 Institutions for ecosystem sharing and management

Till now, ecosystem management has been presented in terms of autonomous individual agency. This section summarises the institutional framework for managing ecosystems using the Kano villages as an example, and then discusses some key issues framing institutional response, using data from the Maradi villages. An attempt is made in what follows to match the existing ecosystem management institutions with four conceptualised ecosystem areas or scales.

5.1 Ecosystem management institutions in Tumbau and Dagaceri

Tumbau and Dagaceri have similar ecosystem management institutions: a result of the dominance of Islamic governance in these parts of Nigeria.

In the local ecosystem area the active management institutions are:

- *The tenure system* (setting rules whereby both indigenes and non-indigenes can access ecosystem resources);
- *the family/household* (which manages private resources, such as farms and trees, and has claims on common resources, such as grazing land);
- *the ward or village head* and the *leader of a pastoral Fulani group*, who allocate and protect rights to ecosystem resources, in collaboration with the traditional village administration and religious leaders;
- *the village elders, title-holders, religious leaders, and informal voluntary self-help groups;*

- *institutionalised gender relations;*
- *the exchange system within the village* with traders operating under accepted rules for such activities as grain buying, commodity selling, the selling of prepared food and a range of services;
- *formal markets*, controlled by the district.

In the District ecosystem area, the important management institutions are:

- *the district head* who though superior to the village head, backs him in upholding rules of access to ecosystem resources and deals with disputes between villages or ethnic groups;
- *the district administration*, title-holders, and officials;
- *the court* (at district headquarters), which adjudicates in disputed inheritances, claims of crop damage, tenurial disputes or conflicts over access to resources that cannot be settled at village level or informally;
- *weekly market regulators*. These markets are visited by large numbers of village people for buying and selling, and integrated through market chains with all ecosystem resources and their management;
- *transport and market associations*, the former organising the safe movement of people and goods between villages and markets, while the latter (including middlemen) manage the smooth transaction of business and security.

Local Government area

Local governments include several districts and are arms of the state government with elected councils. They have larger administrations and infrastructure, are managed by career civil servants, and are subject to political control. Larger and more distant markets (which may meet twice weekly or daily) and their associated organisations are accountable to them. They may also provide rudimentary social services from which villagers may sometimes benefit. They are less involved directly in natural resource management except where a conflict or major development affects more than one local government area.

Regional ecosystem area

The institutions that manage the resources that the people from Tumbau and Dagaceri benefit from in the regional ecosystem area are the state and federal governments. These institutions manage, for example:

- the large urban markets integrated into national supply chains for major food commodities and other ecosystem products, such as fish, timber, and livestock;
- forest reserves, through state forestry departments where some people from Tumbau access hardwood for charcoal, and hunt large game;
- major highways that link the local ecosystems to urban and national consumers and employment opportunities for migrants;
- river basins, subject to river basin development authorities, whose ecosystems are contested by multiple claimants for dry season pasture, farmland, irrigation water or timber, and which support major national investments in storage dams.

Thus an institutional hierarchy reflects the embedding of local ecosystems within progressively larger ones, and the interdependence that characterises them. While the 'higher' institutions need not concern themselves with ecosystem management at local level, the interests of stakeholders at local level are strongly affected by decisions reached by state or federal governments and the implementation of policies in whose determination they have not played any part.

5.2 Constraints to good ecosystem management in Tumbau and Dagaceri

In addition to the threats posed by rainfall uncertainty and population growth, the stakeholders in Tumbau and Dagaceri face a number of constraints in managing the ecosystem, especially in increasing its capacity to produce more in the long term. These are partly linked to institutional issues which originate beyond the village such as very limited access to credit; diminishing cattle corridors and access to rangeland (because farmers encroach on corridors and go unpunished); lack of access to veterinary services; lack of good access roads; and overall perceived neglect by government.

Within the village, however, the key constraints concerned the need to deal with the rising competition between agricultural and livestock-related land-use. Because of the run of the seasons, the two production systems put pressure on the local ecosystem at different times, and a *modus vivendi* has in the past evolved to minimise friction. Nevertheless, the following issues were identified in respect to shared ecosystem resources.

Farmers observed that:

- Transhumant livestock from the north are ‘parked’ on fields during the dry season and manure the soil. However, there is no control over premature and indiscriminate cutting of trees by livestock herders, so that farmers are reluctant to plant on distant fields because they cannot protect them;
- Major stress is caused when transhumant herds return early from the north if poor rains fail to produce adequate fodder. There are fewer and fewer fallows for them to return to, and few alternatives to crop residues. Farmers cannot effectively protect their fragmented holdings from crop damage.
- Theft of *Hyphaene thebaica* shoots; field boundary plants and millet stalks which provide fodder; and fruit from planted fruit trees.
- As woodland is removed, more stresses are introduced to the symbiosis between ecosystems. Instead of wood, people burn cow dung and millet stalks.

Livestock owners in turn noted:

- The decline in pasture area and the loss of some species that cannot set seed before the plants are eaten. Further expansion of farming should be stopped.
- Negotiated and fenced cattle corridors separate incompatible land uses in the rainy season. But they are threatened by new fields established in the corridors by wealthy men with the backing of the chief and the connivance of government.
- Selling animals to buy fields is beginning to take place, but the reverse practice has not been observed
- Forest reserves gazetted by the government are relatively small in size, heavily cut and grazed, and their soils sometimes visibly degraded. Common use strategies are needed at the level of the local community (as distinct from controls policed by forest guards, and seen as directed against communities).

Consensual regulation, of the sort which has in the past been applied to particular natural resource products, is now needed for the whole system. Fortunately, it is now more acceptable to Government than in the past to advocate the use of local knowledge and skills, owing to a convergence between the rhetoric of decentralisation with the rediscovery of local capacities for association and consensus. Local chiefs already deal with land inheritance, and should probably take back the task of regulating access to common land from government agents. Even in the most threatened location, Dan Kulu, there are institutions and practices in place for trying to improve the environment by reconciling exploitation and conservation objectives. This awareness is partly driven by project and government interventions,

but also by the scarcity of valued resources and a recognition of the need for negotiated consensus in management.

5.3 Poverty and inequality in Maradi

Key stakeholders were unanimous about the causes of poverty: not enough rainfall or soil fertility, where farming is the basis of livelihoods. The Chief of Magami noted that while his village is 90% composed of poor people, the landless are the most vulnerable. They have had to sell their land because of a need for cash in an emergency and a lack of alternative assets.

In Serken Hausa, the Chief said that 30% of villagers are landless. Both private and common pasture areas are scarce. Thus, the emergence of landlessness, which denotes the end of a long phase of agricultural land-colonisation and population growth, is itself embedded in a more complex evolution towards a more socially differentiated, *rentier* economy in which livestock may play a crucial role in providing incomes for the land-poor.

6 Spatial and economic aspects

This section explores the spatial organisation and interaction of ecosystems, using the Kano villages as illustrations of general principles. The driving force of these interactions is the framework of incentives offered by the market system which influences the decisions of the users of ecosystem goods and services.

The extent of control that the Nigerian governments historically exerted over markets has been significantly less than in Niger, with the exceptions of the marketing boards that formerly controlled export markets for groundnuts and cotton, and the control of fertilizer supply and subsidies. The rapid growth of urbanisation, the improvement of interregional road communications and the injection of some oil revenues into the wider economy have generated a *laissez-faire* attitude to markets which has both positive and negative implications

Since the costs and benefits of moving commodities about in space have played a major role in motivating economic activity and the demands made on ecosystem goods and services, ecosystems are inseparably linked to the market system through such factors as distance, time, costs, and comparative advantage in primary production.

6.1 Ecosystem hierarchies

Natural and managed ecosystems occur in nested hierarchies. Since it is presumed here that management is an integral part of a functioning ecosystem, management institutions also form part of this hierarchy.

Box 5: Ecosystems and management	
Ecosystem hierarchy	Management Institution
Agro-ecozone	Government
River basin	special authority (e.g. forestry service, river basin authority)
Landscape	community, association, village
field or pasture	family, clan
private tree or garden	the individual, operating under the rules of custom and law

6.2 Local conceptualisation of ecosystem resource components

Stakeholders share a common perception of the components of their ecosystem: the bounded places from which people draw their livelihoods. Not everyone has access to or uses the same resources, nor uses the same management institutions. Some stakeholders only access resources in close proximity to where they live while others also access resources and institutions that are much farther away. But even those who directly depend on local resources and institutions often produce goods that are taken to distant markets by others, or buy commodities from elsewhere.

A common set of ecosystem components in these villages might include:

- houses and garden plots
- cultivated fields with the trees growing on them
- fallowed fields (if any) with their pasture rights
- cattle corridors and roads with common grazing and access rights
- common rangeland and rights to collect firewood
- sources of water – wells and wetlands
- local markets with rights to buy or sell
- distant irrigated farms owned or rented for dry season cultivation
- distant rangeland used by custom for dry season transhumance
- access to urban informal employment or trading opportunities
- the government or chief, whose powers affect people's ecosystem access

Interactive areas

Villagers perceive the location of the natural resources they use for their livelihood activities, and the institutions that mediate access to and management of these resources, as ordered in a hierarchy of interdependent *local, district, regional and sub-national* interactive areas, schematised as four concentric circles (Figures 3 and 4).

The local interactive area (inner circle)

This is where people involve themselves for a large part of their time in directly managing ecosystem resources, and where interaction and interdependence among the stakeholders are most intense. Farm and range lands, water points, markets and other resources, governed by local institutions, are used daily by the residents of the village.

In Tumbau and in Dagaceri the local ecosystem includes the farm and range lands, the locations of other local resources such as trees, wood, grasses, medicinal plants, fisheries and the village market. The ecosystem management institutions at this level consist of the family, represented by the family head the ward head, village head, the district head, religious leaders in the ward, village and district levels, the court, and local government. Access to ecosystem resources is negotiated and disputes settled by these institutions.

The district interactive area (second circle)

The boundary of this area is most often determined by the locations of the markets visited, or by the locations of scarce natural resources collected occasionally (such as hardwood for the blacksmith's forge, and large game).

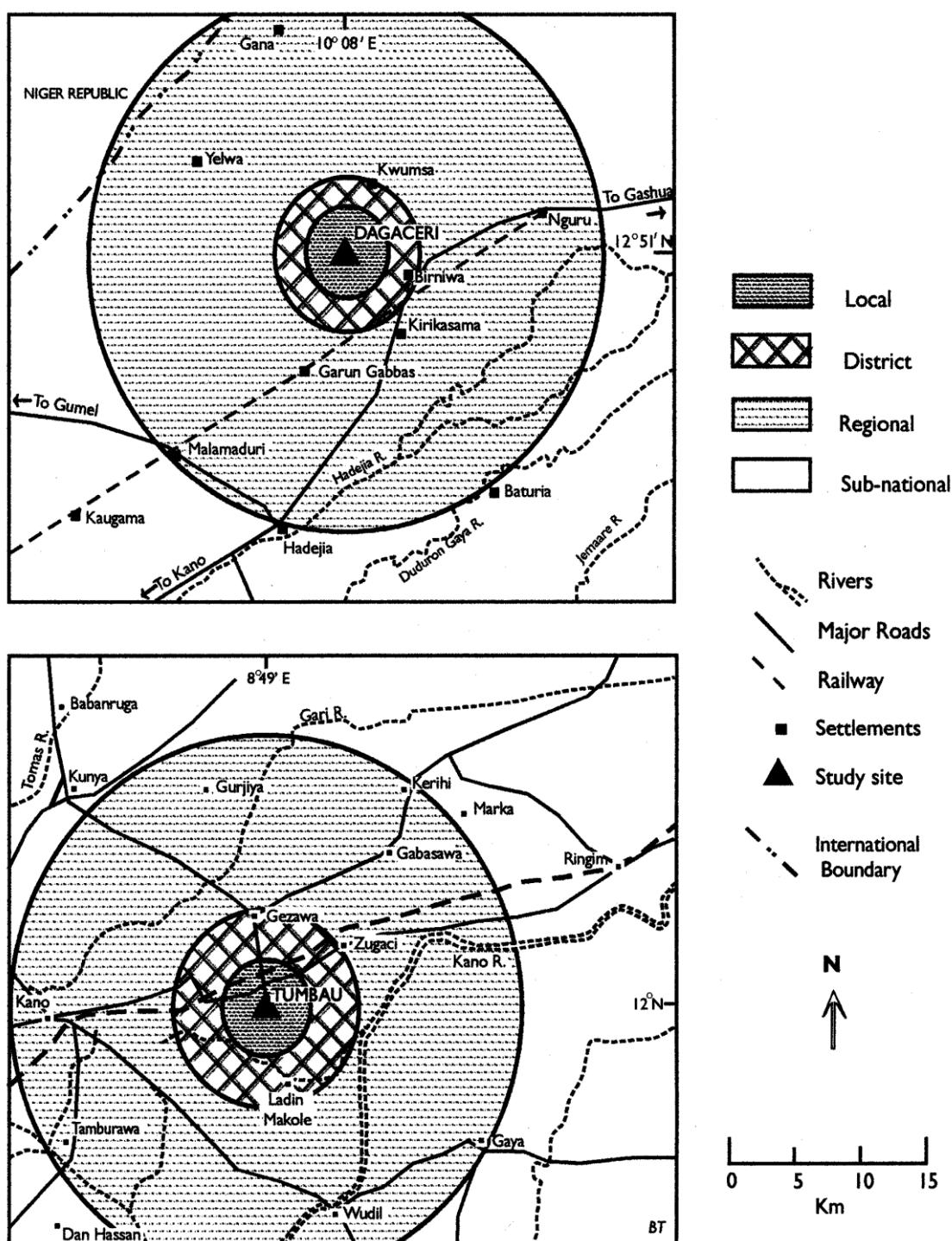
Tumbau's district area extends to Gezawa, the seat of the local government, as well as the large markets at Gezawa and Lahadin Makole. In Dagaceri's case the district area is bounded by the weekly markets in Kumsa and Birniwa. Local government and

courts play a role in management of the ecosystem resources at this level, as well as the state government.

The regional area (third circle)

Next is the much wider *regional area* extending in the example of Tumbau as far as the forest reserve near Gaya (27 km when the river can be crossed; otherwise 120 km) where hardwood for forges and large wild game are hunted, and to the markets in Guyung, Wudil and Kano itself, where craft items and bush meat, as well as

Figures 3 and 4: Schematic representations of interactive areas, Tumbau (upper) and Dagaceri (lower)



livestock, are sold. These markets and resources are controlled by higher authorities including the state and local governments and forestry service. In Dagaceri the boundaries of this area are dictated by the distant markets of Nguru and Hadejia, and the locations of scarce natural resources such as hardwood for the forge (*Prosopis africana*) near the village of Gana (c. 30 km N). Local and state governments are involved in managing the resources in these distant locations.

The sub-national area (fourth circle)

This area, the largest in the hierarchy, includes the dry season grazing areas of the Tumbau and Dagaceri transhumant livestock producers and the destinations of their dry season migrants. Management of natural resources at this level and the transportation routes to them from Tumbau is within the purview of local, state and federal governments which control access to the resources and support the transport systems on which they depend.

The tendency is for the ‘personal ecosystem’ to enlarge as people find opportunities at greater distances from home. Many of these are accessed through markets in urban areas and so do not involve direct access to other ecosystems. However as the markets themselves are linked with other ecosystems through their supply functions (fertilizers, labour, capital equipment) and demand functions (food commodities and woodfuel), it is impracticable to separate them. Markets and ecosystems are locked together in a complex pattern of interaction which has an essential spatial dimension.

Thus, in travelling to an urban labour market or trading opportunity, a migrant from Tumbau or Dagaceri is linking his own ecosystem into a much wider ecosystem which affects his management of his own resources. A man’s trading profits from selling goats from other ecosystems in Lagos during religious festivals, may be brought home and invested in expanding livestock production in his own ecosystem at Dagaceri. For this reason, ecosystem management initiatives cannot be restricted only to the local scale.

6.3 Market chains

It is clear that ecosystem interactions are driven by market chains. Markets are a well organised institution that provides income opportunities for all actors in the chain—transport owners, drivers, truck pushers, loaders as well as the commission agents.

The lowest level in the two villages is the daily village market. Here cooked food, fruits, and soup materials are sold by small boys and girls in the village square and around the village, going from compound to compound.

Grain: There are several small-scale farmer-traders in Tumbau and Dagaceri, who buy small quantities of millet, sorghum, beniseed and groundnuts from other farmers. They take what they have assembled to periodic markets 12-22 km away (67km in the rainy season when the direct route is flooded), and here large scale traders buy it, bulk it further and transport it to more distant wholesale markets and to Kano itself. The activities of these village grain traders are very important. They are indigenous to the village, and generally highly respected on account of their business success and relative wealth. They tend to invest more heavily in farming equipment, bulls, and land, and use more hired labour to supplement their family labour. Consequently, while they usually had to borrow or save in order to commence trading, the capital for expanding their operations usually comes from agricultural profits. Policy impacts on trading are as noticeable as they are unavoidable. In particular, currency devaluation, fertilizer subsidies and fuel prices affect profit margins.

Livestock: Livestock trading is somewhat differently organised, not least because animals can walk from ecosystem to ecosystem and must be fed and watered until the point of slaughter. Small ruminants are taken by their owners directly to markets where commission agents mediate between sellers and buyers for a fee. Animals may also be sold through these agents to larger-scale buyers. Alternatively, village traders may buy a few animals locally, using their own money, and take them to market for sale. Cattle, on the other hand, are taken by their owners or by a village middleman to the nearest large cattle market 20km away (80km away in the flood season) for sale through commission agents to large-scale buyers. These in turn who take the animals up the hierarchy to a regional or urban markets in Kano or Lagos.

Consumables

In addition to providing an export channel for ecosystem goods, the periodic markets offer a wide range of consumer goods to local people including many products of the ecosystem itself (such as edible wild food, fruit, fibre, construction materials, medicines) and processed or secondary products (milk, butter, cooked food, dried fruit). A very large proportion of the population visits at least one market weekly either to buy or to sell.

They are also points of sale for imported foods, clothing and other commodities which substitute, over time, for local ecosystem goods: imported powdered milk substitutes for local cow's milk, and printed imported cloth for locally woven cloth dyed with local vegetable dyes, for instance. Thus the development process mediates between consumption patterns and the demands made on the local ecosystem, in a continuously fluid dynamic. The market is not only a focal point in social and economic behaviour, but pivotal in the relations between social system and ecosystem on the one hand and between local and more distant ecosystems on the other.

The regional market: Kano

The regional markets in Kano are integrated into a national and international trading system of some complexity (Ariyo et al. 2001; Meagher et al, 1995). Despite a need to adapt continually to short-term uncertainties such as rainfall, harvests, price movements and exchange rates, in the long-term there has been relative stability in the extent of Kano's major supply areas.

The trade in grains and in livestock links ecosystems with each other and transmits demand pressures from urban consumers to local ecosystem managers. These linkages may take place over long distances (such as the demand for goats exercised by Lagos on northern producing ecosystems) and across international borders (such as the fluctuations in grain traffic between the Kano markets and southern Niger in response to fluctuating rainfall and exchange rates).

6.4 Incentives to invest in ecosystems

It is important to realise the full potential of human and social capital in managing ecosystems. Private investments are the key to the landscape of intensive farming visible today in the Kano region. Such investments start small, are incremental through time, and may be created by unpaid family labour and skills as well as through the agency of markets.

In an ecosystems context, it is important to distinguish between *productive* and *sustainability* objectives because poor people are often assumed not to be able to invest in the sustainability of their ecosystems. This is to malign small producers,

since evidence from several areas in the African drylands show that the conservation of their natural resources is a prime objective, and that productivity and conservation can be combined in small-scale farming and livestock keeping enterprises. Whether they actually do so depends on the incentives available in a given time and place.

Governments can alter economic incentives through a range of macro-economic, fiscal, or sectoral measures. Macro-economic policies, such as changes in interest or exchange rates, have affected small producers' investment decisions adversely, along with other elements of structural adjustment, such as trade liberalisation and the withdrawing of government services.

Working through institutions affects the *enabling* incentives. A key institution is the system of land tenure, for instance. Credit institutions, decentralised government services, and research and extension systems also have critical roles to play.

Much more needs to be documented about the extent, value and impact of investment by smallholders in dryland ecosystems, the trade-off between productivity and sustainable use (if there is one), and the incentives needed to stimulate investment in ecosystem management.

7 Action research

7.1 The rationale

What distinguishes the focus of the present study on the EA is that sustainable management of ecosystems is given equal weight with development objectives. Such a balance reflects the realities of poor peoples' livelihood strategies in an environment where risk and degradation are understood as threats, and is better adjusted to these realities than an exclusively sectoral and technical approach.

7.2 Dagaceri, Nigeria

The process of participatory project identification

A general meeting of all the stakeholder groups in Dagaceri was held. Those who attended the meeting cut across all the primary and secondary livelihood activities in the village. The researchers took the natural resources-based livelihood activities one by one, and drew attention to what were considered to be the constraints to sustaining the productive capacity of 'their' resources in the long term. This was followed by a long discussion on the steps that could be taken to restore, sustain or even increase the capacity of the resources. The suggestions made focussed on obtaining and conserving more water; on increasing the amount of manure available to each household by increasing livestock holdings, on the planting of a small village forest, and on a wish-list of government interventions (though unlikely to be realised).

The choice of project was narrowed down to the creation of a community tree conservation area. Villagers decided to form the 'Dagaceri Development Association', to spearhead the planning and execution of the conservation area project. It was agreed that it would provide wood for community uses such as lining new graves in the village cemetery and for constructing shaded meeting areas where people could gather to meet dignitaries visiting the village. The Development Association established good links with the agricultural department of Birniwa Local Government to realise this proposal.

Technical sustainability

The view that prevailed at the opening session was that villagers' interest in the short run was in drought-resistant and fast-growing trees. No indigenous species match the qualities of neem (*Azadirachta indica*) for this. Shortage of water was potentially a serious problem faced by the tree seedlings in the dry season, but it was overcome through the readiness of members of the management committee to allow the free use of their ox-drawn carts to collect water, and the readiness of many young boys to fill plastic containers, load up the carts and control the bulls as they pulled them home. There was a high seedling survival rate through the long dry season of 2005-6. After six months, 120 neem trees were well established, but there had been high mortality among mango, guava and cashew seedlings.

Institutional sustainability

Hope for the institutional sustainability of the project rests in the assembly of institutions that were mobilised in planning, establishing and managing it. These institutions include local village administration (the village head), religious leaders, representatives of all stakeholder groups and the youth, representatives of higher level institutions such as the District Head of Birniwa, the local and state government.

A lack of funds with which to procure fencing materials had been the major constraint to planting trees on a large scale in Dagaceri. It is obvious therefore, that in spite of the enthusiasm for the stand of trees, it would not have become a reality if the IUCN project had not provided the funds for the capital items (plastic seedling bags, watering cans and fencing-materials), even though the capital outlay for the project was minimal.

Lessons for community conservation

The first lesson is that the decision to set up the project was knowledge-based: the insight gained during the focus group interviews and discussions increased awareness among the stakeholders and researchers of the constraints and opportunities in the village ecosystem. The second has to do with the efficacy of participatory work in consensus building on community projects. It was the dialogue among the stakeholders who participated in the research, in the interactive session at the end of the survey, and in the meetings held by the steering committee, that led to enthusiasm for action. The third is that this kind of community activity is more likely to be successful if it is managed by a core institution (formal or informal) consisting of a small group of dedicated people who share a common view about the project. Finally, IUCN's modest support for the Dagaceri project was negotiated, and was in kind not cash.

7.3 Magami, Niger

Identifying the project

Through the present study on the application of the Ecosystem Approach, it was hoped to assess the selected communities' perceptions of their resources, and their interest in conserving the environment. Like the rest of Maradi Region, Magami villagers are mainly Hausa peasants or agro-pastoral Fulani and settled Tuareg. All recognise that biodiversity is important for:

- its ecosystem protection value;
- its economic value: some species are needed by specific professions (herbalists, blacksmiths, wood carvers, etc). For livestock keepers, a rich pasture flora is needed not only for feed quality but also for good reproductive performance and for combating diseases;

- its food value; the disappearance of some edible species has affected the nutritional equilibrium of some populations.

Conservation has to be understood through the functioning of the agro-ecosystem of the village. Biodiversity conservation is a priority closely related to peoples' livelihoods, filtered by the economic and governance dimensions of biodiversity management.

The rapid growth of the cultivated area in Maradi has created a scarcity of tree and plant resources for people and animals. Because of intensive exploitation, and use-specific selection criteria (e.g., durability of wood, softness of bark, termite resistance), a majority of villages now suffer from serious shortages. It is necessary to go farther afield to find wanted species and collect prioritised materials. Though increasing tree densities are being recorded as a result of protecting natural tree regeneration when clearing fallows (*défrichement amélioré*), villagers recognised that this does not necessarily result in a much more diverse flora.

The process began with a village assembly which identified stakeholders on the basis of activities internal to the production system. Diverse ecosystem resources and their users were identified. At the community level (organisation and decision making), the Chief and elders were interviewed. With regard to legislative questions, village organisation officials were interviewed. Administrative and project officials in Maradi Region were also interviewed.

Perceptions of rights and benefits

In Magami the village territory accommodates numerous rights of access which apply to the use of resources by distinct user groups. Their perception of rights is expressed at four levels:

The State According to them, the State should assure the security of peasants' rights (both groups and individuals) and arbitrate in conflicts of interest between different users. The State should support rural communities in various ways: in fixing the rules of play, by legislation that reflects social consensus; in controlling pests and diseases before which peasants are powerless; in providing improved and adapted seeds and agro-chemicals and in forestry training.

Pastoralists Pastoralists noted that 'modern livestock keeping is different from before; extensive livestock-keeping needs space but today, livestock keeping must be done at the house as there are no pastures'. They want to see the improvement of pasture in the cattle corridors and reserved forests where resources are held in common with village communities.

The village community Provided that the State ensures security, it is for the community to maintain the viability of their ecosystem through collective or individual action. Respect for private property permits better conservation and gives more responsibility to villagers themselves.

The individual. The individual should continue planting trees, and maintaining protected trees on-farm; he should prevent abusive cutting and respect established rules; the right to the tree should go with that to the land on which it stands; women also have rights and duties where trees are concerned. Conservation of plant resources provides wood for construction, carving and energy, as well as incomes.

The Magami nursery

There had been a nursery in Magami before, which had been used to grow neem (*Azadirachta indica*) for shade trees around the village and market. Villagers were eager to reconstitute the nursery to grow species which had disappeared from the local ecosystem, though it was difficult to find seed/seedlings for these. Blacksmiths were eager to reintroduce hard wood species; herbalists, wood carvers, and women prioritised many of the other species. Those eventually obtained were: *Acacia nilotica*, *Adansonia digitata*, *Annona senegalensis*, *Azadirachta indica*, *Bauhinia rufescens*, *Detarium macrocarpa*, *Faidherbia albida*, *Ficus gnaphalocarpa*, *Prosopis Africana*, *Khaya senegalensis*, *Mangifera indica*, *Tamarindus indica*, *Terminalia spp*, *Ziziphus mauritiana*, *Ziziphus spina-christi*, *Citrus spp*, *Eucalyptus spp* and *Psidium guajava*.

The establishment of the nursery in the rainy season of 2004 was made possible through the support of IUCN in providing facilitation, advice, and contributions of material (in kind, not in cash). Considerable thought was given to nursery sustainability and economic viability for the future. The decision to reanimate the nursery came at a time when the State was encouraging the planting and conservation of trees to rebuild tree-cover in the country. It also coincided with tenure changes under which trees are being moved into more protected tenure contexts, and found increasingly in fields rather than on open public land. Development projects such as the PDRAA had also been encouraging tree protection, and supporting the shift to village management of the natural regeneration of trees. An enquiry carried out by the PDRAA project has estimated assisted regeneration of nearly 100,000 ha, with seedling densities in some places attaining 200-250 trees/ha.

7.4 Conservation in the community

The following observations reinforce the finding that conservation values are important to the community:

- The peasants have a mature understanding of their ecosystem and they adapt their interventions in response to this reality. Innovation is very important, especially in areas of high population density.
- All stakeholders are conscious of the fragility of their ecosystems and the necessity to conserve them in order to ensure continuity of their activities and benefits. They are aware of change, and of interrelations between different ecosystems, notably through observing new species, their provenance and the means of their introduction (wind, animals, water, human agency).
- It is seen to be necessary to integrate the interests of different stakeholders, even if almost all of them practise farming and livestock keeping in differing proportions.
- A clear interest has been demonstrated for each village in active biodiversity management, appropriate technical practices, and the responsibilities of every stakeholder.

8. Conclusions

Five simple findings having implications for practice are as follows.

Knowledge

It is clear from all five villages that the stakeholders' perceptions of ecosystem resources – the goods and services they supply – and capacity to appraise those

resources and manage them with a view to their longer term sustainability, is substantial, relevant, and based on local cumulative experience. In these respects, local knowledge rightly takes its place alongside the science-based, external knowledge that has traditionally driven development interventions by governments and donors. The term 'local' is preferable to 'indigenous', since it shifts emphasis away from 'traditional' and static knowledge to adaptive and dynamic local knowledge, based on interaction with new knowledge as well as cumulative experience of local ecosystems. Donors and researchers have a duty to try to make local, experiential knowledge more visible to policy makers, not as a relic from the past requiring 'modernisation' but fully participatory in constructing shared knowledge that enjoys full recognition and legitimacy.

Institutional development

Some development of existing institutional arrangements will be necessary to achieve the objectives of equitable sharing of ecosystem access and benefits amongst stakeholders. This does not mean that the existing hierarchy of governance institutions in either country needs to be replaced and still less that parallel and competitive institutions should be created, as was done for example in the World Bank's agricultural development projects in Nigeria. But as presently configured, institutional systems fail both to give adequate priority to ecosystem management, and to develop grass-roots autonomy in place of the dependency on government that resulted from the oil boom in Nigeria and the proliferation of donor-supported development projects in Niger.

Creative thinking and action is needed in order to realise the potential of human and social capital. Areas needing attention include: the working of land and resource tenure in an ecosystem stakeholder context; means of access to rotating credit; negotiation processes for sharing access entitlements and benefits; facilitating women's self-mobilisation in environmental decision making; facilitating networks of small-scale, voluntaristic associations based on ecosystem stakeholder interests; ways of exercising demand on service providers (for advice, technologies, inputs, market access); and creating awareness of new opportunities. Developmental work is needed on scaling up the findings of the present study to address the realities of complex and interlocking institutions and differentiated groups of stakeholders enjoying very different powers.

Sustainability

This issue, along with ecosystem degradation, has been over-simplified by scientists and policy makers. The restoration of pristine ecosystems in an area that is ever more densely populated, extremely poor, and environmentally risky is not a relevant target and this is implicitly recognised in the objectives of the EA. Nevertheless, degradation continues to be understood in many scientific and policy circles in terms of equilibrium assumptions. Policy must become more nuanced and realistic, learning from the real managers of the ecosystems as well as taking the best from scientific research. The work reported in this study indicates quite clearly that local people understand the symptoms and causes of degradation and know how to reverse them given the right resources.

Two examples will illustrate this. First, tree planting is rapidly becoming the vogue in response to increased scarcity of harvested products, timber, and fuel as well as environmental benefits (a transition that has been reported on quite a dramatic scale in parts of Niger), evidently confirming that normal rules of supply and demand apply in the environmental sector. Second, soil fertility, when no longer sustainable through fallowing, can be restored to acceptable levels by manuring and inorganic fertilizers. The struggle of poor people to achieve these aims points clearly to poverty as the

constraint, and to the importance of macro-economic policy and global drivers of poverty. Development strategy needs to take account of people's confidence that, with adequate rainfall and effective measures in place to reduce the constraints they have identified, the ecosystems can remain productive in the long term. There is an urgent need to transfer the 'ownership of sustainability' from external agency and funding dependency to local institutions.

Hierarchies and interaction

In the Kano villages, four interdependent levels of ecosystem interaction were identified from local to national. This underlies the economic drivers of change as the incentives to manage or mismanage ecosystems are largely mediated through markets, which are also organised hierarchically. The hierarchical areas were also matched with existing management (governance or supervisory) institutions. The significance that this has for any intervention in ecosystem management is that policy needs to address the different levels and not restrict itself to the notion that ecosystems are local and closed systems – an idea that naturally tends to creep over from the 'old' ecology of 'fortress conservation' where users were ideally excluded. Again it underlines the necessity of paying attention to the macro-economic environment of ecosystem management.

Any area-based development faces the risk that unless the policy environments are right, real and sustainable, changes will be hard to accomplish at local level. The linkages between local and national policy institutions and processes should receive careful attention. Without an effective (and modernised) 'lobby' for the semi-arid north, Nigeria in particular may be prone to overlook needs specific to these ecosystems.

Scaling up

This study reports on five small communities which, though fairly representative of the semi-arid zone of northern Nigeria and Niger, did not provide the opportunity to take on board a wider variety of stakeholders, ecosystem resources and management institutions.

Broadening the spatial scope of the research is necessary, therefore, in order to identify more varied stakeholder groups, including those with a deep but indirect interest in ecosystem resources, community-based organisations and international donor agencies. A wider spatial coverage will also facilitate the identification of more diverse ecosystem management institutions. Especially in the context of action research, it should bring all levels of government directly into a participatory framework that is necessary for devising better ways of ecosystem management for sustainable use. It is hoped that the SCNN project will in due course scale up the findings of this study to the shared catchments and eventually to the transborder region as a whole.

Acronyms

EA	Ecosystem Approach
GEF	Global Environment Facility
IUCN	International Union for the Conservation of Nature
NNJC	Niger-Nigeria Joint Commission
PDRAA	Aguié District Rural Development Project
SCNN	Integrated Ecosystem Management in Shared Catchments between Niger and Nigeria

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ⁱ This chapter is a shortened version of a much fuller report by the same authors, available on the IUCN Commission on Ecosystem Management website.

ⁱⁱ The shift to the 'privatisation' of trees by resident farmers is a cause of conflict with transhumant herders, since they rely on access to trees found in common pool areas or on private farms. The temptation for them is to deny that such privatisation is happening, and to continue to access tree browse and crop residues wherever they may be found.