Why invest in drylands?

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Executive Summary

This paper argues a case for investment (both public and private) in drylands, with a focus on rainfed (rather than irrigated) African drylands, where assessments have been the most negative. Based on their needs, residents of dryland areas deserve more attention. Based on their right to participate fully in human development, they have a strong claim to more assistance. This case rests on new evidence of long-term success stories achieved by small producers and a re-evaluation of key trends. A new paradigm of drylands development is proposed. Priorities in policy formation by governments, donors and international agencies are suggested.

Why the drylands matter in global development (Section 2). The drylands have been perceived as risky investments by governments and donors for six reasons. First, poverty seems endemic among the large populations in the drylands; the numbers of poor people are so large that they threaten to block the achievement of the Millennium Development Goals. Second, these populations seem to suffer from chronic food insecurity and are dependent on food aid. Third, agricultural productivity is severely constrained, and natural resources, according to many data, are being degraded (desertification). Fourth, the drylands provide a litany of failed development projects, which create an urgent dilemma for policy: whether to continue business as usual, or find new approaches. Fifth, frequent droughts and other risks threaten both investors and producers. Sixth, economic marginality has been matched by policy inaction. The following sections take up each of these questions in turn.

More people, more poverty? Success stories (Section 3). Findings of six studies at the district level challenge the links normally made among the drylands, population growth and poverty. The first study covered the Machakos and Makueni Districts, Kenya. A sixfold increase in the value of output per square kilometre was achieved over nearly 60 years (1930-87), while the value of output per capita doubled, even as the population grew at an annual rate of up to 3.1%. Yet, rather than degradation, there was an impressive improvement in soil and water conservation, much of it due to the efforts of the farmers themselves. The second and third studies were in Burkina Faso, where rainfall declined and population increased beginning in the 1960s. In the Central Plateau, grain yields per hectare and soil conservation both rose significantly over two decades (the 1980s and 1990s). In the Eastern Region, average grain yields increased by 400 kg/hectare after 1980, and production per capita doubled. The fourth study involved the Kano Close-Settled Zone in northern Nigeria where the highest rural dryland population densities in Africa are found. Yet, a labour-intensive form of agriculture helped sustain yields per hectare at acceptable levels and conserved the soil for more than 100 years. The study confirmed the crucial role played by urban food commodity markets in this region. A fifth study identified 'incipient success' in Maradi Department, the Niger. Severe degradation, accompanied by a crisis in the production system, was diagnosed after the Sahel drought of the 1970s. Yet, instead of the expected decline, average grain production per capita was maintained, and there are signs of a transition towards more sustainable land-use practices. Finally, in Diourbel Region, Senegal, farmers adapted to the collapse of the state-controlled agrarian system by diversifying into livestock and new crops. They also reallocated their capital resources outside agriculture, where returns were sometimes better. The success stories show that investments in

sustainable and productive land-use are the best approach to fighting poverty and protecting natural capital.

Food security under threat? Evidence of resilience (Section 4). The foregoing success stories are documented at the district level. But, even at the national level, there are reasons for questioning the commonly expressed view that the agricultural sector has failed in Africa. Long-term agricultural data (1960-2001) provided by the Food and Agriculture Organization of the United Nations for three West African countries with large dryland regions (Mali, Nigeria and Senegal) show that the truth is more complex and varies from country to country. Small producers have been responsive to policy incentives and market signals. This is why yields of several *export* crops affected by global prices have declined or been diverted to domestic markets. Supply constraints, even in the drylands, were less critical for *food* production than is sometimes supposed. The 'new' cereals (rice, maize) and livestock were most responsive, while the 'old' cereals (millet, sorghum) were less so. Nevertheless, except in Senegal (where the Government intervened to promote the use of imported rice), the production of the 'old' cereals per capita was stable over the long term. The improvement of incentives should be an aim of new policy.

Dryland degradation? Reversing the trends (Section 5). Recent analysis of earth satellite data shows an unexpected greening of Sahel vegetation between 1982 and 1999, probably continuing through 2003. The trend is statistically significant. The process responsible, however, is not adequately understood. There appears to be some correlation with rainfall, but, taken alone, this explanation is not sufficient. Land-use changes appear to be involved. Policy-makers have long regarded deforestation as a major threat. However, data from many studies show that farmers value, plant and protect trees, especially on farmland. The problem of cutting for fuel has been exaggerated. Dry woodlands are more productive than formerly thought. Another controversial theme is soil fertility (and, in particular, carbon) management. Whereas global data have been used to show severe losses in plant nutrients and to justify interventions on a large scale, studies show that farmers invest in more sustainable practices that also facilitate carbon sequestration. These studies suggest that the drylands, rather than being a 'development sink', requiring urgent and costly rescue from destruction, may yet offer acceptable returns on investment. They may even make a contribution to global climate improvement as good land-use practice intensifies, securing and improving ecosystem goods and services.

Public investments failing? Evidence of favourable returns (Section 6). New evidence from India shows that public-sector investments in dry and sub-humid rainfed areas may give returns superior to those in humid or irrigated regions. This finding is not directly applicable to Africa, owing to differences in stages of development. But analyses of five donor-supported projects in Africa (soil and water conservation, irrigation rehabilitation, forestry management, agricultural extension and market development) lead to the conclusion that economic rates of return can be favourable in African drylands, too. Much has been learned from past mistakes.

Private investment unaffordable? Incentives work (Section 7). Private investment by small farmers and livestock producers is the key to sustainable management of drylands, which is too large a challenge for the state or donors alone. Small producers invest in small-scale, incremental and long-term strategies often overlooked by outsiders. They invest in order to construct

secure livelihoods in which agriculture is by no means the only source of income. A range of indirect incentives is available to policy-makers to promote such investments. *Enabling* measures (such as institutional changes) and *variable* incentives (like input and output prices) determine the profitability of an enterprise. Unless public-sector investment stimulates private investment, and of small producers in particular, development is not sustained. In drylands, risk imperils private investment. But the 'success stories' show that there is a capacity to invest, given incentives.

Policy inaction inevitable? The cost of doing nothing (Section 8). The high costs of a business-as-usual strategy are illustrated with provisional data from China and Ethiopia. The database for such an evaluation is still weak, but the orders of magnitude of these estimates justify concern. In China, the direct costs have been estimated at USD 7.7 billion (4% of GDP), and the indirect costs at USD 31 billion. In Ethiopia, the monetary value of the yearly losses of nutrients from agricultural areas has been estimated at USD 106 million, of forest at USD 23 million and of livestock capacity at USD 10 million, for a total of USD 139 million, or 3% of agricultural GDP. The price of inaction will ultimately be paid in lost production, the reduced value of natural capital, reduced food security, increased poverty and the costs of welfare and emergencies. Proactive investment and policy are a superior strategy, for, if the costs of neglect are huge, so are the potential benefits of action.

A new paradigm for dryland development (Section 9). A new policy landscape is emerging. 'People centred development' reverses the priorities from top-down technical solutions to the release of human resources. Small-scale resource managers need support in their efforts to create sustainable dryland production systems. There is still a role for technology. But, rather than universally applicable new or 'miracle' technologies, the small producers of the drylands need a diversity of site- or enterprise-specific solutions from which they can choose according to individual circumstances and that they can adapt in light of their own experience and knowledge. The agenda is thus shifting for development agencies, research institutions, governments and donors. Some drylands have made impressive progress despite severe constraints. It should be the role of the public sector to: (a) relax these constraints; (b) improve the incentives for investment; and (c) facilitate the scaling up of the successes.

The case for investing in African drylands (and, by extension, in other tropical drylands) rests, therefore, in: (a) the size and population of drylands; (b) the achievements observed in the success stories, (c) the evidence that agricultural systems are resilient; (d) the evidence that degradation is not inevitable; (e) the evidence that public investments can and do pay; (f) the evidence that policy incentives (to invest) do work; and (g) the evidence that the costs of neglect and the benefits of action are potentially huge.

1. Introduction

A case is made in this paper for investing in tropical and subtropical drylands (**Box 1**) in poor or middle income countries. The focus should be on rainfed (rather than irrigated) drylands. Investments in these environments, their people, and their production systems have long been regarded as risky on account of the following drawbacks:

- *endemic poverty* worsened by distant markets and lack of health and education services and safe water;
- *perennial food insecurity*, with the consequent dependence on food aid;
- *low agricultural productivity*, caused by low rainfall and high evaporation, infertile soils and the degradation of natural resources.[1]
- *failed projects*, suggesting that the development potential is low;
- *frequent, but unpredictable droughts*, bringing losses to investors and producers; and
- *economic marginality*, contributing little to national economies, yet dependent on linkages with cities or more humid areas.

In poor countries generally, productivity gains in *agriculture* are considered by many to be a condition for broadbased economic growth because:

- about 70% of the world's poor still live in rural areas;
- agriculture provides employment for two thirds of working Africans and 60% of Asians and generates a third of Africa's and 27% of Asia's gross national income;
- where economic growth is most rapid, agricultural productivity has risen the most;
- no other economic activity benefits the poor so much; and
- efficient agricultural production provides food to non-agricultural consumers at low cost.[2]

Drylands differ from this general agricultural scenario in two respects. First, they face special challenges that are not generally shared in more humid regions. Second, drylands have fallen behind more favoured environments in agricultural, economic and social development. There is a risk that the gap will widen in the future.

But assessments are changing, and new evidence supports the premise that 'there are important and significant populations in the world's drylands who, given the right conditions and incentives, can achieve good livelihoods, accumulate assets to reduce vulnerability, and escape from poverty'.[3] Africa should be no exception to this. However, among the drylands in all the continents, those in Africa receive the most pessimistic assessments.[4] Because Africa faces the greatest challenge in dryland development, it is the focus of this paper.

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1 The term 'agriculture' here includes both crop and livestock husbandry.
2 DFID (2003) 'Agriculture and Poverty Reduction: Unlocking the Potential'. DFID Policy Paper. London: Department for International Development.
3 Dobie, P. (2001) Poverty and the Drylands, 2. Nairobi, Kenya: United Nations Development Programme, Drylands Development Centre.
4 UNEP (1992) World Atlas of Desertification. Nairobi, Kenya: United Nations Environment Programme.

The case for investment (both public and private) is set out as follows. In Section 2, reasons are given that show why the drylands matter in global development. The issues have often been presented in terms of crisis scenarios in which the six perceived drawbacks listed above are rephrased and addressed in Sections 3 to 8, as follows:

- More people, more poverty? Success stories - *Section 3*
- Food security under threat? Evidence of resilience - *Section 4*
- Dryland degradation? Reversing the trends - *Section 5*
- Public investments failing? Evidence of favourable returns - *Section 6*
- Private investments unaffordable? Incentives work - *Section 7*
- Policy inaction inevitable? The cost of doing nothing - *Section 8*

In Section 9, the new policy landscape is analysed, and priorities are suggested.

2. Why the drylands matter in global development

The world's drylands have received a bad press in development debates. In this section, the reasons for this are summarized so as to offer a launching pad for the new perspective that is argued in the subsequent sections.

More people, more poverty?

Excluding deserts, polar or mountain regions, and major cities, the drylands are home to 1.2 billion people, or a fifth of the world's population (perhaps 200 million households). Past rates of population growth have often exceeded 3% per year. Cultivable land is now scarce, and landholdings are rapidly becoming smaller.

Dryland people are more likely to be poor relative to more favoured regions, where trends in standard indicators are more encouraging. For example, in Africa:[5]

- in Kenya, the highest incidence of poverty is in the northern arid and semi-arid districts, and life expectancy, adult literacy, secondary school enrolment and the human development index are lower there than in Nairobi; and
- in Cameroon, although only 31% of the people live in the semi-arid Northern Region, 50% of the country's poorest people are found there; the region has the highest rates of illiteracy, poor housing and maternal mortality.

Within the drylands are found many disadvantaged groups, such as woman headed households, land poor farmers and pastoralists. The progress towards the Millennium Development Goals is slower in drylands than it is in more favoured environments. Based on their needs, dryland people deserve more attention. Based on their right to participate fully in human development, they have a strong claim to more assistance. As measured by the number of poor people, poverty in the drylands, unless it is reduced, will threaten the achievement of the Millennium Development Goals.

Box 1: What are the 'drylands'?

The tropical and subtropical drylands are divided into three zones based on the moisture (or aridity) index. The precipitation over potential evapo-transpiration index measures the relationship between annual rainfall and the loss of water to evaporation either directly, or through plants. The index for the three zones is as follows:

Arid	0.05-0.20
Semi-arid	0.20-0.50
Dry sub-humid	0.50-0.65

5 Dobie (2001) op. cit.; Hazell, P. (2001) 'Agricultural Research and Poverty Reduction'. Food, Agriculture and the Environment Discussion Paper, 34: 7. Washington, DC: International Food Policy Research Institute.

These three zones correspond to a range in the average length of the growing period from 75 days in the arid zone to a maximum of about 180 days in the dry sub-humid zone. Variability does not feature in this typology, which is based on mean values. Rainfall in the African Sahel declined from the late 1960s to the 1990s. In other drylands, rainfall data suggest long-term cycles.

Drylands so defined cover 40% of the earth's land surface, occur on every continent and provide homes for 38% of the world's population. Excluding the deserts, 43% of Africa is dryland.

Source: UNEP (1990) *World Atlas of Desertification*. Nairobi, Kenya: United Nations Environment Programme.

Food security endangered?

The contributions made by drylands to local and national food security cannot easily be estimated. Rural dryland households try to produce as much of their own food as possible, or else they obtain it by selling crops or livestock products. Great distress occurs when drought reduces this productive capability. Small producers seek to achieve food security and prefer not to risk being over-dependent on markets. Crops, livestock and fish from drylands also feed urban populations. As cities grow, the market demand for staple food grains and higher value foods (such as meat, fish, cowpeas) increases.

Major threats to dryland agriculture can be discerned that may adversely affect food security at a national level. First, stagnating or declining crop yields caused by soil degradation or by rainfall decline may reduce productivity. In the past, declining yields could be offset through the expansion of the cultivated area, but this is now ceasing to be possible, as productive land is becoming scarce. Second, livestock production may be adversely affected by falling productivity in natural rangelands. These rangelands are declining in size as more land is taken up for farming, increasing the risk of overuse. Third, resident rural populations are still growing, though more slowly than previously, and they need to assure their own food security, as well as supply markets. However, intensification is slow or patchy. A failure in dryland agriculture has adverse effects on an economy, boosting balance-of-trade deficits, donor dependency, the urban immigration of poor people, and the costs of service provision and welfare. When the maize belt of Zimbabwe was hit by drought in 1991-92, national agricultural production fell by 45% (with falls of 62% in the stock market, 9% in manufacturing output and 11% in GDP).[6]

Dryland ecosystems being degraded?

Both the productivity and the sustainability of dryland ecosystems are threatened by degradation processes collectively known as *desertification* (**Box 2**). These include erosion by water or by wind; increased surface runoff after rains, reduced infiltration and declining water tables; soil degradation or the

6 United States Agency for International Development, cited by E. Patrick, United Nations Development Programme, Drylands Development Centre, Nairobi, Kenya.

loss of fertility; deforestation or the destruction of natural vegetation; and the loss of biodiversity.[7] A loss of economic productivity will weaken livelihoods directly. A loss of 'ecosystem goods and services' (such as reduced biodiversity, forest and wild habitats, rainfall infiltration and groundwater recharge) undermines the functioning and integrity and, therefore, the future sustainability of natural ecosystems. Human management is critical, though the impact of climate change is also acknowledged.

The impact of desertification is suggested by estimates such as the following, which are based on global surveys.[8]

- About 40% of the earth's land surface is dryland (arid, semi-arid or dry sub-humid). In Africa, the share is 43%, all of which is susceptible to degradation.
- About 1 billion ha, or 20% of the global extent of susceptible dryland soils, are being degraded by human activity. In Africa, the fraction is 25%.
- About 467 million ha, or 9% of the global extent of susceptible dryland soils, are being degraded by water erosion. In Africa, the fraction is 9%.
- About 432 million ha, or 8% of the global extent of susceptible dryland soils, are being degraded by wind erosion. In Africa, the fraction is 12%.
- There is a strong correlation between a high severity of soil degradation and low values on the index of vegetation, which highlights the exposure of the drylands relative to more well vegetated and more humid areas.
- In Africa, all but three of 38 countries are said to be losing more than 30 kg/ha/year of the key soil nutrients: nitrogen, phosphorus and potassium.[9]
- In West Africa, net rates of forest loss in dryland countries vary from 0.2 to 3.7% per year.[10]

All estimates of dryland degradation depend on uncertain data. This uncertainty is sometimes ignored in the interpretations of the data.

Box 2: What is desertification?

The definition used in the United Nations Convention to Combat Desertification is as follows:

"Desertification means land degradation in arid, semi-arid and sub-humid areas resulting from various factors, including climatic variations and human activities."

The adoption of this definition has not resolved many of the contentious issues reflected in earlier definitions, especially the priority (or lack thereof) of human

7 Bonkoungou, E. G. (2002) Biodiversity in Drylands: Challenges and Opportunities for Conservation and Sustainable Use. Nairobi, Kenya: United Nations Development Programme, Drylands Development Centre.
8 UNEP (1992) op. cit.
9 World Bank (2002) World Development Report 2003, Sustainable Development in a Dynamic World: Transforming Institutions, Growth, and Quality of Life. Washington, DC: World Bank.
10 FAO (2001) Global Forest Resources Assessment, 2000: Main Report, 116. Rome: Food and Agriculture Organization of the United Nations.

agency and the time-scale of the resulting changes (termed 'desertification' if they are not easily or quickly reversible).

The United Nations Conference on Desertification (1977) approved a Plan of Action to Combat Desertification. This plan was largely unsuccessful owing to a failure to attract donor support on the scale necessary for the ambitious activities proposed. The facilitation of national activities under the terms of the United Nations Conference on Desertification was the responsibility of the Desertification Branch of the United Nations Environment Programme (Nairobi, Kenya) and its Clearing House Mechanism. The National Action Plans now prepared under the terms of the United Nations Convention to Combat Desertification are the primary responsibility of the countries, the Global Mechanism of the United Nations Convention to Combat Desertification (Rome) mobilizes funding, and the convention secretariat (Bonn) serves the Convention. Other global institutions – the development banks, the Consultative Group on International Agricultural Research, the Food and Agriculture Organization of the United Nations, the Global Environment Facility, IFAD, the United Nations Development Programme and the United Nations Environment Programme – are involved in partnerships that explicitly target desertification.

Public investments failing?

- Many development projects and programmes have given poor returns on investment or proved unsustainable for technical, managerial, or economic reasons. Development assistance to the agricultural sector has fallen; governments are short of funds, and it is clear that new thinking and new strategies are required. Reflecting a long historical view, the following examples illustrate the breadth of this failure.

- Senegal: the collapse of the Programme National Agricole. The groundnut producing region, or 'peanut basin', in dryland Senegal enjoyed nearly a century of public investments in transport and marketing infrastructure. The Government adopted a monopolist role in credit, input and equipment supply, technical advice, marketing and processing. It also controlled the internal trade in grains and supplied imported rice. But the Government was forced by the deterioration in its finances to withdraw many of its services beginning in 1983-85. Seed and subsidized inorganic fertilizers supplied on credit were affected. The sudden withdrawal of support resulted in an abrupt fall in groundnut production, and the reduced prices led to a diversion of output from the state oil mills to local markets. Farm capital was reportedly being sold off. Fertilization slumped, and agricultural intensification faltered.

- Nigeria: irrigation in the Lake Chad Basin. During the 1960s and 1970s, irrigation projects were developed that were based on the water resources of the Yobe River and of Lake Chad itself and that were driven by a policy of import substitution (mainly of wheat). But high development costs, remoteness from markets, poor yields (affected in some places by soil salinity), the low value of output, and ultimately, reduced river flow and the disappearance of the lake from Nigerian territory led to the demise of

these large schemes. However, small-scale irrigation, mainly using private capital, still prospers along the banks of the Yobe.

- The Niger: well provision in the pastoral zone. The large scale sinking of government wells and boreholes was carried out during the 1960s. This opened up areas of grazing that had previously been difficult to use during the dry season owing to a lack of surface water. Unlike the wells managed collectively by pastoral groups in the area, these new wells became open-access water sources and stimulated a rapid growth in livestock numbers. Notwithstanding the income benefits, they led to risks of overgrazing, and conflicts among farming communities increased.

- Nigeria: arid-zone afforestation. Nigeria embarked on extensive afforestation programmes in the states along its northern border during the 1970s. However, high costs were incurred in establishing nurseries in remote locations, acquiring fencing and land for shelter belts, and promoting on-farm tree planting. Most of the shelter belts suffered from low survival rates and incursions from livestock, and the millions of seedlings distributed to farmers met with a sceptical reception. Late planting, low rainfall, poor tending and inadequate protection from livestock were the results. Little lasting evidence can now be seen of this programme.

Low financial rates of return, financial unsustainability, unsatisfactory uptake or impact, unforeseen consequences, and mismanagement contributed to poor project performance. Recent projects have attempted to correct the mistakes, but it is not surprising that a negative stereotype is widely held of dryland development potential.

Public resources were invested instead in areas of high potential in which intensification was expected to bring greater improvements, and new technologies greater scope. However, treating drylands as 'development sinks' may ultimately lead to high costs in terms of lost production, more welfare provision and social instability.

Private investment unaffordable?

Another widely held view is that poverty inhibits private investment by small producers and therefore compels a short term approach to natural resource management. Woodland is reduced by cutting, or cultivation is extended onto 'fragile' soils, while other forms of the mining of natural capital are practised. Because conservation was regarded as a precondition for improved productivity, public-sector investment often concentrated on technical interventions, which were driven by expert diagnoses and were sometimes coercive. Such agendas did not necessarily correspond with the priorities of the peoples, nor were they necessarily viable financially.

Negative stereotypes of the incapacity or unwillingness of small producers to make investments distracted the attention of outsiders from the characteristics of the investments in natural resource management and the kinds of incentives required. Evidence of such investments is given below. Not discounting the future is, after all, a condition for a sustainable livelihood.

Policy inaction inevitable?

An inability to assess the true costs of ecosystem degradation has stood in the way of macroeconomic policies for natural resource management based on economic analysis. Instead, piecemeal, sectoral approaches to localized hazards, such as the prevention of soil erosion on steep slopes, have been typical. Paradoxically, these approaches tend to direct public resources to the projects that are the least likely to yield satisfactory returns on investment. It is not surprising that there should be resistance to sending more funds along that path, as public resources become scarce.

On the other hand, the same economic analyses can demonstrate the likely benefits of controlling degradation and point to appropriate policies that transfer some of the responsibility from an overburdened state to private investors.

A new paradigm of dryland development

Major dilemmas therefore face public policy with regard to investing in drylands. The degradation model continues to speak loudly to planners. Is there an alternative approach? This paper argues that there is such an approach and sets out the respective essentials in the conclusion (Section 9).

3. More people, more poverty? Success stories

Perceptions of degradation have thus been influential in driving development policies in drylands and pointing towards technical (external) solutions. However, in certain drylands, internal responses have evolved both to constraints and to opportunities. These have drawn attention to local knowledge, technical adaptation and the capacity to invest, as well as to the critical role of appropriate and well-timed interventions. They are evidence of an impressive degree of success on the part of small producers. Lessons can be learned from these stories, including about whether and under what conditions the interventions are replicable elsewhere.[11] The seven stories come from African drylands, where rapid demographic and economic change (and rainfall decline in the Sahel) offers major challenges.

Machakos and Makueni Districts, Kenya[12]

The changes observed in Machakos District over a period of 60 years have led to findings linking up population growth, market development and sustainable environmental management.[13] In the 1930s and 1940s, officials were extremely concerned about erosion on the hillside farms and the clearance of dry woodland. Yet, the district saw the value of output per square kilometre increase sevenfold between the 1930s and the 1980s (**Box 3**). On a per capita basis, a doubling in output occurred, even though the population had risen fivefold.

The Akamba farmers achieved this by means of a fundamental transformation of their farming system. The following took place: a dramatic reversal of erosion thanks to the construction of thousands of kilometres of farm terraces and field drains; improved productivity through integrated crop-livestock production systems; new or adapted farm technologies; increased labour inputs; and increased private investments, which were financed in part from off-farm incomes.

The factors responsible for these changes were as follows.

- Customary land tenure provided sufficient security to encourage the investments of farmers; later, this was reinforced by title registration.
- Trading, travelling and education gave access to incomes outside the district; some of the incomes were used for farm investments.
- New knowledge and technologies became available from neighbouring European farms and missions, government extension, private-sector service providers, on-farm experimentation and community exchanges.
- Project interventions played a key role at certain times, particularly during the 1940s (the African Land Development Board, whose coercive conservation measures were initially successful, but later widely neglected) and the 1970s (the Machakos Integrated Development

11 Reij, C. and Steeds, D. (2003) 'Success Stories in Africa's Drylands: Supporting Advocates and Answering Skeptics'. A paper commissioned by the Global Mechanism of the United Nations Convention to Combat Desertification. Amsterdam, the Netherlands: Centre for International Cooperation, Vrije Universiteit.

12 This area is hilly, with annual rainfall varying from <500 mm to >1 000 mm, deeply weathered, but eroded soils that need fertilization under cultivation, and population densities from <50 to >200 per km2.

13 Tiffen, M., Mortimore, M. and Gichuki, F. (1994) More People, Less Erosion: Environmental Recovery in Kenya, 95. Chichester, United Kingdom: John Wiley.

Programme, which assisted the revival of conservation that made Machakos what it is today). However, even at its peak, the greater part of investment was private.

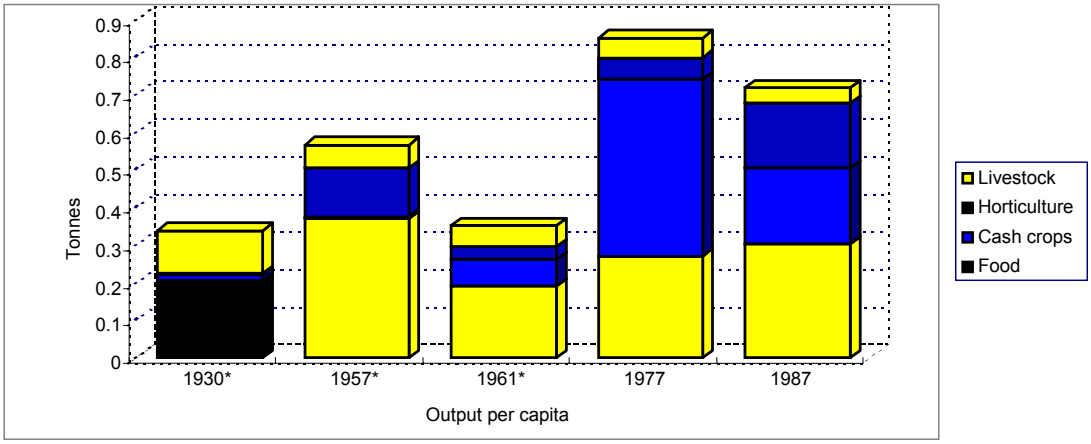
- The integrating of crop and livestock production provided on-farm synergies, additional revenue per hectare and better nutrient management.
- Access to urban and overseas markets via the Nairobi-Mombasa highway and rail line offered the necessary incentives for the commercial production of coffee, fruit and horticultural produce.
- Institutional flexibility fostered the dissemination of knowledge, the mobilization of labour (notably in women's work groups) and other advances.

The relaxation of restrictive practices by the Government (e.g. allowing Africans to grow coffee, 1954; allowing interdistrict trade in food commodities, 1980s) gave more freedom to farmers and entrepreneurs.

Box 3: Value of output per capita and per square kilometre in Machakos District, Kenya, 1930-87

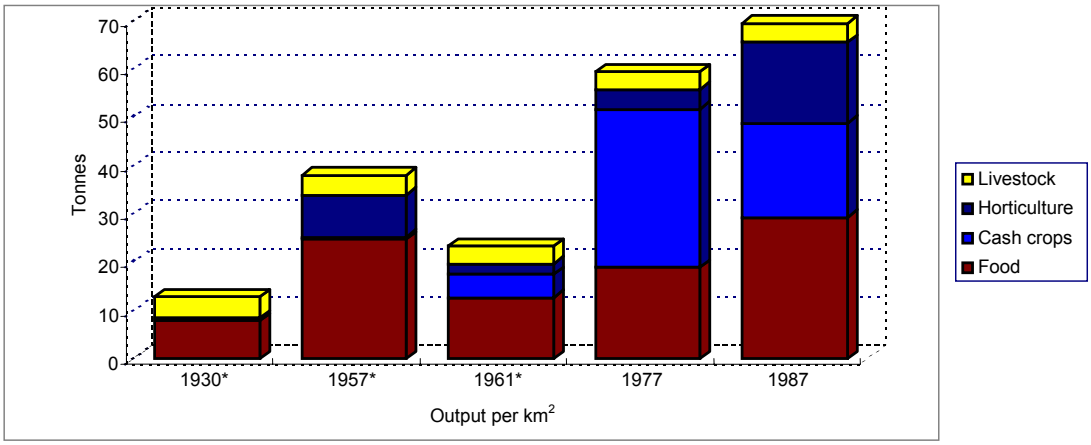
The charts below are based on the (inadequate) data available. They show in value terms what farmers achieved over the long run. The values are expressed as equivalents of maize (the staple cereal food), using 1957 prices for the years 1930, 1957 and 1961, and 1977 and 1987 prices for later years. The fall in values in 1961 was due to a widespread drought that year, which affected both of the short growing seasons (March-May and October-December). The fall in the per capita value of output in 1987 was caused by declining prices for coffee and cotton (the principal components of 'cash crops'). Actual production increased, as may be inferred from the continuing rise in value per square kilometre. Trends have not been analysed for years after 1987.

Source: Tiffen, M., Mortimore, M. and Gichuki, F. (1994) *More People, Less Erosion: Environmental Recovery in Kenya,* 95. Chichester, United Kingdom: John Wiley.



* Expressed in 1957 prices.

Figure 1 - Output per capita (expressed in terms of maize equivalent)



*Expressed in 1957 prices.

Figure 2 - Output per square kilometre (expressed in terms of maize equivalent)

In 1999, follow-up studies in the new Makueni District (which includes the driest part of the old Machakos District) showed that the achievements in natural resource management had not been put at risk by a decade of structural adjustment and falling prices even in this drier area. However, off-farm incomes had become more difficult to generate, and poor families were struggling to continue investing in education. There was still poverty in households that had not succeeded in diversifying.

Central Plateau and Eastern Burkina Faso

In 1980, the Central Plateau[14] was experiencing degrading soils, declining yields, a loss of natural vegetation, falling water tables and the emigration of up to 25% of families (though village populations still increased). The common view was that droughts, food shortages and degradation were endemic; these continued into the 1990s.

However, a study of the densely populated northern part of the Central Plateau presented a different picture.[15] Over a relatively short period of 20 years, significant increases occurred in crop yields **(Box 4)**.

Box 4: Improving grain yields in three provinces of the Central Plateau, Burkina Faso (kg/ha)

Sorghum and millet are the main cereal staple foods. Averaged over three periods during the past 20 years, yields per hectare show a consistent improvement. It should be noted that these averages include drought years.

14 This area has 500-700 mm of annual rainfall, soils of marginal fertility and population densities up to 100 per km2.

15 Reij, C. and Thiombiano, E. (2003) Développement rural et de l'environnement au Burkina Faso: la réhabilitation de la capacité productive des terroirs sur la partie nord du Plateau Central entre 1980 et 2001. Amsterdam, the Netherlands: Centre for International Cooperation, Vrije Universiteit.

Province and crop	*1984-88*	*1989-95*	*1995-2001*
1. Bam			
Sorghum	446	489	703
Millet	406	478	619
2. Yatenga			
Sorghum	594	534	733
Millet	473	539	688
3. Sanmatenga			
Sorghum	408	644	680
Millet	509	515	580

Source: Reij, C. and Thiombiano, E. (2003) *Développement rural et de l'environnement au Burkina Faso: la réhabilitation de la capacité productive des terroirs sur la partie nord du Plateau Central entre 1980 et 2001*, 16. Amsterdam, the Netherlands: Centre for International Cooperation, Vrije Universiteit.

Additionally, the following improvements in natural resource management were observed, particularly in villages practising soil and water conservation.

- Soil and water conservation led to a rise in the number of on-farm trees (aiding soil protection)
- The number of livestock owned by farmers increased (providing more manure)
- The regeneration of vegetation was enhanced (providing more fodder)
- Livestock management began evolving from extensive to semi-intensive management
- Local groundwater levels rose substantially
- Emigration decreased, with some return migration
- Household food security improved and the incidence of rural poverty declined

These changes occurred concurrently with the widespread adoption of soil and water technologies by the Mossi farmers, but not all the achievements can be credited to these technologies. A critical role was played by sound macroeconomic management and improvements to infrastructure that linked producers more effectively with markets. Much has been achieved, but much remains to be done (e.g. in improving soil fertility and controlling degradation on uncultivated land).

Over a longer period of 40 years, changes in the Eastern Region[16] have been documented in another study.[17] There were several trends that are often considered to be linked to degradation: a quadrupling in population, a tripling in livestock numbers and a decline in average annual rainfall of about 300 mm since the 1950s. But, instead of evidence of stress or soil degradation, the study found that, after 1980, the average production of staple grains per capita rose more rapidly than did the area cultivated (**Box 5**) and that average yields increased by some 400 kg/ha.

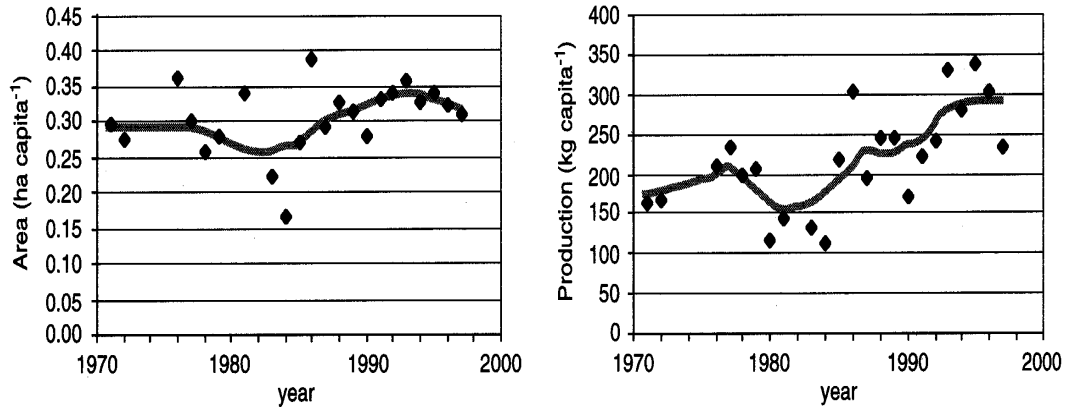
16 This area has 600-900 mm of annual rainfall, soils of limited depth and low fertility and population densities ranging up to 60 per km2.

17 Mazzucato, V. and Niemeijer, D. (2000) 'Rethinking Soil and Water Conservation in a Changing Society: A Case Study on Eastern Burkina Faso'. Tropical Resource Management Papers, 32. Wageningen, the Netherlands: Wageningen University and Research Centre.

There is a large repertoire of soil and water conservation strategies that also raise productivity. Farmers adjust, adapt and experiment. Mechanization and inorganic fertilizers explain only a small part of the yield increases. The Gourmantché farmers maintained a productive and environmentally sustainable production system in spite of changing natural and social conditions, successfully adapting their institutions to regulate access to natural resources.

Box 5: Improving grain production in Burkina Faso's Eastern Province, 1970-2000

In the early 1980s, in Burkina Faso, as in most other West African countries, there was a failure in agriculture that was reflected in falling cereal output. After this low period, both the area planted to millet and sorghum and the amounts produced increased on a per capita basis. However, the first indicator, the area planted, faltered as land became scarce in the 1990s, while the second rose to levels that were higher than those achieved before the drought cycles of the early 1970s and 1980s. This provides evidence of intensification.



a. millet and sorghum area per capita

b. millet and sorghum production per capita

Figure 3

Nigeria: The Kano Close-Settled Zone[18]

Two critical factors in success stories are population growth and markets. The interactions of these factors are illustrated by the next two stories from northern Nigeria.

In the Kano Close-Settled Zone, population densities outside the city grew from 226 per km^2 in 1962 to 414 per km^2 in 1991. The practice of divisible inheritance ensured that smallholdings became smaller with each generation, and the amount of farmland available now averages <0.5 ha per member of the

18 This area has 650-700 mm of annual rainfall (a decline of nearly 200 mm between the 1960s and the 1990s), sandy soils with low fertility and on-farm population densities rising to >220 per km2. Average slopes are low.

resident farming families. But, instead of inducing the degradation of natural resources, this demographic pressure was accompanied by a continuation of a long-term trajectory of agricultural intensification that had been in place for at least 150 years (**Box 6**).

Externally funded statewide agricultural-development support was introduced in 1981. Subsidized inorganic fertilizers, technologies, advice, road infrastructure and other kinds of support were available, though thinly spread among a population approaching 10 million. The scaling down of activities and the removal of subsidies took effect in the 1990s, but significant technical changes have been adopted widely since 1981 (e.g. new varieties of groundnuts, cowpeas and maize, many more ox-drawn ploughs and ridgers). Most of these changes, if not all of them, are privately financed. Expanding labour, input and land markets are making Hausa and Fulani farmers more reliant on capital resources. Successful livelihoods depend on earning off-farm incomes with which to finance farm investments and reduce dependency on home-produced food. Those without such opportunities are food-insecure.

Box 6: Agricultural intensification by smallholders in the Kano Close-Settled Zone

The methods and achievements of small farmers in the Kano Close-Settled Zone are relevant in the search for intensification strategies in dryland environments. Farmland is under annual cultivation, with no fallowing, except on <10% of the fields, where labour or inputs are not available. Over 85% of the surface is under this regime (excluding settlements, communications, burial grounds, waste, etc.).

By efficiently recycling plant nutrients through intensive grazing, manuring and composting and by allocating large amounts of family labour to fertilizing and weed suppression, farmers can secure grain yields of >1 000 kg per ha and 350 kg per capita under average rainfall (650 mm). Without fertilizer, yields fall to a half or a quarter, and farming becomes non-viable. Livestock are kept by nearly all households and are valued highly. The more people there are, the more livestock. As there is no rangeland, the livestock depend on crop residues and weeds or tree browse laboriously cut for them. Annual manure and dry compost treatments are on the order of 3.5-5.0 tonnes/ha. This material is a composite of animal manure, household refuse, vegetable matter and ash. Estimates in 1968 suggest 40 tropical livestock units per km^2, which may produce 43 tonnes/km^2 or 0.43 tonnes/ha of manure. Mixed with the other materials, this may yield 4 tonnes/ha. Inorganic fertilizers are used, but on a very small scale (owing to their cost). Nitrogen added per hectare is usually less than that obtained through fixation by leguminous crops or that supplied in manures. Key soil nutrients at the field level fluctuate according to rainfall, the cropping system and a farmer's ability to provide inputs. However, comparative analyses at the same sites over a 13-year period suggested no significant trend at that timescale.

Sources: Harris, F. M. A. (1998) 'Farm-Level Assessment of the Nutrient Balance in Northern Nigeria'. *Agriculture, Ecosystems and Environment*, 71: 201-14; Harris, F. and Yusuf, M. A. (2001) 'Manure Management by Smallholder Farmers in the Kano Close-Settled Zone, Nigeria'. *Experimental Agriculture*, 37: 319-32.

Grain markets in northern Nigeria

Throughout the 20th century, Hausa farmers in Kano's dry hinterland, working in the proximity of one of the greatest markets in West Africa, adjusted to changing economic circumstances and a background of agrarian policy shifts.[19] Earlier, they had supplied the city with staple grains, but, after the railway came in 1911, they diversified into the cultivation of groundnuts for export. After decades of prosperity, this trade collapsed because of drought and the rosette disease in 1975. However, the number of urban consumers in Kano rose from 250 000 in the 1960s to >1.5 million in 1991. Kano, not surprisingly, is a focal point for food marketing in a wide region. The Kano Close-Settled Zone can no longer supply all the needs of this region, but its markets provide incentives for farmers. In spite of increasing demand, land scarcity and diminishing rainfall, the trend in the real prices of millet was downwards during the 1980s and 1990s, implying increased productivity (**Box 7**).

Box 7: Downward trend in real prices of millet (per tonne) in Kano urban markets, 1960-98

Consumers complained of rapid price inflation beginning with the Sahel drought (1972-74), but this reflected nominal prices during general inflation. Producers complained of rising marketing costs. The trend in real prices was, in fact, downwards, suggesting that supply constraints (land scarcity, low soil fertility, high costs of fertilizers, middlemen's margins and illegal rent-seeking in the market chain, fuel scarcities, etc.) were being overcome successfully. The prices reflect not only local demand, but the national trade in food commodities and cross-border movements to or from the Niger.

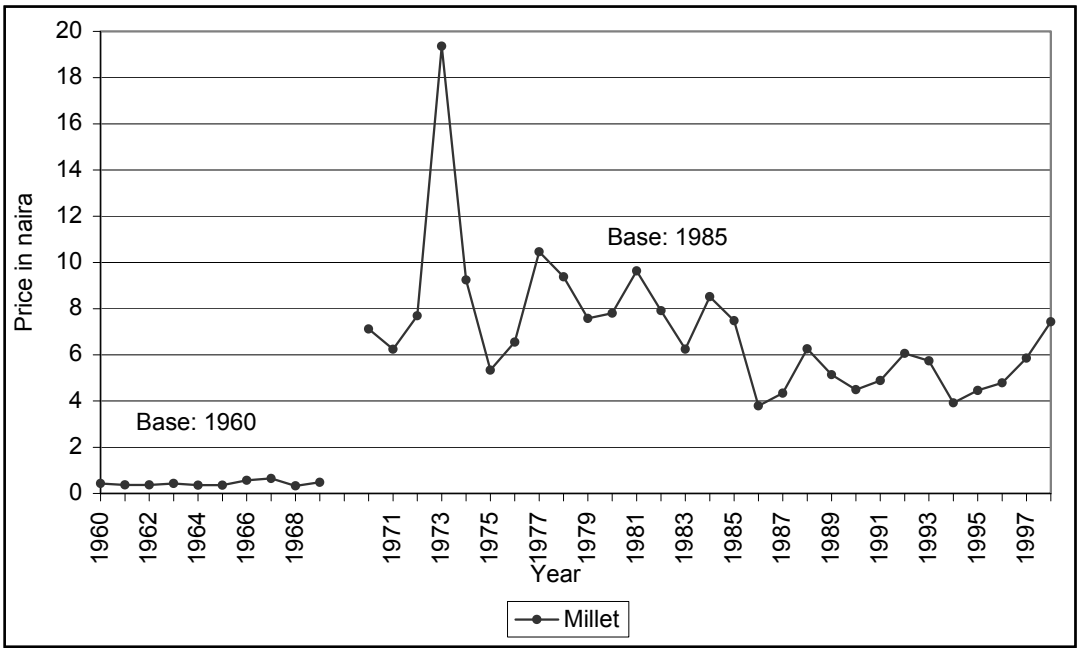


Figure 4

19 Mustapha, A. R. and Meagher, K. (2000) 'Agrarian Production, Public Policy and the State in Kano Region, 1900-2000'. Drylands Research Working Paper, 35. Crewkerne, United Kingdom: Drylands Research.

Source: Ariyo, J., Voh, J. and Ahmed, B. (2001) 'Long Term Change in Food Marketing in the Kano Region, 1960-2000'. *Drylands Research Working Paper*, 34. Crewkerne, United Kingdom: Drylands Research.

With its centuries-old markets and interregional trading networks, Kano challenges the stereotype of remote and unproductive drylands, and the power of its markets (which extend well beyond food commodities) suggests that policies to promote interaction and trade could benefit other drylands also. With the exception of groundnuts, these markets have prospered from a minimum of state regulation since precolonial times. Kano also provides a model of complementary rather than competitive rural-urban relations, which has tended to disperse incomes and stimulate on-farm investments.

Box 8: Planted areas and crop production in Maradi, 1979-98

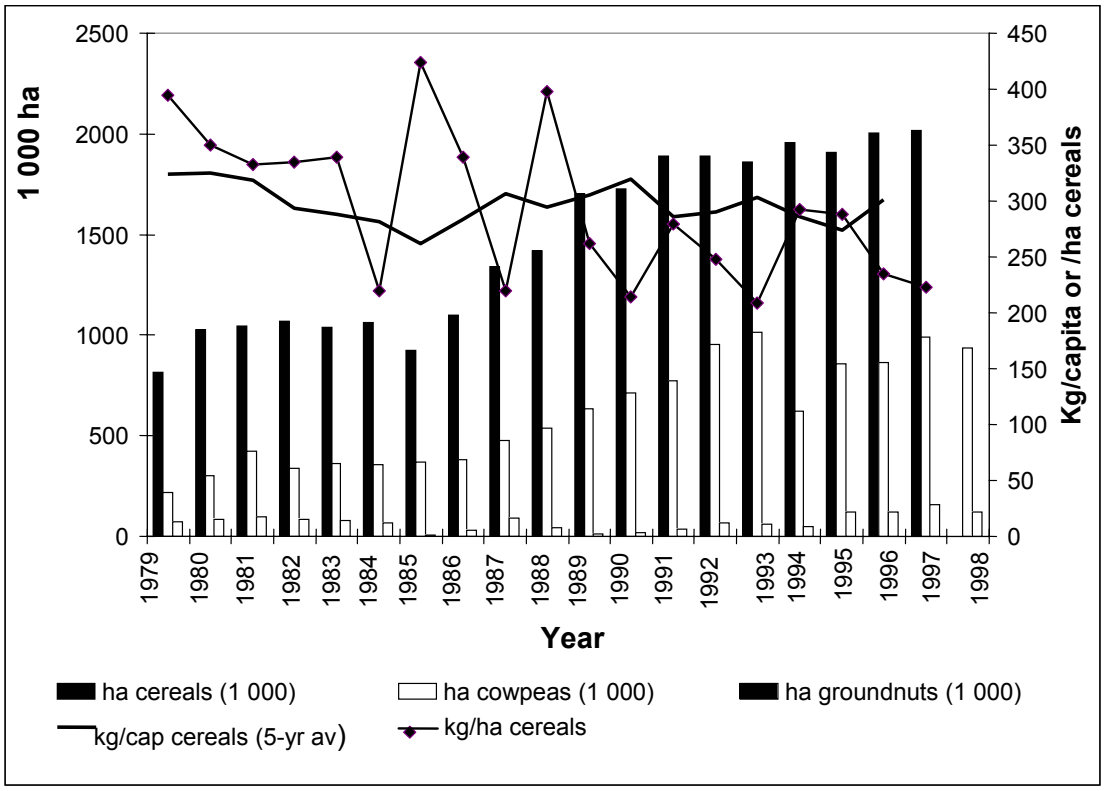


Figure 5

The extent of the areas planted to cereals doubled between the early 1980s and the late 1990s. The state (transferring its dependence from groundnut exports to newly discovered uranium) had adopted a 'self-sufficiency' policy after the Sahel drought through a focus on inputs, marketing and development programmes. There was also a response through land tenure reform, which motivated farmers to assert private ownership rights by cultivating unclaimed land. But this expansion levelled off after 1994, whereas yields per hectare maintained an upward trend during the 1990s, though still very low. Cereal (millet and sorghum) production, though falling after droughts, showed no long-term decline. Millet output tended upward under 'self-sufficiency' (1975-85) and

structural adjustment (1986-98), when the end of the uranium boom brought unsustainable debt. From 1979 to 1998, output was sustained above 200 kg per capita, which approximates average food requirements.

Source: Hamadou, S. (2000) '*Evolutions à long terme des productions agricoles, du système de commercialisation et des prix des produits dans la zone de Maradi*'. *Drylands Research Working Paper*, 32. Crewkerne, United Kingdom: Drylands Research.

Incipient success, the Niger: Maradi Department[20]

On the northern fringe of Hausaland, but within reach of the markets at Kano, Maradi Department south of the pastoral zone was under stress because of rapid population growth as a result of a sustained influx of land-hungry farmers into the area.[21] After the drought cycle of the 1970s, the production of groundnuts, the export of which had been the mainstay of the Government's economic policy, collapsed, and grain deficits became common. The rising population densities, the growing scarcity of new land, with reports of the degradation of soil and vegetation, the shortening of fallow cycles and declining crop yields, and overgrazing by armies of cattle and small ruminants suggested that the productive and social systems were not sustainable. By the early 1990s, in many areas there was no more unclaimed farmland ('saturation').

In Maradi Department, however, food production was sustained. Average output per capita exceeded the estimated minimum food requirement, even after the expansion in cultivated area levelled off owing to saturation (**Box 8**). In the south, the conditions for a transition are present (land scarcity, more agricultural labour and market incentives because of trade with Nigeria). Farmers there are intensifying in many ways: a decline of fallowing; more grazing of livestock on fields; greater attention to maintaining fertility (by mulching, composting, manuring and mineral fertilizers); new seeding, cultivation and tree conservation measures; the growing popularity of protecting valuable trees on farmland; adaptations in the customary land tenure system to compensate for land scarcity and increasing individualization; investments in livestock, ploughs, planters and carts; and the enhanced roles for women in farm investment. Groundnuts yielded place to cowpeas as the primary market crop. The data show no evidence of a decline in the livestock population except following droughts. Like cowpeas, animal production is targeted at the buoyant markets in Nigeria.

Struggling to adapt, Senegal: Diourbel Region[22]

Diourbel is at the centre of the groundnut exporting region, or 'peanut basin'. Its population of Wolof and Sereer mixed farmers grow millet for subsistence.

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20 This area has a mean annual rainfall increasing from 250 mm in the north to 450 mm in the south, coarse sandy desert-edge soils and rural population densities rising from about 13 per km2 in 1960 to about 44 per km2 in 1999.

21 Mortimore, M., Tiffen, M., Boubacar, Y., and Nelson, J. (2001) 'Synthesis of Long-Term Change in Maradi Department, the Niger, 1960-2000'. Drylands Research Working Paper, 39e. Crewkerne, United Kingdom: Drylands Research.

22 This area has a mean annual rainfall of 450 mm, sandy, unproductive soils on gentle slopes and variable population densities of 46-151 per km2. Over 80% of the land has been under cultivation or on short one-year fallows since 1954.

The collapse of centrally directed agricultural policy in Senegal is briefly described in Section 2.[23]

After 1969, the region was hit hard by droughts, which reduced average annual rainfall from over 600 mm to about 400 mm. In the 1980s, observers thought that the export of plant nutrients in the groundnuts, declining yields, inadequate fertilization and shortening fallows threatened a collapse of the production systems, but the termination of the *Programme National Agricole* was decisive. Producers had few alternatives to groundnuts, as Senegalese consumers had acquired a preference for rice, which was imported and sold under subsidy. On the other hand, the state's control of farm profits made families more reliant on off-farm earnings and the social networks that gave access to these. Much rural wealth was invested in Dakar.

A closer look at the rural sector reveals, however, that important adjustments have been made by farmers (**Box 9**). In crop production, there is suggestive evidence that yields of millet and groundnuts per mm of rainfall (which is the most scarce factor) have improved owing to technical changes. Millet yields per hectare and per agricultural worker also improved. Livestock numbers were maintained (in cattle) or increased substantially (in small ruminants). Fattening animals became both profitable and popular, based on the intensive use and exchange of crop residues. Animals are popular investments, including for women, and add value to farming systems.

Diourbel shows that demand incentives can drive vigorous adaptive strategies, even where dependence on the state has become a habit. This adaptation is taking place in the face of severe constraints in soil productivity and rainfall.

Box 9: Adjustments to policy failure in Diourbel, Senegal

Over the long term (1960-2000), the staple food commodity, millet, was undermined by competition from rice, and production per capita fell by 50% nationally. However, trends in the use efficiency of scarce factors were positive. Millet yields per hectare rose by about 20% over the period; yields per millimetre of rainfall doubled, and yields per agricultural worker climbed by about 25% after a low point in 1980/81. A similar contradiction appears in groundnuts: output per capita went into rapid decline, and yield per hectare went into a rather slower decline, but there was a noticeably rising trend in yield per millimetre of rainfall, resulting from the adoption of drought resistant, upright varieties.

In the livestock sector, the numbers of cattle, donkeys and horses fluctuated around mean values that did not change significantly over the same period, while small ruminants roughly doubled in number. Between 1975 and1981, the numbers of cattle managed for fattening in Diourbel increased from 350 to 10 437, and the numbers of small ruminants rose from 1 409 to 31 430. The trends continued, as poor people, including women, tried to buy or rear goats or sheep for economic gain. Buoyant meat prices helped, and currency devaluation (1994) raised the price of imported meat. The possession of more livestock facilitates integrating crop with livestock production, giving synergies in draft

23 Faye, A., Fall, A., Tiffen, M., Mortimore, M., and Nelson, J. (2001) 'Région de Diourbel: Synthesis'. Drylands Research Working Paper, 23e. Crewkerne, United Kingdom: Drylands Research.

energy and in soil fertility on manured fields. But organic materials cannot fully compensate for the inorganic fertilizers which farmers can no longer afford.

Source: Faye, A., Fall, A., and Coulibaly, D. (2001) '*Région de Diourbel: évolution de la production agricole*'. *Drylands Research Working Paper*, 16. Crewkerne, United Kingdom: Drylands Research.

Rewards of success

There is evidence in the success stories that:

- populations have continued to support themselves (though not exclusively) from agrarian livelihoods at population densities higher than any in the past
- markets have been extremely important in driving change, and farmers have been responsive to market opportunities
- farming systems have tended to move towards more intensive, diverse and environmentally sustainable combinations of crops, livestock and technologies
- households and individuals have found it necessary and advantageous to diversify their incomes outside agriculture, including increasing their participation in short term migration
- macroeconomic policies have had discernible effects, both positive and negative, on the pursuit of livelihood objectives
- customary land tenure has adapted, where necessary, to land scarcity and also to legislative or project interventions by the state
- social institutions have not impeded individual or community action, and the household remains the locus of diverse economic activity and investments and the sharing of risks or benefits

The 'incipient success stories', while still inconclusive, suggest that such positive changes are capable of replication. Policy failure, furthermore, is not the end of the road for dryland people, whose resilience to environmental risk has been applied on occasion to adapting to changing policy. Policy determinants are dealt with again in the next section.

There are thus good examples to show that investing in dryland development is sound at both the micro- and macroeconomic levels and above all in social terms. The best approach to fighting poverty and unsustainable ecosystem management in drylands is to promote investments in sustainable and productive land-use practices; added value is the best defence against both poverty and the mining of natural capital.

4. Food security under threat? Evidence of resilience

An often repeated consensus view is that agriculture in sub-Saharan Africa, in contrast to that in Asia, has failed to perform as expected during the past 40 years. For example, according to a policy paper of one donor, agricultural production declined by 5% between 1980 and 2001, while the absolute number of people going hungry increased by 50 percent.[24] Among the reasons given for this state of affairs are falling commodity prices, poor incentives, ineffective aid and a decline in private investment.

Is this view accurate and does it apply to countries with dryland areas? The long-term data published by the Food and Agriculture Organization of the United Nations can only answer this question at a national level. In six West African countries, *export* agriculture declined over the four decades, 1961-2000.[25] Only cocoa exports from Côte d'Ivoire maintained a strong upward trend. In Mali, cotton exports rose steeply until 1976, fell equally steeply until 1985 and then stabilized. Cocoa stagnated or declined in Ghana and Nigeria. Exports of cotton, groundnuts and (in coastal countries) palm oil and kernels declined or collapsed in several countries.

On the other hand, *food* production per capita, notwithstanding the growth in population, increased in Africa by 4%, between 1969/71 and 1997/99. But performances in the food producing sector did not, however, conform to a general pattern (**Box 10**). They reflected the impact of several factors: rising domestic demand for food, declining prices for export crops, government policies and droughts. Also, the substitution of imported foods (rice or wheat) for domestically produced cereals (millet, sorghum, maize) and of roots or tubers (yams, cassava) for dryland cereals continually reshaped food commodity markets. Buoyant markets have appeared for the protein-rich cowpea, which is mainly grown in semi-arid areas. The livestock sector is also buoyant, benefiting from rising incomes among more well off urban consumers.

Thus, dryland cereal production has tended to keep up with demand over the long term, except where explicitly discouraged by policy. The resilience of the food producing subsector is more remarkable than any weakness in the face of supply constraints.

24 DFID (2003) 'Agriculture and Poverty Reduction: Unlocking the Potential'. DFID Policy Paper, 1, 3. London: Department for International Development.

25 Mortimore, M. (2003) 'The Future of Family Farms in West Africa: What Can We Learn from Long-term Data?' Issue Paper, 119. London: Drylands Programme, International Institute for Environment and Development.

Box 10: Long-term performance of the cereal producing subsector in West Africa

What narratives do the long-term data suggest with regard to the food commodity subsector, particularly cereal grains produced in the drylands? Findings from a study of six countries emphasize the critical role played by policy, as the following examples show.

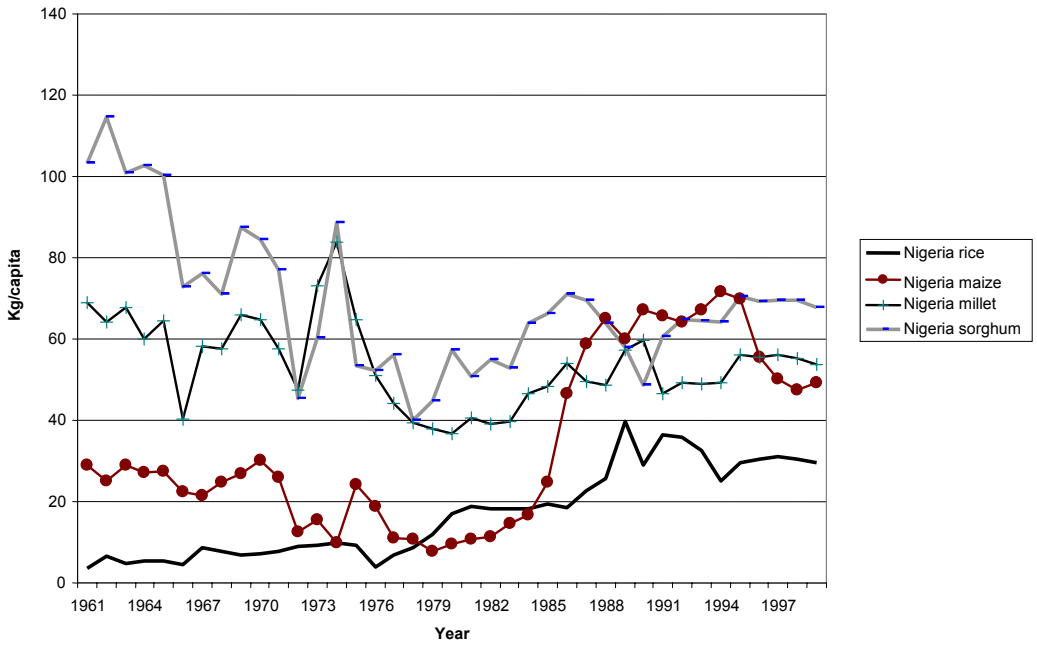

Figure 6 - Cereal crop production, Nigeria (per capita)

In Nigeria, the northern third of the country is dryland. There were major policy-related changes in the agricultural sector, in particular *Operation Feed the Nation* – fertilizer subsidies, import protection, technology promotion (maize), and irrigation (rice) – in the 1970s, and structural adjustment policies (which retained fertilizer subsidies and import protection) from 1986. The stagnation that affected dryland cereal crops from the 1960s was reversed. The 'new' dryland cereals increased dramatically. However, they fell back (maize) or stagnated (rice) in the 1990s. The 'old' dryland cereals (millet and sorghum) recovered from decline in the 1980s. In the 40 years, cereal production per capita of the national population did not change significantly (-1.2% overall), and, in aggregate, dryland cereal production was maintained at about 200 kg per capita of the total population, notwithstanding the fact that half of Nigerians rely on roots and tubers more than on cereals.

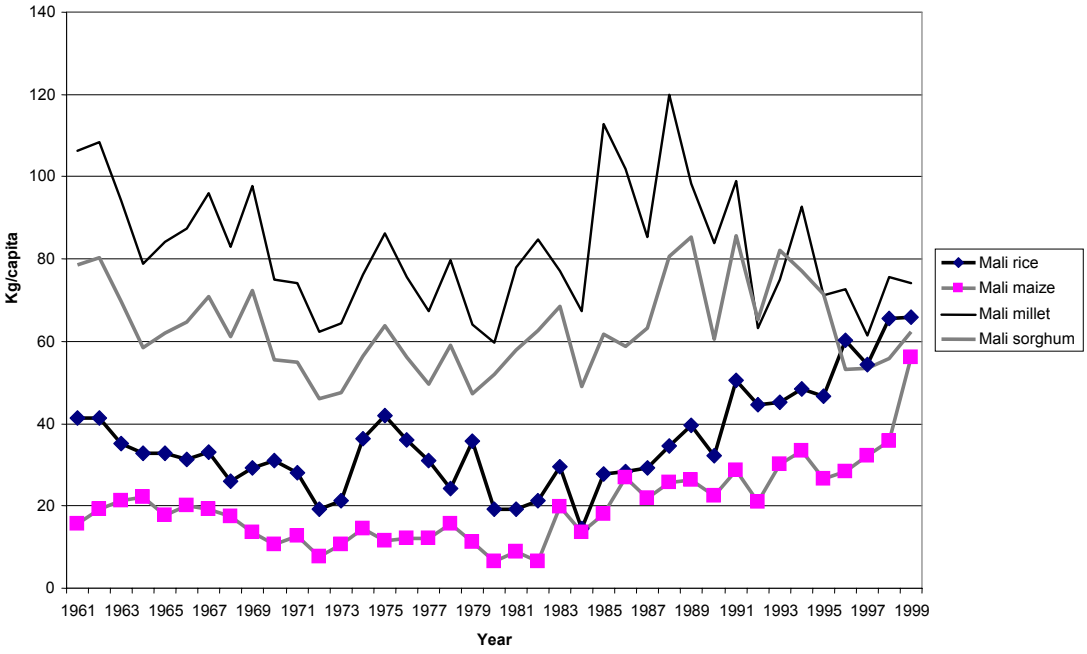

Figure 7 - Cereal production, Mali (per capita)

Data are available for the same four crops in Mali, which lacked a large humid zone, enjoyed no oil boom and is not extensively urbanized and thus offers a sharp contrast to Nigeria, which has a large humid zone, enjoyed an oil boom and is extensively urbanized. Yet, the pattern was similar: decline in output per capita (though less marked than in Nigeria) until around 1980, followed by improvement under structural adjustment, which was lasting among the 'new' cereals, but short lived in the 'old' cereals. The difference was that the demand for the new cereals was growing, and, by the end of the 1990s, the new cereals had achieved equality (more or less) with the old cereals. Production of all cereals per capita showed no significant change over the 40 years (-2.6% overall), remaining well above 200 kg per capita.

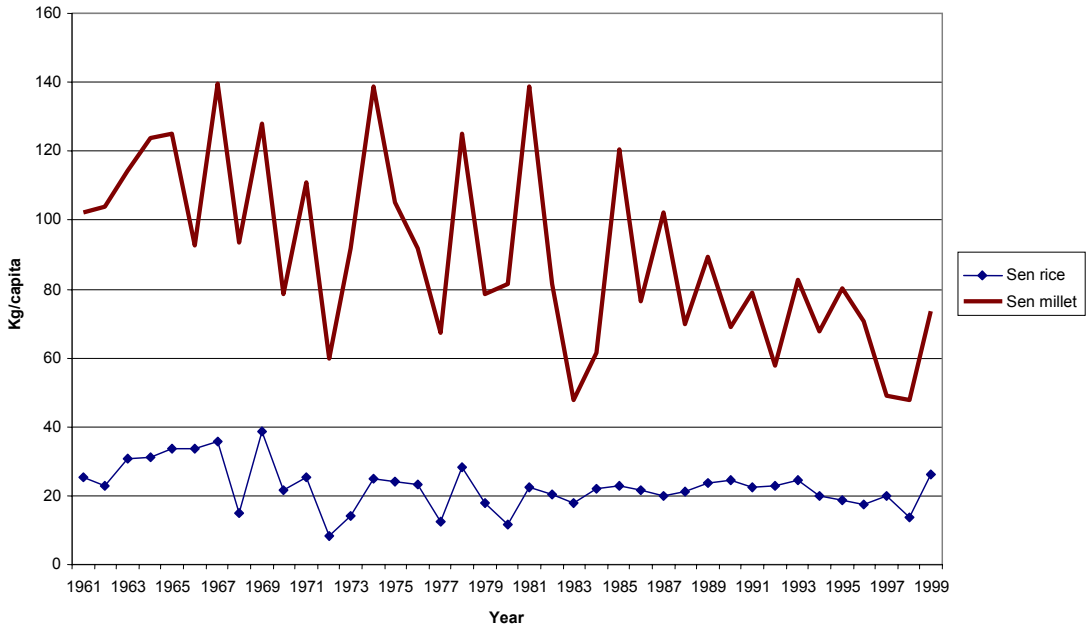

Figure 8 - Cereal crop production, Senegal (per capita)

Even stronger evidence of the influence of policy – this time, negative – is reflected in data for Senegal. There, sorghum and maize are comparatively unimportant. Thanks to a policy that promoted imported rice and subsidized its price, millet (the traditional staple) declined notably over the period as a whole. The production of rice, now the preferred staple, was unable to compensate. Irrigated production in the Senegal River valley was beset with management problems. Overall, cereal production fell by 41% per capita, accentuating import dependency.

Source: Mortimore, M. (2003) 'The Future of Family Farms in West Africa: What Can We Learn from Long-term Data?' *Issue Paper*, 119. London: Drylands Programme, International Institute for Environment and Development.

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5. Drylands degradation? Reversing the trends

There is a widely held view that the ability of dryland ecosystems to provide goods and services has been compromised by the degradation of land and water and loss of biodiversity. Public sector and donor investments are considered to yield low or zero returns and need to be justified more on social than on economic grounds. This view is informed by a narrative of degradation that has been dominant since the United Nations Conference on Desertification in 1977.

The greening of the Sahel

Environmental change in the Sahel has interested scientists for four decades. Several devastating drought cycles affected the region between the late 1960s and the 1990s. Average annual rainfall declined by up to 30% between 1931-60 and 1961-90 and did not fully recover by 2001. Land degradation has also been blamed on mismanagement by farmers and pastoralists.

However, time-series data from earth satellites have recently been analysed for the region.[26] A 'greenness' index (the normalized difference vegetation index) derived from advanced very high resolution radiometer data shows a strong increase in values between 1982 and 1999. This improvement took place mainly in the period after 1993. Preliminary studies indicate a continuation of the trend through 2003. Assessments of other parameters linked with the data, support the conclusion that the observed trend is a real change on the land surface.

Analyses of the rainfall data show an improvement towards the end of the period. The greening, however, is not uniform, and, in some places, negative trends are observed. This suggests that factors other than rainfall are also contributing. These factors need to be studied through site-specific investigations on the ground, as the resolution of the satellite data is coarse (8 km).

It is too early to say whether the greening represents a recovery from the trend of declining rainfall and land degradation. As the data series begins at the base of a drought cycle, that of the early 1980s, some improvement would be expected in subsequent years. Comparable normalized difference vegetation index data are not available for the period before 1970. Other studies using satellite data show vegetation changes with rainfall fluctuations on the southern edge of the Sahara. The geological record offers evidence of longer term swings between desert and savannah conditions.

It would be mistaken to expect the vegetation in the Sahel to return to an earlier equilibrium, as the average rainfall is still far short of the level experienced before the 1970s, and some of the changes that have occurred may be irreversible. The ecology of the Sahel is not equilibrial in nature. Communities with livelihoods based on natural resources must continue adapting to this uncertainty. Much more understanding of human-environmental interactions is required.

26 UNEP (2003) 'Workshop on Changes in the Sahel, Nairobi, Kenya, 14-16 October 2003: Preliminary Report, Abstracts'. Nairobi, Kenya: United Nations Environment Programme.

However, the greening of the Sahel reveals that a simple projection of recent trends into the future is not a sound basis for policy, which, until now, has been informed by the narrative of degradation. As the success stories indicate, farmers have found ways to improve their management of natural resources. Policy must release the creativity of farmers and livestock producers, so that they may be better able to deal with the return of drought. Greening – whatever exactly it indicates on the ground – does not justify rolling back degradation control. Rather, it shows that positive trends are achievable.

Tree management in the Sahel

One landscape transformation that illustrates the need for a critical evaluation of the degradation narrative involves the management of trees and woodland. Sahelian farmers and pastoralists were accused since colonial times of irresponsible destruction by fire, farming and woodcutting, and repressive legislation was imposed to 'protect' the trees. The expanding population's fuelwood consumption was considered at fault. Shifting cultivators were also accused of destructive burning. More significantly still, during the past half-century there has been a dramatic increase in the clearance of land for farming, with a corresponding reduction in natural woodland. In more densely populated areas, the cultivated fraction rose from <25% to >70%. Such data can be used to support a global scenario of deforestation.

Much new evidence shows that there is another side to Sahelian 'deforestation'. An emerging consensus suggests that the fuelwood crisis has been exaggerated owing to an underestimation of the size of woodland areas and yields.[27] Woodland management is more sustainable than was previously supposed, and some urban demands may pose no long-term threat. Field studies indicate that land clearance for shifting cultivation is rotational, and mature trees are normally pollarded (not felled) to facilitate their regeneration after the cultivation cycle. When shifting cultivation gives way to permanent fields, these valuable trees grow to full canopy, and seedlings, regenerating spontaneously, are given protection until grown to maturity. They may also be planted. The emerging 'farmed parkland' vegetation may support more plant biomass than neighbouring woodland. The following cases are illustrative.

- In the *Kano Close-Settled Zone* of northern Nigeria, old, established farmed parkland has mature tree densities of 7-15 per ha. Although some species are becoming rare, the population as a whole is regenerating. While harvesting fuelwood and selling to urban dealers, farmers managed to maintain stable or increasing tree densities from the 1960s to the 1980s, despite two drought cycles when they were under pressure to raise incomes by selling wood.[28]

- In the *Maradi Department* of the Niger, where rapid conversion of forest to farmland took place from the 1920s until the 1970s, farmed parkland

27 Foley, G. (2001) 'Sustainable Woodfuel Supplies from the Dry Tropical Woodlands'. ESMAP Technical Paper, 013. Washington, DC: World Bank.

28 Cline-Cole, R. A., Falola, J. A., Main, H. A. C., Mortimore, M., Nichol, J. E., and O'Reilly, F. D. (1990) Wood Fuel in Kano. Tokyo: United Nations University Press.

can now be seen on permanent fields close to villages, and the practice of protecting valuable seedlings is popular and is promoted by policy.

- In the 'peanut basin' of Senegal, declining tree densities have been reported on farmland. However, field surveys at four sites (where farmed parkland is >75% of the surface) show tree densities of 14-30 per ha, including seedlings.

Farmed parkland is now so extensive in West Africa that increasing densities of mature trees can be expected to have a long-term signature in remotely sensed data. Furthermore, the multiple values of trees (including construction, crafts, food, fodder, medicines), together with the extensive indigenous knowledge possessed by communities, provide strong incentives for biodiversity conservation at the local level. The same is true of herbage vegetation, which is more prone than trees to short-term rainfall effects. New approaches to biodiversity conservation should seek to support these capabilities rather than override them.

Soil management and carbon sequestration

Soil carbon is relatively scarce in drylands. The amount in soil generally increases with rainfall and with the level of productivity. The presence of organic carbon in the soil depends to a large extent on the recycling of vegetation either directly through biological action, or via livestock grazing and manuring. If plant nutrients (e.g. nitrogen) are lost through soil degradation or in crop removals, the capacity to produce plant biomass is reduced, and organic carbon will only accumulate if nutrients are provided to support primary production. Generally, there is a strong and consistent relationship between soil carbon and nitrogen ratios.

Carbon is also supplied by sequestration from the atmosphere by living plants. Increasing carbon dioxide sequestration is now a global preoccupation, along with reducing emissions, under the Kyoto Protocol. Until recently, the potential of drylands for sequestering atmospheric carbon was not highly regarded because plant biomass stocks are relatively low, especially where they are degraded. However, this logic also suggests that there would be proportionate gains if degradation could be reversed. The vast territorial extent of the drylands has drawn attention to the possibility that a very small overall increment in plant biomass achieved through improved management could make a significant contribution to the global carbon budget. Such management options include:[29]

- increased fallow periods
- reduced tillage
- incorporation of crop residues
- mulching and green manuring
- increased composting or manuring
- rainwater harvesting
- erosion control

29 USGS (2000) Soil Carbon Sequestration in Semi-Arid and Sub-Humid Africa. Sioux Falls, SD: EROS Data Centre, US Geological Survey.

- agroforestry
- irrigation
- use of inorganic fertilizers and pest control
- rehabilitation of degraded natural vegetation

Many of these options are consistent with the aims of farmers and agropastoralists and have been taken up widely in the success stories. Modelling studies suggest that, within the structure of current dryland farming systems, including some of those referred to in this paper, alterations can be made that will lead to annual rates of carbon sequestration in the range of 0.02-0.29 Mg per ha/year.[30] A system of carbon emission reduction credits (purchased by carbon emitters in industrial countries) has been proposed as a way of promoting improved farming practices. Whether such a system is economically viable remains unproven, but there is no doubt that enhancing soil nutrients through sustainable practices adds value per hectare.

The new political economy of carbon offers an opportunity to reverse the view of drylands as a 'development sink' to one of a potential 'carbon sink' based on a stronger convergence of interests between the industrial-urban economies and the need for poverty reduction in the drylands. Incentives are critical at all levels, and it is to this subject that we now turn.

30 Farage, P. K., Ardö, J., Olsson, L., Ball, A. S., and Pretty, J. N., (in preparation) 'The Potential for Soil Carbon Sequestration in Tropical Dryland Farming Systems of Africa, Asia and Latin America: A Modelling Approach'.

6. Public investments failing? Evidence of favourable returns

Wrongly targeted, inappropriately designed, or badly managed interventions have contributed to the view that drylands are a sink for public-sector investments. But new evidence from India indicates, on the contrary, that economic rates of return may actually be higher in rainfed drylands than in humid and irrigated regions.[31] Rural districts were classified into predominantly irrigated or rainfed, and the rainfed areas were subdivided into 13 agroecological zones, which were ranked by land productivity. Historical data were used to estimate the returns to different types of investments (**Box 11**). Five categories of public investment were analysed: research on high-yielding crop varieties, rural roads, canal irrigation, electricity, and education.

Box 11: Marginal returns to investment by agroclimatic zone, rural India[a]

Zone		*Rainfall (mm/yr)*	*Research on high-yielding crop varieties*	*Rural roads*	*Canal irrigation*	*Electricity*	*Education*
Irrigated		858	4.64	26.80	2.76	0.86	0.22
Rainfed[b]							
Humid	1	1 690	0.00	38.38	4.90	1.18	0.10
	2	1 391	26.14	8.29	6.27	10.02	1.54
Sub-humid	3	986	7.50	102.83	3.17	5.15	0.09
	4	902	0.00	29.94	3.63	0.80	2.50
	5	960	0.86	37.88	2.19	1.28	0.86
	6	918	12.87	135.85	3.51	1.09	1.07
	7	965	29.80	100.47	6.96	4.44	0.94
	8	924	0.41	137.28	7.81	4.28	2.41
Semi-arid	9	508	5.30	82.53	1.95	2.92	10.55
	10	649	9.21	9.14	0.14	6.90	6.76
	11	443	0.02	2.57	2.53	0.16	11.93
	12	719	10.67	50.88	2.71	5.78	1.10
	13	335	0.00	113.29	0.00	31.42	12.37

[a] Annual returns are in rupees for every rupee invested.

[b] Rainfed zones are ranked by land productivity (1 = highest, 13 = lowest).

Source: Shenggen Fan, Hazell, P. and Haque, T. (2000) 'Targeting Public Investments by Agroecological Zone to Achieve Growth and Poverty Alleviation Goals in Rural India'. *Food Policy*, 25: 411-28.

There is considerable variability among the rainfed zones, but many values for the semi-arid zones exceed those for irrigated or humid zones. In rural roads, electricity and education, the semi-arid zones performed better on average than did the irrigated areas. The authors also found that investments in rural roads and education had a greater impact on the numbers of poor people in rainfed zones.

Are such results replicable in Africa? The authors caution against transferring their findings from India to Africa because of historical divergences. In India, after several decades of agricultural investment and a green revolution, the best

31 Hazell, P., Jansen, H., Ruben, R., and Kuyvenhoven, A. (2002) 'Investing in Poor People in Poor Lands'. Paper prepared for IFAD. Washington, DC and Wageningen, the Netherlands: International Food Policy Research Institute and Wageningen University and Research Centre.

options for humid and irrigated areas may now be exhausted. Hence, the rainfed drylands offer some good returns (though, as the data show, this is not inevitable).

Nevertheless, the question is very pertinent for African drylands. No comparable data have been compiled but, at the project level, the authors of the study cited earlier present a number of histories that demonstrate good rates of return to investment or, if financial data are not available, reliable evidence of satisfactory uptake.[32]

- ***Soil and water conservation, Illela District, the Niger.*** This project promoted simple water-harvesting techniques in a dry area with annual rainfall of 400 mm. It provided community infrastructure and work tools; the expenditure was USD 1.5 million in 1988-95. Farmer visits to Burkina Faso, where improved planting pits had been taken up on a large scale, were decisive in popularizing this technique in Illela, though this had not been a part of the project plan. About 9 000 ha, or 15% of the cropland, were so treated. The project cost was USD 250 per ha, and the on-farm incremental benefits were USD 65 per ha/year, giving an economic rate of return of 20% at completion.

- ***Farmer management of irrigation, Office du Niger, Mali.*** Set up in 1932, this large government-controlled irrigation scheme was beset with problems: poor maintenance, tenure insecurity, inefficient water management, land degradation and marketing. Rice yields were only 1.5 t/ha in the 1980s. However, with the transfer of maintenance and water management to farmers committees after 1986, yields increased to 5.5 t/ha; crops were diversified; 30 000 ha were rehabilitated, and 30 000 ha were newly irrigated. Rice income increased from USD 450 per ha on degraded land to USD 1 000 per ha on rehabilitated land, and the economic rate of return was 30%.

- ***Forest resource management in Mwanza and Tabora Districts, the United Republic of Tanzania.*** The aim of the project was to strengthen local forestry services as a part of the Forestry Action Plan. New field activities included community participation in forest management through local institutions, tree nurseries and improved wood stoves. A plan for joint Government-community management in a 13 000 ha forest reserve was also included. The nurseries and wood stove projects yielded an internal economic rate of return of 12%. Community management was introduced, with benefits for both local empowerment and forest management.

- ***Farmer-to-farmer extension, Tigray, Ethiopia.*** Participatory approaches to extension that make use of the knowledge and experience of farmers themselves and farmer-to-farmer learning was successfully introduced. Implemented by university students with local partners, the scheme attracted the participation of thousands of farmers in evaluation workshops, and 100 extension agents were trained in participatory technology development. Extension policy was changed in 16 drought prone districts as a result. Farmer innovations have started to spread in Tigray.

32 Reij and Steeds (2003) op. cit.

- ***Market improvement through low-cost information technology, Mali.***[33] People in remote drylands were at a competitive disadvantage after the removal of pan-territorial pricing and the failure of private entrepreneurs after the public sector withdrew from marketing. The project introduced a low-cost market information network based on sending price information electronically to regional offices where it was transmitted by local radio. A majority of Mali's 11 million inhabitants now tune in to the market reports, and the private sector has increased its capacity to move grain surpluses to where the grain is needed.

Project failures were common in drylands 15 to 20 years ago, often because they were designed by outsiders who did not involve local people in the design and execution. Much has been learned since then. It is important to collect monitoring data on projects so that successes can be identified.[34]

33 Hazell et al. (2002) op. cit.: 47.

34 However, investments in soil and water conservation in sub-Saharan Africa have given lower returns on average than those in Latin America and the Caribbean (Knowler, D. (in press) 'The Economics of Soil Productivity: Local, National and Global Perspectives'. Land Degradation and Development.

7. Private investment unaffordable? Incentives work

How small producers invest

The purpose of public investment in dryland development is to trigger cycles of investment in the private sector. In southern and eastern Africa, there is a large commercial producing sector, but, in western Africa, an overwhelming majority of the private investors are small farmers and small livestock producers. It is important to release the full potential of private financial capital.

Private investments are the key to each of the success stories, even where public-sector agencies have played a major role. In Machakos, Kenya, during the 1980s, more soil and water conservation was financed by private capital than was implemented through project assistance. In the Kano Close-Settled Zone, Nigeria, the landscape of intensive farming visible today owes more to centuries of land improvements accomplished by small farmers with limited resources than to the World Bank-assisted programmes in the 1980s. Such investments start out small in scale, are incremental through time and may be created by unpaid family labour and skills, as well as through the agency of markets (**Box 12**). Risk, especially exposure to drought and food scarcity, can easily lead to divestment through emergency sales.

Box 12: Some examples of microinvestments

Investments on the farm	***Investments in animals***
Clearance and enclosures	Animal pens
Tree planting and protection	Hen houses
Regular soil amendments	Tethering equipment
Storage structures	Riding gear and yokes
Wet or dry compost pits	Watering vessels and well-lifting gear
Crop drying floors	Milk containers
Threshing floors	Ceremonial artifacts
Field drains	Salt cures
Erosion checks: terraces and vegetation strips	Feed (for fattening or when scarce)
Wells	Bull service-fees
Locally made tools	Immunization
Seed selection, storage and purchase	Purchase of young animals

Why small producers invest

Incentives, financial or in kind, are often offered to participants by development projects. After project support is withdrawn, project sustainability and scaling-up depend on private investment. A study commissioned by the Investment Centre of the Food and Agriculture Organization of the United Nations distinguishes project incentives (called *direct* incentives) from those that operate beyond the project beneficiaries.[35] These latter are called *indirect* incentives and are of two types: *variable* incentives, which act through pricing mechanisms to

35 Knowler, D., Acharya, G. and van Rensburg, T. (1998) Incentive Systems for Natural Resources Management: The Role of Indirect Incentives. Rome: Investment Centre, Food and Agriculture Organization of the United Nations.

alter the profitability of an investment, and *enabling* incentives, which, by their presence in the institutional or regulatory structure, affect the strategies open to investors. Examples of the first type are levels of input subsidies, and, of the second type, land tenure reform.

The context of the decisions of small investors is critical. There are opportunities and constraints facing the individual investor that reflect the enabling incentives present in the economic environment, macroeconomic policies and the risk of external shocks such as drought. Resources are allocated to meet livelihood objectives (which include other elements besides agriculture), taking account of the costs and expected benefits (e.g. to present or future income, leisure, inheritance). Many considerations, in addition to financial returns, have a bearing on these decisions. Among the considerations are consumption requirements, social obligations and off-farm income opportunities. Many constraints, however, impede investment, including risk, lack of funds, soil infertility and ignorance of markets or off-farm alternatives. Thus, natural resources are embedded in a livelihood investment framework.

Incentives work

The success stories recounted in the previous sections of this paper and the production profiles in **Box 10** illustrate how investments made by small producers over many years have responded to incentives or disincentives. For example:

- a policy to subsidize imported rice drove Senegalese farmers away from cereal production for the domestic market and into groundnut production for export, but the withdrawal of input subsidies and agricultural credit provoked them to divert their resources to livestock production and off-farm incomes

- the growth of food commodity markets in northern Nigeria and an open border policy helped to stimulate investments in farm expansion and initiate intensification in southern Maradi

- infrastructural development and supportive sectoral policies in Burkina Faso encouraged investment in soil and water conservation, intensification and tree protection in the Central Plateau

- urbanization and market growth encouraged investment in education, in order to access employment opportunities in Machakos, Kenya, with ultimate benefits for farm investment

- expanding markets for research-based maize, together with subsidized fertilizers, encouraged rapid farm expansion and intensification in the dry sub-humid zone of Nigeria

Investments, undertaken in response to economic incentives, may also affect the sustainability either of livelihoods, or of ecosystem management. The direction of these effects cannot be easily predicted. For example:

- new maize increased fertilizer dependency in Nigeria, with adverse effects when subsidies were reduced

- the move into livestock in Senegal was beneficial for soil-fertility management, in so far as this was based on organic materials

- education in Machakos, Kenya could either help in financing soil and water conservation, or deprive farming households of labour

All the evidence accords a critical role to market incentives. The observed behaviour of most dryland peoples, particularly where investment is a factor, underlines the importance that these peoples attach to greater market participation. Increased dependency on markets may not always be beneficial (for example, the obligation to purchase food at high prices in times of scarcity). But, for most farmers and agropastoralists, the risks associated with isolation from markets (food scarcity, unemployment, knowledge deprivation) now outweigh the risks of closer involvement. Closer involvement is seen to have many benefits (sales of produce; supplies of food and consumables, inputs and technologies; labour exchange; information; education-based careers; remittances; and investment funds).

Private investment, then, can be stimulated by public-sector investments and policy. Dryland peoples respond to incentives. The evidence suggests that healthy private investment is accompanied by a release of human potential (knowledge, skills, technical adaptability, associational and institutional capacity, management of complex livelihoods and social resilience in the face of uncertainty).

What kinds of incentives?

The public investments examined in India (see **Box 11**), besides bringing returns directly to the public sector, would function as *enabling* incentives for private investors. If they reduce market or other transaction costs, these changes act as *variable* incentives. There is plenty of evidence from Africa, too, that infrastructural improvements have enabled producers to get to market or to employment and to improve the returns on their own investments. Educational provision enabled the Akamba of Machakos, Kenya, to access incomes outside the district, incomes which later helped to sustain farm investments at home. But there is some disdain for formal education in parts of West Africa, where social networks and market institutions are sometimes better at disseminating knowledge and information.

Governments can alter economic incentives through a range of macroeconomic, fiscal, or sectoral measures that chiefly affect the *variable* incentives.[36] There are differences in the ways in which *variable* incentives work. While sectoral policies (such as input subsidies) are targeted at the agricultural sector and have impacts on producer investment decisions, macroeconomic policies (such as exchange rates) take account of political interests that are different from or wider than those of agriculture and have still less relationship with the interests of rural drylands. Hence, policies may work positively or negatively for small

36 Knowler, Acharya and van Rensburg (1998) op. cit.

producers in drylands. Even an incentive that is intended to benefit agricultural producers may, under certain circumstances, have a perverse effect on the sustainability of natural resource management. For example:

- subsidizing credit to mechanize agriculture could encourage commercial producers to extend cultivation onto marginal land without proper measures for maintaining fertility

- subsidizing chemical (inorganic) fertilizers so as to increase their use could mask degradation in soils that calls for biological or physical treatment

- subsidizing irrigation water (by failing to charge users the full cost) can encourage waste, leading to the risk of waterlogging or salinization

Macroeconomic policies are regarded as blunter instruments than sectoral policies, and their effects on the decisions of small producers are indirect and difficult to predict, the effects of changes in interest or exchange rates, for example. The impact of structural adjustment policies is also difficult to track, as the term covers several different policies. Trade liberalization may have an impact that is different from that of the withdrawal of government services. As long as there is uncertainty with regard to the impact on agriculture of these policies, it remains difficult to foresee specific applications to drylands.

A way out of these dilemmas is to pay more attention to work through institutions that affects the *enabling* incentives. Among such institutions are systems or rules of land tenure, common pool resources, credit institutions, decentralized government services, and research and extension systems. Few generalizations are possible, as the scope for influencing investment depends on the architecture of a particular country's institutions.

8. Policy inaction inevitable? The cost of doing nothing

A final and compelling argument for investing in drylands revolves around the losses that will accrue to both global and national economies through policies of inaction on dryland degradation. Estimating these costs is not easy. But it is important to be able to set public-sector expenditures aimed at reducing or reversing degradation in the context of the losses being borne at both local and national levels. In answer to this challenge, a series of case studies was commissioned through the Global Mechanism of the United Nations Convention to Combat Desertification, and the publication of their findings is currently in hand.[37] The countries examined in the case studies were China, Ethiopia, Mali, Mexico, Chile, Indonesia, Rwanda and Uganda. Of these countries, the first four possess dryland areas that comprise a large proportion of the national territory. Some findings from two of these studies are summarized below in order to illustrate the scope of a quantified approach.

China

According to the Government of China, over 40% of the land in the country is adversely affected by wind and water erosion, loss of grazing, deforestation and salinization, and degradation is on the increase (from an additional 1 800 km^2/year in the 1980s to 3 436 km^2/year in the late 1990s). The most intensively affected area is the vast western region.

Official estimates of the costs of degradation for the country as a whole are USD 7.7 billion in direct costs (water and wind erosion, salinization and sandstorms), which is about 4% of GDP, and nearly USD 31 billion in indirect costs. Another estimate divides the costs between on-site and off-site costs. The on-site costs (desertification, soil erosion, salinization and pollution) are reported at USD 11 billion, with an additional USD 6.4 billion for the replacement of lost nutrients,[38] and the off-site costs (mainly the loss of reservoir functions) are reported at USD 12 billion. These huge estimates reflect the size of the territories and populations involved.

Ethiopia

By the mid-1980s, 50% of the highland areas of Ethiopia were estimated to be significantly eroded. The costs of land degradation include:

Direct costs

- nutrients lost in the erosion of topsoil (based on replacement costs)
- lost production owing to nutrient loss and soil erosion
- amount of forest removed
- lost livestock carrying capacity

37 Berry, L. (2003) 'Land Degradation in China: Its Extent and Impact'. Case Studies on the Impact and Costs of Land Degradation. Rome: IFAD, Global Mechanism of the United Nations Convention to Combat Desertification; Berry, L. (2003) 'Land Degradation in Ethiopia: Its Extent and Impact'. Case Studies on the Impact and Costs of Land Degradation. Rome: IFAD, Global Mechanism of the United Nations Convention to Combat Desertification.

38 Nutrient replacement costs (i.e. inorganic fertilizers) are difficult to estimate realistically.

Indirect costs

- loss of environmental services
- silting of dams and rivers
- increased irregularity in stream flow and reduced groundwater capacity
- loss of labour and skills owing to malnutrition, poverty, or migration

Estimates of the losses due to land degradation are mostly confined to direct costs and are highly variable, reflecting the inadequacies of the data. A World Bank study estimated yearly losses of USD 106 million from nutrient removal from agricultural areas, USD 23 million from forest losses and USD 10 million from the loss of livestock capacity, amounting altogether to USD 139 million, or about 3% of agricultural GDP. Another study of aggregated costs estimates the losses of nutrients under wheat at USD 46-544 per ha in grain output foregone, and under maize at USD 31-379. Applied to all cropland in the highlands, the total losses would be approximately USD 1.7 billion.

Cautions

The authors of the studies emphasize the methodological difficulties of estimating the costs of degradation and the data limitations, which must include the baseline assumptions (**Box 13**). All the studies show links between poverty and degradation, particularly where livelihood diversification is constrained, and links with policy. The indirect costs of degradation are the least well known. An integrated framework for understanding the social, institutional and economic (as well as the environmental) linkages of degradation would contribute to better policy formation.

Scenarios of future losses vary according to the baseline and operational assumptions. The accuracy of these scenarios is less important than the stimulus provided by such estimates for the formulation of coherent strategies at the national level to deal with land degradation.

In addition to the long-term costs of land degradation, governments of dryland countries and donors absorb the short term costs of crisis management when food scarcities threaten large populations after drought or conflict. There are no aggregate estimates of the total costs of the Sahel drought of the 1970s or the Ethiopian famine of the 1980s. Emergencies absorb resources that could have been invested in longer term development. If the costs of neglect are huge, so are the potential benefits.

Box 13: Improving the database for the assessment of dryland degradation

Despite many efforts, the information and data on land degradation are neither sufficient, nor sufficiently accurate to support policy decisions. There are also methodological deficiencies, in particular with regard to the use of agreed indicators of degradation. The Johannesburg Plan of Implementation of the World Summit on Sustainable Development called for international cooperation in improving the use of science and technology for environmental monitoring, modelling, databases and information systems. Among the initiatives being undertaken by international organizations are the following.

- ***Africover.*** A harmonized classification of land cover has been developed by the Food and Agriculture Organization of the United Nations and the United Nations Environment Programme and tested in ten eastern African countries. Its utility will soon be expanded to western Africa and later to other regions of the world.

- ***Land Degradation Assessment in drylands.*** This initiative adopts a holistic approach to assessing changes in the physical characteristics of land, including the context of these changes (driving forces, pressures, impacts and responses). It aims to assess the nature, extent, severity and impacts of land degradation on ecosystems, watersheds, carbon storage and biodiversity. It also aims to build national and regional capacity to mitigate the impacts and promote sustainable practice.

- ***Global Forest Resources Assessment*** includes the use of remotely sensed data on vegetation cover and land use.

- ***Global Land Cover.*** This data set being developed by the European Commission uses remotely sensed data supplied through international cooperation.

- ***United Nations Environment Programme, National Aeronautics and Space Administration, US Geological Survey (Landsat data).*** These three organizations are cooperating to produce three decades (1970s, 1980s, 1990s) of high resolution satellite data for African countries. Efforts are also under way to develop the institutional capacity to assess environmental impacts and land-use change.

- ***World Overview of Conservation Approaches and Technologies*** is a global computerized database on conservation activities and technologies.

Source: UNEP (2003) *Workshop on Changes in the Sahel, Nairobi, 14-16 October 2003: Final Report and Abstracts*. Nairobi: United Nations Environment Programme.

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9. A new paradigm for dryland investment

A new policy landscape

The global policy environment has changed radically since the dominant approach to the development of drylands took root in the movement to 'control desertification' following the UN Conference on Desertification in 1977. This approach took sustainable natural resource management as its aim and saw the halting and reversing of desertification as a necessary condition. There was pressure to impose technical solutions without adequate attention being paid to indigenous capabilities or to economic and other incentives.

Since then, the following changes have occurred.

- The endorsement of the Millennium Development Goals, the Rome Declaration on World Food Security (1996), and international conventions have turned the spotlight on a rights-based approach to poverty reduction.

- Poverty reduction has become the main aim of development, with the implication that policies and interventions should be targeted. Poverty-reduction strategies require that governments focus on vulnerable groups.

- An emphasis on technology and natural resource management as the prime means of raising productivity (which it was assumed would benefit the rural poor) has given way to a broader approach, including access to assets, markets and supportive institutions.[39]

- Within an institutional framework, issues of governance, decentralization and empowerment have emerged as powerful mediators of technical change in natural resource management.[40]

- There is increasing recognition of the complexity of rural livelihoods, in which natural resource management finds a place as one (often the most important) of several components. Assets and incomes are distributed among the components, and investment decisions take place within this framework.[41]

A retreat from agricultural sector support characterized many donors during the 1990s, but, following a sanguine evaluation of experience with alternatives, there is now a renewed enthusiasm for such support (see Section 1). The Pretoria Statement[42] states that:

> "Only improved agricultural productivity can simultaneously improve welfare among the two thirds of all Africans who work primarily in

39 IFAD (2001) Rural Poverty 2001: The Challenge of Ending Rural Poverty. Rome: IFAD.
40 USAID (2002) Nature, wealth and power. Washington, DC: United States Agency for International Development.
41 Ellis, F. (2000) Rural Livelihoods and Diversity in Developing Countries. Oxford, United Kingdom: Oxford University Press.
42 Pretoria Statement on the Future of African Agriculture, 2003. Participants at the International Conference on Successes in African Agriculture: Building for the Future, Pretoria, South Africa.

agriculture as well as the urban poor, who spend over 60% of their budget on food staples."

The background to these changes has been a dynamic global economic environment, with increasingly concentrated market power and rapidly evolving biological, information and communication technologies. It is urgent that development policy give dryland people the best prospects possible in a world of liberalized trade (in which, however, poor countries may not compete on equal terms), decentralized government (which is not always effective) and de-restricted private initiative.

People at the centre: Creating an enabling environment

In the past, policies focused on the presumed limitations of the natural resource base rather than on the people and their knowledge, skills and capacity for innovation. Although poor in natural, financial and physical assets, the people of the drylands possess substantial human and social capital (see the previous section). The strength of these internal resources is now more understood by policy-makers. The cases described in the boxes in this paper provide strong support for an emerging truth, namely, that drylands, like other environments, should be seen as stage and scenery, the greater importance being with the players and their ideas of what can be done with the resources at hand.[43]

Drylands have, however, fallen behind more favoured areas in the development process. While this situation is a cause for concern, it also offers an opportunity. As the Indian data suggest, comparatively rapid gains may be available from strategic public-sector investments that are implemented from a low baseline. This ought to be attractive both to governments and to potential donors that need to mobilize the unrealized potential of these uncertain and risky environments. But, to make a difference, one does not need to depend on costly interventions by the public sector. Policy measures may have greater impact.

Based on the reasoning above and on two recent policy papers,[44] the priority areas are:

- ***Developing improved investment incentives.*** In line with the argument above, urgent reviews of incentive frameworks are needed that take account of the specific circumstances of dryland areas within different states. The purpose of improving incentives is to widen the range of opportunities (across all sectors) for dryland people, remove barriers to investment and participation in economic activity and secure the benefits of investment. The place of natural resource management in an incentive framework for dryland areas will be based on a negotiated alignment of the priorities of local communities with a long-term strategy for sustainable ecosystem management.

43 USAID (2002) Nature, Wealth and Power: Emerging Best Practice for Revitalizing Rural Africa. Washington, DC: United States Agency for International Development; Anderson, J., et al (2004) Chance, Change and Choice in Africa's Drylands: A New Perspective on Policy Priorities. Participants at the Workshop on Development Assistance in the African Drylands, Durban, South Africa, August 2003.

44 Ibid.

- ***Unleashing individual and organizational capacity.*** Authority and functions in rural areas are changing as decentralization programmes are implemented. In drylands, decisions in these matters may have implications for the sustainability of ecosystem management. It is important that these decisions are made at a level that ensures implementation and responsibility through local empowerment. Rural organizations (for example, credit and producer associations, market institutions) deserve assistance, as they create economies of scale and raise the economic returns to poor people. A voice for local people should be promoted through capacity-building in local languages, strengthening interaction with higher levels of authority or function, increasing accountability downwards and strengthening the processes of negotiation.

- ***Sharing knowledge and information in new partnerships and improved management systems.*** Local knowledge, as well as science-based knowledge, should be valued, and research should be owned by local communities in new partnerships with institutions. Technological priorities should reflect community and family livelihood needs, as well as the scientific objectives identified by research institutions, which are still important providers of a range of technical options. Social learning, innovation, farmer-to-farmer exchanges and adaptive management require equal emphasis, along with conventional capacity-building through training.

- ***Developing the capacity (level), confidence and competence of service providers.*** Government extension and research agencies, NGOs and local authorities should respond to the expressed needs of small producers and not push them towards technologies that are inappropriate to their circumstances. Institutional arrangements for interaction with local people and for taking on new functions under decentralization programmes should be strengthened. The weight given to local experience should be increased, and the content of training programmes should be improved to cover more than a few simple extension messages, and to ensure continuity.

- ***Diversifying incomes and securing linkages.*** Income diversification and rural-urban linkages should be promoted by improving road infrastructure, market and technology information networks, and postal and savings services. It must be recognized that dryland people have both the right and the need to diversify out of agriculture. Commercial investment (which is low in most drylands) can be attracted through fiscal measures, in small towns or places with tourism potential, for example.

New technical and economic opportunities

Small producers in drylands make a major contribution to agricultural production in many countries. They live in diverse circumstances and need a menu of technical and economic options from which to choose. This is a challenge to research and extension systems, too long influenced by a search for miracle technologies and simple universal messages. However, new

opportunities abound, and key elements in a science-technology and economic agenda for dryland agriculture include the following.[45]

- ***Crop breeding*** must meet a need for diversification in response to falling prices for traditional market crops, as well as supporting food security through traditional staples. The complexity and variability of the circumstances of farmers in the drylands should be recognized, and technical packages should be developed, in participation with farmers and other stakeholders, that take account of needs, costs and benefits. There have been breeding successes (e.g. maize), and others should be sought. New biological and other technologies should be exploited.

- ***Soil health*** is a priority. Biological interactions need to be better understood. Cost-effective fertilizer applications (e.g. microdoses), the integrated use of organic and inorganic fertilizers, and crop-livestock integration require more development.

- ***Trees*** should be integrated into crop production; local biodiversity should be protected, and promising new species should be promoted.

- ***Integrated ecosystem management*** provides a holistic context in which to seek technical solutions.[46]

- ***Marketing systems*** need to develop rapidly in order to improve the competitiveness of small producers. There are many directions for such improvements, for example: more efficient aggregation and transport of output, better marketing information for producers, more collaboration among producers and the involvement of producer associations in quality control. The management of supply chains (vertical farmer-to-market coordination) should involve the producers, as well as the traditional focus on production. The scope of *extension systems* should be broadened from promoting research-based messages to advisory and participatory roles, including testing and the scaling up of the experimental successes of the farmers themselves, in soil and water conservation, for example.

- ***Regional cooperation*** in trade and agricultural technology is especially relevant to drylands, which often straddle borders. The harmonization of trade regulations should reflect the informal interaction that already takes place, and information exchanges should be promoted. For example, regional cooperation in the sharing of new biological technologies can offer synergies. The New Partnership for Africa's Development provides a suitable framework.

To these should be added pest and disease management, the failures of which continue to cost farmers too much. Dialogue between research and policy needs to be strengthened because macroeconomic and fiscal policies, institutional

45 ICRISAT (2003) Symposium on Building Sustainable Agriculture Systems in the Drylands, Niamey, December 2003: Recommendations. Sadore, Niamey, the Niger: International Crop Research Institute for the Semi-Arid Tropics; Pretoria Statement (2003) op. cit.

46 Gill Shepherd (2004), The Ecosystem Approach. Five steps to implementation, IUCN -The World Conservation Union, Gland Switzerland

legislation (such as on land tenure) and enabling measures (such as infrastructure) can make or break technology development and promotion.[47]

Why invest in drylands?

The cases reported in this paper argue that investment in the public or the private sector can yield returns in African drylands (where the conditions are the most difficult) and, by extension, in other tropical drylands. Past policy or project failures have served to highlight the resilience and adaptive capacity of many dryland communities. There is now an opportunity to reassess the development potential in light of the new knowledge and to design integrated and participatory strategies in order to make the best use of incentives, institutions and appropriate technologies.

Public investments, strategically placed, can strengthen the incentives for private investments by small producers, particularly those investments that link the small producers more closely with market opportunities. Thus, a dual strategy for the state is advocated that consists in strategic *public investments* (for example, in rural roads), together with *policy measures* (for example, strengthening institutions for the local management of natural resources) that are designed to *enable* or to *vary* the returns to private investment. There is an increasing body of evidence indicating that dryland people respond vigorously to economic incentives. Poverty is often assumed to block private investment in more productive technologies or in sustainable natural resource management. The evidence shows, however, that, in certain areas, there have been sufficient private, small-scale investments to transform entire landscapes over a period of time.

Much of the poverty in drylands is the result of asset dispersal during food scarcities. This is well documented with respect to livestock producers, who lose many animals from forced sales or mortality. Farmers, too, may have to sell capital equipment, inputs, consumables, land and even houses when their normal strategies of selling their labour or their skills fail. Vulnerability to asset loss perpetuates poverty and widens the gap between those who sustain their productive capacity and accumulate assets and those who fail to do so. So, protecting the investments of poor peoples, which have been accumulated with great difficulty, offers an additional challenge for drylands policy. But there is already in place a capacity to manage such risk, as the landscape of any densely populated, long-settled dryland will show.

Given acceptable returns, investment generates confidence in economic growth at the grass roots. Such confidence is a precondition for further investment. It also contributes less tangible benefits, such as positive evaluations of education, strengthened social capital and local empowerment in decision-making and governance, which also offer long-term gains to the community. Some drylands have made impressive progress in these respects despite severe constraints.

Finally, the argument of this paper is that investing in dryland development is sound at both the micro- and macroeconomic levels and, above all, in social

47 Michael Mortimore and Mary Tiffen (2004) 'Introducing research in to policy: lessons from district studies of dryland development in sub-Saharan Africa' Development Policy Review,22/3:259-286

terms. The best approach to fighting poverty and the best protection against unsustainable ecosystem management is to promote investments in sustainable and productive land-use practices. Added value is the best defence both against the mining of natural capital and against poverty.