Water-based Ecosystems, Poverty Alleviation and the Desakota phenomenon in sub-Saharan Africa: A Regional Literature Review

Julia Cloete

with contributions from

Sheona Shackleton, Dylan McGarry and Mike Mortimore

Consortium for Ecosystem Services and Poverty Alleviation in sub-Saharan Africa, Grahamstown, South Africa

1. Introduction

The Desakota phenomenon is defined as driven by four areas of interlinked rapid change: the overall political economy; water based ecosystems; global environmental changes; and poverty. This literature review attempts to re-examine the relationship between the water-based ecosystem goods and services and poverty alleviation in sub-Saharan Africa through the Desakota lens.

To lay a foundation for understanding the key drivers of change in the area, the socio-economic, environmental and spatial context of the region must first be examined. This is done in Chapter Two. In Chapter Three, the drivers are examined in relation to their role in determining the importance of understanding the effects of the Desakota phenomenon on water-based ecosystems and poverty. Chapter Four explores how these drivers affect meso level relationships between people and ecosystem goods and services. In conclusion, Chapter Five outlines some of the most pertinent research gaps and possible entry points to emerge from the study.

In order to assess the extent to which poverty and water-based ecosystem services interact to determine the well being of the people in sub-Saharan Africa, it is necessary to make some broad generalizations and look for trends that offer some level of understanding of the complexities at hand. Within these trends much of the sub-continent's inherent diversity will be lost, as trends say little of the complex realities facing the people living on the sub-continent. Similarly, the enormous genetic, climatic and biological diversity of the region will only be hinted at, as such richness eludes capture in a report of this nature.

The Desakota phenomenon, driven by interlinked processes of economic, technological, demographic and environmental change, have led to increasing levels of physical, electronic and cultural connectivity across the sub-region. This, coupled with the greater penetration of the cash economy; an increasing dependence on mixed livelihood strategies and land-use options; a greater diffusion of modern production and resource extraction technologies; and the increasing penetration of formal governance institutions; is rapidly changing the face of poverty and poor people's relationships with ecosystem goods and services in sub-Saharan Africa. These changes are increasingly coming into focus on national and international research agenda's, but the inter-relationships between these processes, and the increasing incidence of poverty in the region, have yet to command the full attention of researchers, policy makers and development institutions. Given the scarcity of such research, this report highlights the need for further investigation of the effects of the Desakota phenomenon on water-based ecosystems and poverty in sub-Saharan Africa.

The literature, case studies and conceptual frameworks used in this review are deeply embedded in two broader situational analyses; the Sub-Saharan African Revie), and the

Desakota Review. Subsequently, the findings in this review draw on some of the fieldwork and consultations conducted for those reviews. No primary research, however, was done specifically for this review. Instead, a broad range of peer reviewed and grey literature was surveyed in an attempt to contextualize the broader findings within the Desakota context in sub-Saharan Africa.

Definitions

The definitions of key concepts used in this analysis, for the sake of compatibility, follow those used in the sub-Saharan African Situation Analysis of the Ecosystem Services and Poverty Alleviation project, and are summarised as follows:

Poverty and well-being. A broad definition of poverty is the deprivation of well-being due to a lack of material assets or income, low levels of health provision, poor or no education, chronic or short-term food insecurity, inadequate nutrition, vulnerability or exposure to risk, and a lack of 'voice' (World Bank 2000). The last of these takes poverty beyond the conventional economic measures. The concept of well-being lays greater emphasis on the social welfare indicators and helps correct the conventional emphasis on economic indicators, and is consistent with Sen's (1999) concept of 'development as freedom'.

Risk and vulnerability. The concept of vulnerability includes exposure to risk (harmful livelihood impacts) and the lack of capacity or capability to respond to its consequences. Thus it may be either a cause or a consequence of poverty. Living with risk is especially characteristic of dryland livelihoods. (In this report, the term *drylands* is taken to be synonymous with the ecological zones *arid* and *semi-arid.*)

Indicators of poverty and well-being. There are many indicators of poverty, both global (applicable everywhere) and national (specific to the governmental requirements of a particular country). As this analysis relates directly to the achieving of the MDGs, the indicators of $1 /day and $2 /day are relevant. However an important distinction is between 'absolute' poverty and relative poverty which discriminates among a given population to take account of equity and distributional considerations. This is more relevant to access to ecosystem services which is highly differentiated at a local level (Sen 1999).

Ecosystem services. These may be defined as

> 'the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life. They maintain biodiversity and the production of ecosystem goods such as seafood, forage, timber, biomass fuels, natural fibre and many pharmaceutical industrial products and their precursors. In addition to the production of goods, ecosystem services are the actual life supporting systems, such as cleansing, recycling g and renewal, and they confer many intangibles, aesthetic and cultural benefits as well' (Daily 1997)

The conventional typology of ecosystem services is as follows:

- Provisioning services (products or goods, e.g., fodder, fuelwood, non-timber forest products, water)
- Regulating services (or 'buffering', e.g., run-off reduction and soil water infiltration)

- Cultural services (non-material benefits, e.g., recreation, aesthetic, spiritual)
- Supporting services (necessary for the other ecosystem services (e.g., biodiversity, soil fertility)

Some services cross categories, and there are ambiguities in defining agriculture and livestock producing activities. In the Sahel, small-scale resource users may mix exploitation of naturally regenerating vegetation with crop production on the same plots, allow natural cross-pollination of cultivars, or blur the distinction between natural rangeland and fodder crops or residues.

Trade-offs. This term refers to the ecosystem service losses from one land use system in converting to another, for example, the loss of biodiversity in natural woodland in converting the land to agriculture. It is implicit in most changes wrought by humans in natural ecosystems.

Drivers. Any factor which changes the structure or function of an ecosystem is referred to as a driver (MA 2003). Drivers may be divided into *direct* and *indirect* (or proximate and remote drivers). Examples of the first are climate change, land use change, technology; of the second, demographic growth, economic change such as markets, change in governance.

Thresholds. A threshold is defined as 'a break-point between two regimes of a system' (Walker and Meyers 2004), or a 'situation in which a social and/or ecological system changes or 'switches' from one state to another' (Shackleton et al 2008). While well-researched in ecological theory (Reynolds and Stafford Smith 2001), this concept has not yet been successfully extended to the understanding of human systems in contexts such as that of the Sahel.

2. Regional Context

2.1 Political Context

The histories of the countries in sub-Saharan Africa are widely varied, with various degrees of colonial and religious influences; periods of peace and conflict; utilization and commercialisation of natural resources and within the last two decades, mixed responses to HIV/AIDS and malaria. Due to a series of continent wide and global economic and political reforms over the last decade, Sub-Saharan Africa is presently facing more political stability and less conflict than it has in the preceding decades since independence. Having said this, the sub-continent remains highly varied, and volatile, with some regions showing relative political stability, while others still teeter on the brink of returning to civil war.

Even in those regions of relative peace and stability, the recent rapid economic and political decline of countries like Zimbabwe and Kenya, indicate the relative volatility of the region. There are still five active civil wars on the continent, but in comparison to the sixteen that ravaged the continent in the late 1990's, there is relative peace and stability in the region (African Development Bank 2007). The overall political, economic, environmental and social costs of the last few decades of political instability and conflict have, however, taken a significant toll on the sub-continent. High numbers of economic, political and environmental migrants and refugees are one of the many hangovers of these conflicts that impact directly on the expansion of Desakota characteristics across the region. Weak states, failing economies and crumbling infrastructure in many regions continue to affect land use planning and economic choices.

Estimates by IANSA, Oxfam and Safeworld put the economic cost of armed conflict to the Continent at around $300bn since 1990 (IANSA et al 2007). This figure equals the amount of financial aid provided by major donors during the same period (IANSA et al 2007).

Decades of colonialism and independence struggles have left a deep scar on the sub-continent, and even states that gained independence earlier than others, such as Ghana and Nigeria, still struggle with tensions linked to the arbitrary drawing of borders across ethnic groupings, and the concentration of wealth and resources amongst a privileged few. The development of NEPAD, and it's governance peer review mechanisms, bode well for the future of the continent, indicating an increase in intergovernmental cooperation and accountability, but international interests and markets still play a significant, and often negative role in the development of true political stability in the region.

2.2 Demographic Context

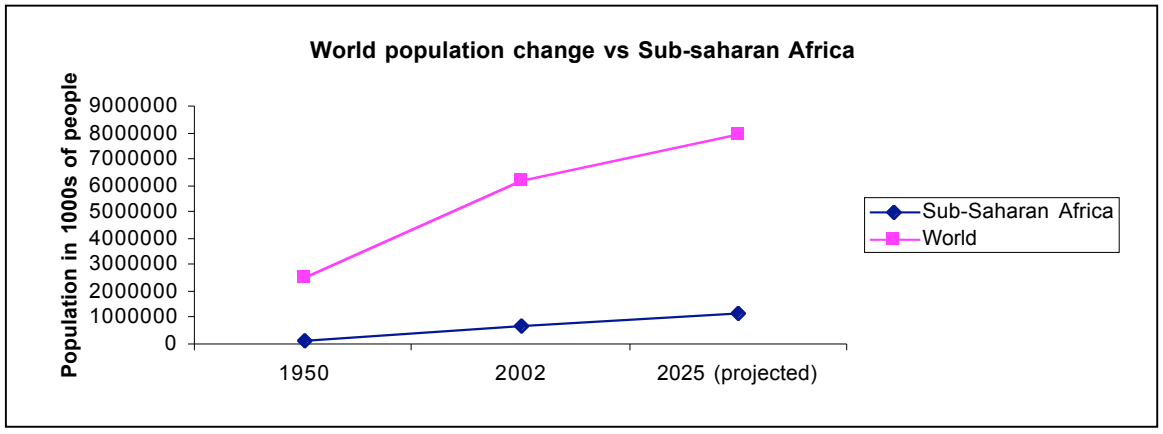

Figure 1: Global and Regional Population Growth between 1950 – 2025

Despite relative political and economic insecurity, population figures across the sub-continent have continued to soar over the last fifty years (Figure 1). In comparison to East and South Asia, however, most countries still have relatively low population densities, with Nigeria being the only country to have crossed over into having more than a billion people, with a very high population density.

Populations are, however, not evenly distributed across the continent, or within countries, with population densities varying from national averages of above 120 people per square kilometre (Nigeria), to below twenty (Namibia).

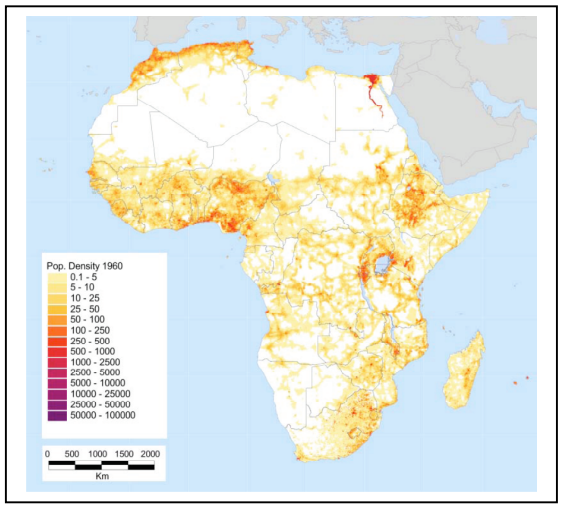

Figure 2: Distribution of Population Densities across Sub-Saharan African Countries 1960 (UNEP 2004)

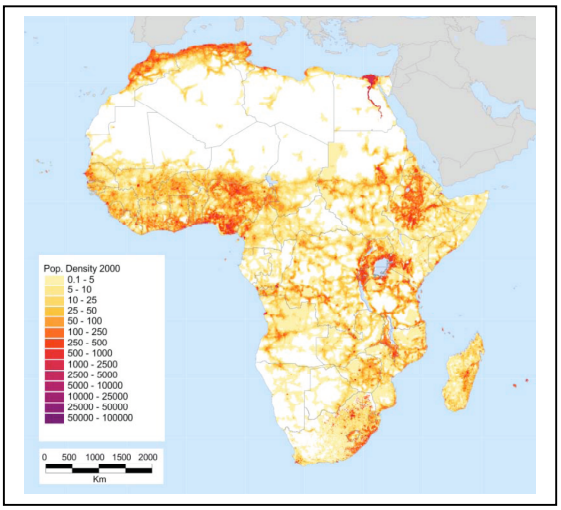

Figure 3: Distribution of Population Densities across Sub-Saharan African Countries 2000 (UNEP 2004)

Figures 2 and 3 illustrate the increasing scale and density of population concentrations across the continent, showing significant increases in West and East Africa.

The distribution of populations across the continent is shown to be highly variable, with higher population densities mimicking to a degree humidity trends in Western, Eastern and Southern Africa. Populations in East Africa cluster around the inland lakes, placing immense pressure on these fragile ecosystems. Across the continent population densities increase in riparian zones, and while these areas offer more water-based ecosystem services than others, they are increasingly under threat from growing populations.

Areas of dense population (shown in red) are not limited to cities and urban areas, and increasingly high densities in previously rural areas, and the expanding peri-urban zone have left much of the continents highly populated area's displaying Desakota characteristics such as mixed landuse, increased connectivity and the increasing penetration of the informal cash economy.

The affects of HIV are expected to take a serious toll on the regions demographic trends, and while the overall population is still expected to increase, some estimates indicate lower growth rates for the period 2005 – 2015 than those observed between 1975 and 2005. Figure 4 illustrates projected growth rates for a selection of sub-Saharan African countries.

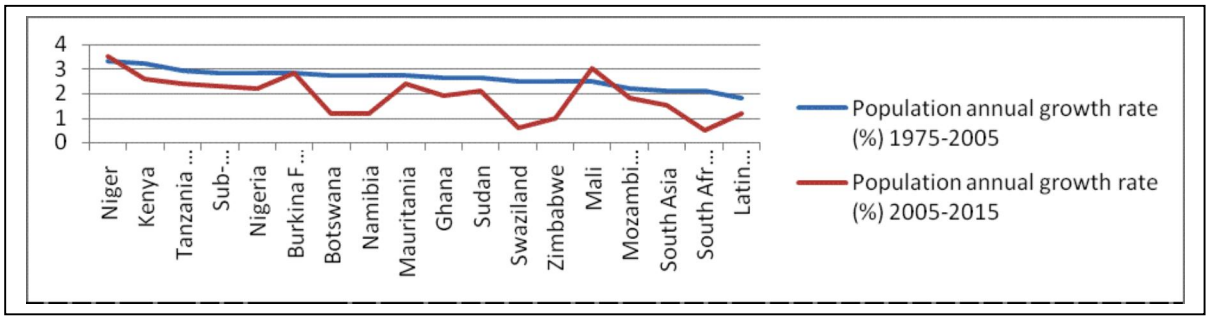

Figure 4: Population Annual Growth Rates for the periods 1975-2005 and 2005-2015

2.3 Economic Context

African economies have been classified as amongst the most volatile in the world, and despite periods of significant growth, the continent as a whole has shown little overall formal economic growth over the last thirty years (World Bank 2007). Such volatility can be ascribed to a range of factors, from internal disturbances related to conflicts and governance issues, to a high level of vulnerability to external disruptions in commodity prices, international interventions in national economic policies and the forced opening of markets to external, highly protectionist economies.

The main cause of low growth rates across the continent has been attributed to a failure to develop sound manufacturing sectors, with a negative total factor productivity across the continent since the 1960's (Bosworth and Collins 2003). This lack of formal sector growth is the product of unequal trade liberalization policies attached to the dominance of competitive advantage economics, and the lack of capital investment into industry and infrastructure in the region. This has led to a continued reliance on mineral and agricultural exports, and commodity imports. Within semi arid and arid sub-Saharan Africa, only three countries (Kenya, Mauritania and Swaziland) list anything other than

crude minerals or primary agricultural produce amongst their top three exports. Top imports across the continent include machinery, transport equipment, food stuffs and petroleum (World Bank 2007).

The sub-continents marginalization from global patterns of increased industrialization, rapid economic globalization and an increase in consumption patterns, has placed African economies in a position of relative dependence on external demand for their primary products, and a high level of vulnerability to changes in global commodity prices. This trend has to some extent reproduced the extraction based economic processes established during colonial times.

The relatively small size of most sub-Saharan economies, and the sub-continent's wide lack of sufficient long distance transport infrastructure, and increasingly weak currencies, has meant that regional trade is increasingly gaining importance in national economic growth strategies. The New Partnership for Africa's Development (NEPAD) has called for regional economic integration as a central strategy towards continent wide economic growth, placing a strong emphasis on developing infrastructure in trade corridors, common institutional and legal frameworks to govern trade and common property resources (especially in regions where multiple countries border large bodies of fresh water, such as Lake Victoria) and improvements in customs administration (World Bankd 2007). Most countries have signed conventions regulating the joint development and management of shared water resources (including navigation and fisheries), hydropower, trade corridors, irrigation and flood control (World Bank 2007). These partnerships have also facilitated the easier movement of people, migrants and immigrants, between countries, encouraging a broader range of regional migration and opening up markets for informal and formal traders.

Despite little overall economic growth over the last three decades, there have been periods of intense growth and development across the continent. As a result, economic activity, technology, production processes and labour patterns have changed significantly since the 'independence decades' of the 1960's and 1970's. A new trend seems to have emerged in the mid 1990's showing a general increase in economic growth across the continent. However, growth rates vary significantly from country to country, and there seems to be a growing disparity between countries surging ahead from oil exports or new found investor confidence, and those held back by poor governance, conflict and financial mismanagement. In 2005 this difference ranged from growth rates of –5.3 per cent to 20.6 per cent, but only eight countries reached the 7 per cent growth rate needed to sustain poverty reduction (World Bank 2007).

2.4 Land Use Context

The political and economic processes described above have had varying impacts on individual countries, with periods of civil conflict, natural disaster, poor governance and externally imposed structural adjustments impacting each economies ability to sustain growth and 'modernize'. As a result, small-scale subsistence farmers still constitute the majority in many parts of Africa.

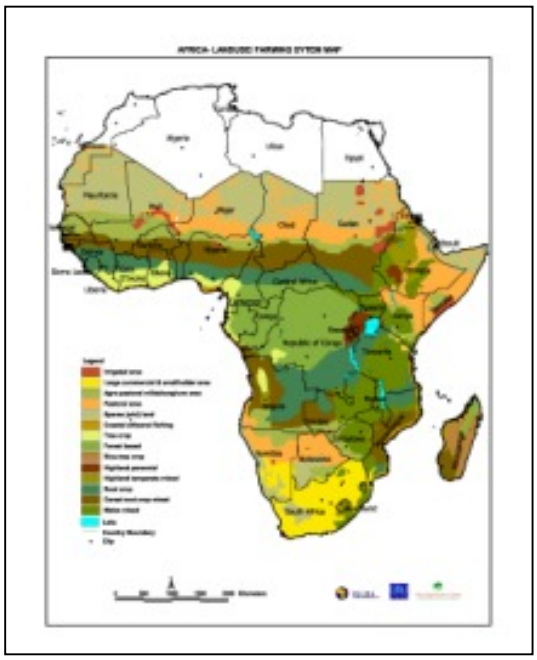

Figure 5: Land Use in Africa

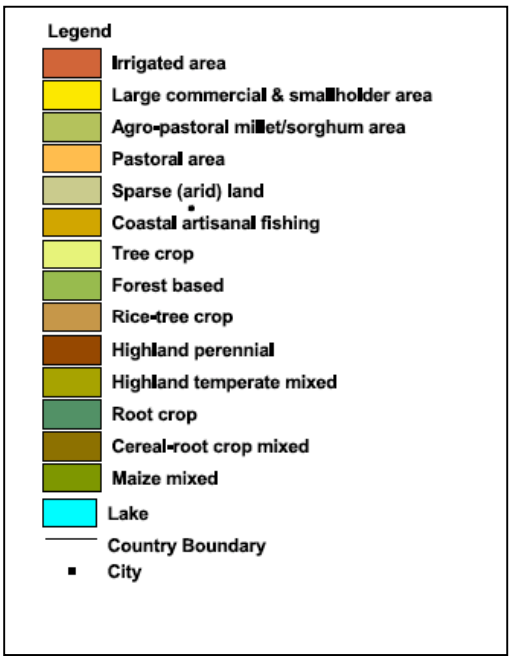

Figure 6: Legend: Land Use in Africa

Despite the predominance of agriculture in people's livelihoods, and as a land use choice, most periods of economic growth and technological advancement in the region were aimed at developing industrial and mineral extraction sectors, and on the whole agriculture remained a low priority on national growth strategies. As a result, little capital was made available to invest in the modernization of small scale agriculture, and today little, if any, modern methods, inputs or equipments are used outside scattered commercial agricultural efforts. This has led to little growth in agricultural production and yields, and many African countries are increasingly unable to produce enough food to feed their rapidly growing populations. This was particularly true in the 1980's, when population growth averaged three per cent per annum, in contrast to food production, which on average only increased by one per cent per annum (African Development Bank 2007).

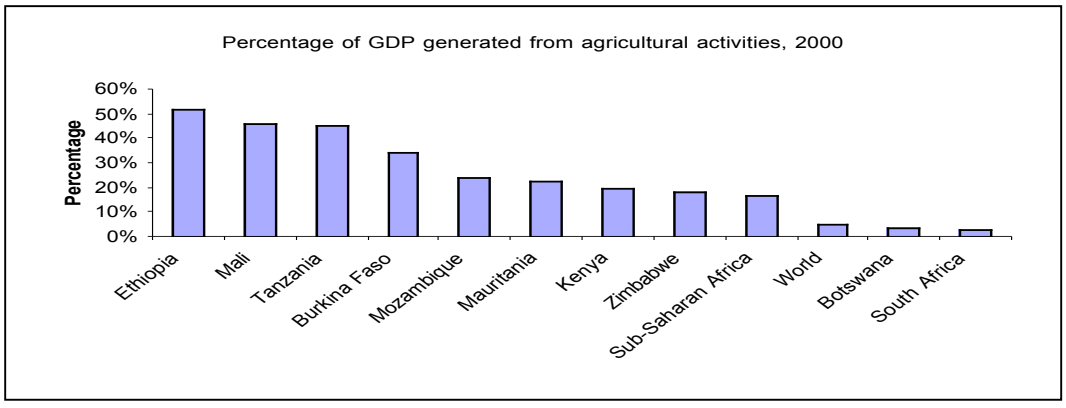

Figure 7: Percentage of GDP generated from Agricultural Activities in 2000

The importance of understanding land use patterns, and changes therein, relates not only to economics, but also to the social and ecological changes that accompany these shifts. The Sahel, for example, forms a major agro-ecological zone in which the land use pattern is the major differentiator of ecosystem service provision and use. Access to the different components of the land use system determines a household's capacity to adapt to failure in a major activity (such as agricultural drought), and often drive people's choices in diversification strategies. Changes in land use therefore have major significance to our understanding of the relationships between poverty and resource use in Desakota areas, where increasingly diversified livelihoods choices interact with changes in land use patterns, and their resultant affects on ecosystems (Mortimore et al 2005).

The implications of land use change for ecosystem services are fundamental, though they have not been quantified. Decreasing woodland means less fuelwood, timber and NTFPs; expanding agriculture means less biodiversity and fauna, and *may* mean diminished soil resources (chemical nutrients, biological agents, moisture). Diminished surface water (as in Senegal (Badiane et al 2000) or seasonal waterlogging threatens wetland ecosystem services, such as dry season pasture, perennial cropping and small-scale irrigation (e.g., in the *fadamas* of northern Nigeria).

Dam construction, whether or not for irrigation, has drastic and well-known consequences for ecosystems including above-site flooding, and below-site flow regime change with impacts on plant species, fish populations, grassland composition and richness, and sub-surface water flow. The Inland Niger Delta in Mali (IUCN 2007), the Komadugu Yobe river system in northern Nigeria, and Lake Chad are examples of ecosystem services initially taken for granted in relation to land use changes, then subjected to misdirected engineering interventions, and now receiving urgent attention with the aim of better planned, more holistic and socially responsible management. Land use choices are particularly pertinent in Desakota areas, where competing demands between formal and informal water users can lead to health risks for both the ecosystems and the people dependent on them. In instances where small scale farmers and small scale industries are forced to draw water from the same source, for example, a lack of proper waste regulation and water allocation can lead to serious consequences.

2.5 Poverty

The political, economic and land use climate described above has led to sub-Saharan Africa housing almost 400 million people living in absolute economic poverty (African Development Bank 2007). This comprises almost half of the subcontinents population, the majority of its rural subsistence farmers, and an increasing percentage of it's urban and desakota populations. However, such tallies don't take into account the social, natural or physical capital available to many households across the sub-continent, and therefore skews our understanding of what actual resources households have available to them. This is not to say that these less economically tangible resources compensate for the lack of financial capital and access to basic services and infrastruture, just that taking

cognisance of them would deepen our understanding of the actual social conditions under which people are living.

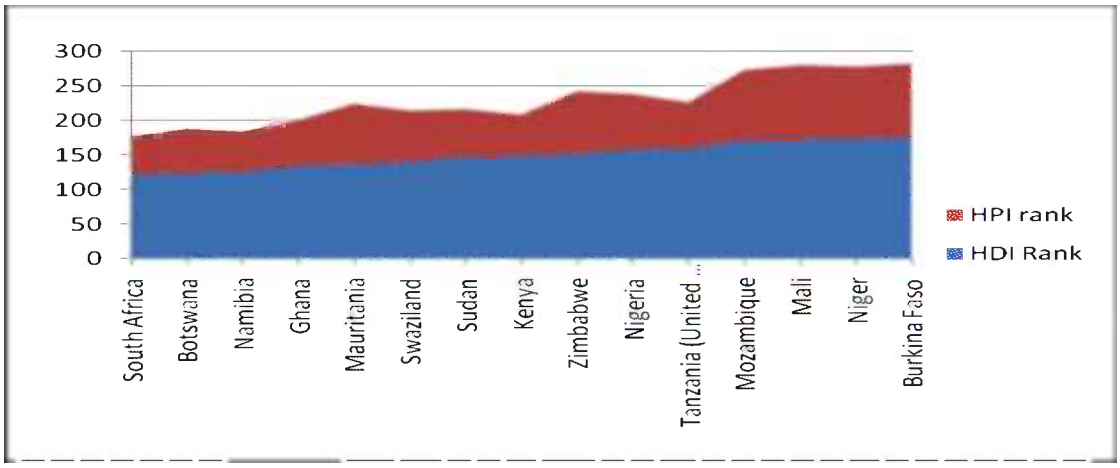

Figure 8: HDI and HPI Ranks of Selected Sub-Saharan African Countries (COS DATE)

The United Nations Poverty Indicators attempt to paint a more nuanced picture, which nevertheless remains rather bleak. The sub-continent, despite not being classified as the world's poorest region, has higher infant mortality rates, death rates and malnutrition rates than both South America and Asia, this despite the continents wealth of natural resources and land (UN 2007). Most African countries are situated in ecoregions which could favourably support several harvests a year, and yet malnutrition remains a serious concern across the continent, with almost 26 percent of all children under five suffering from severe malnutrition or stunting (African Development Bank 2007). In terms of access to education, health care, clean water and sanitation, the continent lags behind other developing regions. Of the 32 countries assessed by the United Nations as having the lost Human Development Indicators (HDI) in the world, only two were not in Africa (UNDP 2007)

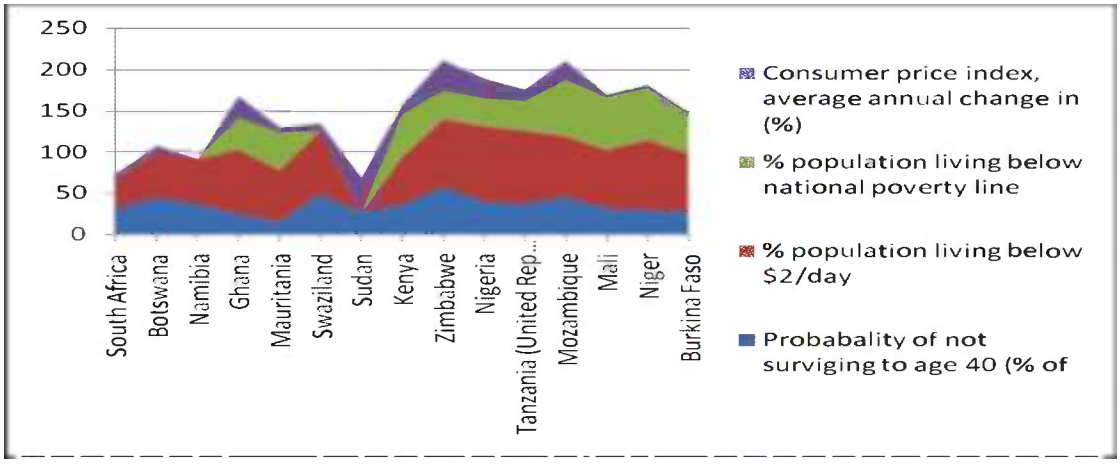

Figure 9: Poverty Indicators for Select sub-Saharan African Countries

While Africa is in absolute terms not the world's poorest region, it is the only region where the number of poor people is increasing significantly. Though the number of poor people has decreased recently in developing countries, Africa saw a significant increase in the number of its poor. Hence, Africa accounts today for some 30 per cent of the poor in developing countries, compared with about 16 per cent in the mid 1980s. (African Development Bank 2007)

2.4 Ecosystem Services

Ecosystem trends usually rely on a triangulation from a range of different methods, including remote sensing, patching together results across several independent and disparate investigations, expert opinions and community perceptions. The danger, however, is that frequently larger scale (e.g national or continental) reports on the status and or trends in ecosystem services are based on extrapolations from disparate, context specific, local-level studies. Remote sensing is a useful and increasingly used tool for several services, but cannot be used for many (e.g soil fertility, drought mitigation, species richness, cultural services).

There are, however, indications of overall continous degradation of ecosystem services in the region in terms of deforestation, degradation of soil fertility and conversion of rangeland to cropland as well as unsustainable agricultural practices (MA 2005, Molden 2007, S-Africa Synthesis p. 56,57). Examples include the decrease in woodland by 10% in the Romwe catchment between 1984 and 1999 due to a clearing for expanded cultivation (Campell et al 2002); or the decrease in forests in Kenya from 3% to 1.5% (WRI/ILRI 2007). These in turn have negative effects on the potential of drylands to sequester carbon as well as their local and regional climate regulation. However, positive examples such as in northern Nigeria, indicate that intensive integrated crop-cattle local farm systems can increase the soil carbon stocks while reversing degradation (FAO 2004). Similar cases exist in Sudan and Kenya (FAO 2004).

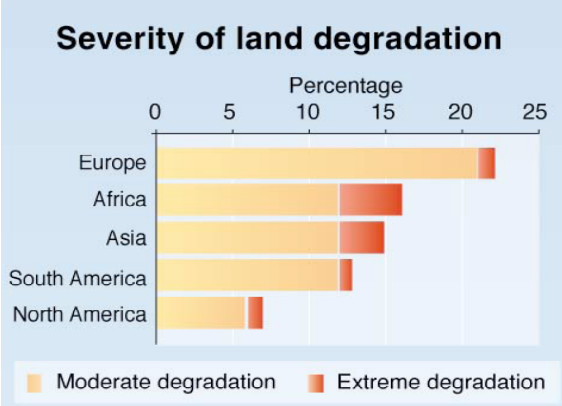

Figure 10: Global Land Degradation (UNEP 2002)

Degraded lands, particularly in arid and semi arid areas, are noted (Figure 7) as comprising over 15% of the total land area on the continent. While areas facing moderate degradation are on parr with other developing regions such as Asia and South America, Africa has a disproportionately high percentage of lands classified as being extremely degraded, the highest portion globally, according to UNEP (2002).

Carbon sequestration in drylands is particularly linked to soil carbon stocks, which are higher in dryland forest soils than in controlled grazed grasslands and the carbon in the latter is again higher than in croplands (FAO 2004).

By definition arid and semi-arid lands have limited and patchy water resources. Those more humid areas that have plentiful water supplies, such as the great lakes region, nevertheless struggle with high levels of rainfall variability, fluctuating regularly from drought to flood. The availability of water is the primary requirement to generate ecosystem services. Any discussion of trends in ecosystem services therefore needs to recognize the primary role of rainfall in determining primary production, river flow and groundwater recharge, and the resultant ecosystem services accruing to local people.

Rainfall is inherently variable in Africa, and this, connected to the increasing inadequacy of rainfall and river gauging networks has led to inconclusive and often conflicting conclusions on long term trends. For example, while some authors point to recent increasing run-off in individual catchments (Mahe and Olivery 2005), others point to long term decline over the last century in the same basin. While some see a dynamic and variable system, others are prepared to draw straight lines of declining average flow. The lack of good consensual data and analysis on rainfall patterns compromises not only political discourse, currently preoccupied by a "Water Crisis", a crisis that is one of management choice rather than a crisis of availability, but also the analysis of underlying drivers of ecosystem services and consequent development choices. In the medium term it also hampers our capacity to predict future trends due to climate change.

Nonetheless in some regions, long-term declines in rainfall have been argued, with obvious consequences in declining productivity of a range of ecosystem services. For example, several studies show a general decline of the climate over the past 50 years in the West Africa region. Taking into account coming climate change, the scenario of rainfall decline will remain. The 2007 study of the World Bank on the evolution of rural structures in Mali and Senegal shows a considerable impact of this decline. In Senegal, for instance, the mean annual rainfall has declined by one-third and the length of the rainy season has been reduced by two months. Salt has invaded some lands traditionally used for rice cultivation.

Water is often cited as one of the key scarce resources throughout sub-Saharan Africa, and most countries own or share major river systems, whose arterial capacity to convey water (often from higher rainfall, distant mountains) contrasts sharply with low surface water availability in semi-arid areas distant from water courses.

The Senegal, Niger, Nile, Okavango, Orange and Save rivers all perform this transfer function, as to some extent does the Zambezi, supporting drylands livelihoods in the process. For the river systems, rivers and their associated wetlands provide a wide range of ecosystem services that deliver direct or indirect benefits to riverine populations (Dugan 1991)

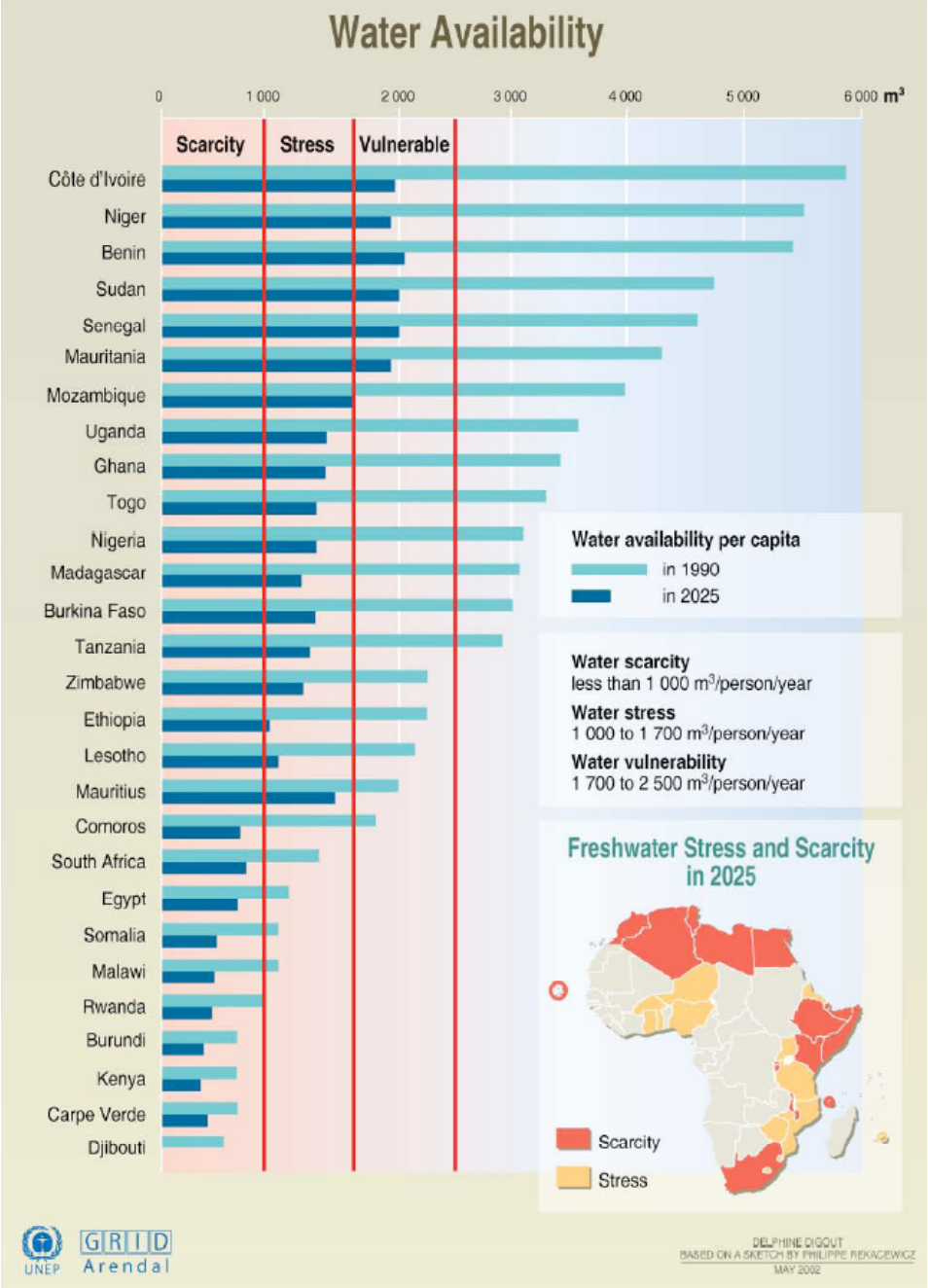

Figure 11: Water Scarcity in Africa (GEO 2000)

2.5 Desakota in Sub-Saharan Africa

The combination of rapid population growth, economic decline and political instability have led to an increasing number of people depending on multiple livelihood sources to survive. In order to capitalize on the advantages of rural access to ecosystem goods and services and the growing markets in urban areas, many households have begun to straddle the rural-urban devide. Growing transport and communications infrastructure have

influenced the nature of these strategies, and some of the multiple ways in which households and spaces increasingly exhibit Desatoka characteristics is explored below.

The Desakota regions of South East Asia have no physical equivalent in sub-Saharan Africa (Tacoli 1999). Instead Desakota regions in Sub-Saharan African are more fluid and not inherently limited to spatial locations. The ability of both rural and urban areas to sustain themselves is dependent on the flows of socio-economic and ecosystem goods and services through the peri-urban interface (Allen 2001). In sub-Saharan Africa, rural and urban economies are closely linked at multiple scales, from the formal, to the household. Formal urban market demands drive rural agricultural choices, and formal rural economies feed essential resources into urban economies. In most regions, rural areas still predominantly produce and supply primary resources, such as food or minerals, to urban industries and markets. Cash flowing back to rural areas either through remittances or markets is thus often recirculated back into urban economies through the purchasing of commodity goods, basic services and transport. Very little cash generated in, or sent to, rural areas, is fed back into rural economies, hence the low levels of development and innovation across the sub-continent.

The increasingly informal nature of the flow of goods and people between rural and urban areas, however, has led to a high proportion of individual household economies on the sub-continent interacting across the rural-urban continuum. This is done either by locating themselves in peri-urban areas where members of the household can engage in a range of livelihood options, including agriculture, waged labour, trading and service provision; or by locating various members of the household at different spatial points along the rural-urban continuum, so that they can focus intently on traditionally rural or urban activities, and feed the benefits back to other members of the household. This includes an intra-household transfer of cash, commodity goods, labour, produce, NTFP's and care between members of the household located in different spaces, but still belonging to a single economic unit.

Veenhuizen (2002) argues that it is in the physical peri-urban interface, which is usually characterized by numerous desakota characteristics, that opportunities for capital investment amongst the poor are the highest, but little data has been collected to substantiate whether or not these households are truly better off than households reliant on a strong rural or urban base, that rely on migrant labour and a transfer of goods and services to diversify their income.

In sub-Saharan Africa, desakota areas are capitalized on by multiple social and economic groups and usually include:
'high and middle-income households moving to residential areas in 'greener' areas well-connected to the centre; low-income residents moving from central areas, looking for more space as well as more affordable housing and cheap land on which they can build their own house; new migrants from rural and inner urban areas or other urban centres (in many cases tenants) and people living in villages incorporated into city boundaries' (Tacoli 1999).

Small and Medium Sized Urban Areas and Desakota

Small and medium sized urban centers are an important part of urbanization in sub-Saharan Africa and particularly so for understanding the Desakota phenomenon. Based on a combination of census data and case studies, Satterthwaite and Tacoli (2003) estimate that almost half of the sub-continents urban populations live in small cities and towns of less than half a million residents. They illustrate that in sub-Saharan Africa most of this urbanization occurs in administrative centers and market towns with between 5 000 and 100 000 residents, and argue that small and medium sized urban centers are important part of urbanization studies which have been undervalued and under-researched.

Size and class of settlement	Number of inhabitants in millions			
	1970	2000	2005	2015
Small urban settlements	67.1 81%	206.6 69.9%	242 68.6%	318.4 65%
Urban agglomerations	10.1 12.2%	69.7 23.6%	82.9 23.5%	126.2 25.8%
Mega-cities	5.6 6.8%	19.1 6.5%	27.9 7.9%	44.5 9.1%
Total Urban inhabitants	82.8 100%	295.4 100%	352.9 100%	489.1 100%

Figure 12: Inhabitants by Class of Settlements in Africa 1975 – 2015 (Hassan 2005)

Administrative and market towns have particular significance and relevance in the region, where they have a long history of providing governance, education, health and market services to otherwise disconnected rural areas. These centers play an important role in urban-rural interlinkages, particularly for small-scale subsistence farmers and the urban poor. The most successful Desakota livelihoods are often associated with smaller urban centers, where availability of land, labour, and informal markets is higher than around large urban agglomerations, and entry level barriers are lower. The reliance of both urban and rural residents on a mixture of livelihoods strategies is more marked in such centers.

The size of the towns allows for enough of a market to generate cash income for a range of goods and services to survive, if not thrive, but is inhibited from allowing serious economies of scale to develop. In this sense they are not necessarily high end contributors to the national economy, but play a very important role in providing opportunities for the poor. Rural-Urban migration and immigration, although usually motivated by a lack of resources, requires a certain level of social and financial resources. The number of resources required to migrate, or immigrate to large urban centers is much higher than those needed to move to smaller urban centers. For this reason, it is usually the poorest rural residents that move to smaller urban centers which are closer to their rural homesteads. Because of these costs, many people prefer to maintain permanent bases in rural areas and travel on a daily or weekly basis to nearby small towns. This

option is limited by the availability of reliable transport infrastructure, and the dearth of proper transport options in most parts of the sub-continent limit the range of migration options for those too poor to access land or resources in urban or peri-urban areas. Increasing transport connectivity, however, is driving a rapid increase in the number of people able to capitalize on these markets and services, and cities and towns are broadening their net of inter-dependent Desakota and rural areas.

In southeast Nigeria, for example, low-income people commute regularly from the villages to the intermediate town of Aba to work as domestic workers, gardeners and so on. This allows them to grow their own food and generally to spend less cash than they would need to by living in the town. Commuting also helps avoid labour shortages during specific times in the farming season, which are often associated with migration (Satterthwaite & Tacoli 2003).

Amongst the poor, women are particularly vulnerable to social and economic shocks, and there appears to be tendency amongst female headed households to move closer to smaller urban centres than remain in rural areas. Living without a male partner has significant impacts on the ability of women to generate enough labour and cash resources necessary to maintain a rural, purely subsistence based lifestyle. In search of diversified incomes and access to waged labour women left to head households by death or separation often migrate to nearby small towns, where their chances of accessing land and drawing on existing social networks are much higher than in larger urban centres. For example in Biharamula in northwestern Tanzania (population 20 000), woman head approximately 30 % of the urban households, which is considerably different to the rural villages where only 7 % of households are headed by woman (Baker 1995:1).

Summary

The socio-economic, demographic, political and environmental patterns particular to the sub-Saharan African context have left many of the continents poor increasingly dependent on a mixed livelihood base to help them buffer against economic, political and environmental shocks. These features, while not isolated African phenomenon, have particular consequences in the context of an increasingly water stressed region. Chapter Three investigates in more detail how some of the processes driving this context impact on the interlinkages between water-based ecosystems and poverty alleviation.

3. Regional Patterns and Drivers of Change in Desakota Regions

The socio-economic, political and environmental contexts described in chapter two outline some of the key features affecting the nature of the Desakota phenomenon in sub-Saharan Africa. Desakota areas, however, are constantly in flux, influenced by a range of macro and micro level drivers that influence the ways in which various characteristics manifest. There are, however, some ongoing processes that have been identified as having particular relevance for our understanding of the current, and constantly changing nature of the Desakota phenomenon in the region.

3.1 Urbanization

Poverty indicators for sub-Saharan Africa show that the majority of the poor live in rural areas, with subsistence agriculture, fishing and hunting as the main sources of livelihood. In both urban and rural areas, women comprise, relative to men, a disproportionate number of the people living in absolute poverty (African Development Bank 2007). Increasing numbers of urban dwellers, however, also live in absolute poverty, as urban economies flounder, and urban populations increase. Currently, 39.6% of people in Sub-Saharan Africa live in urban areas.

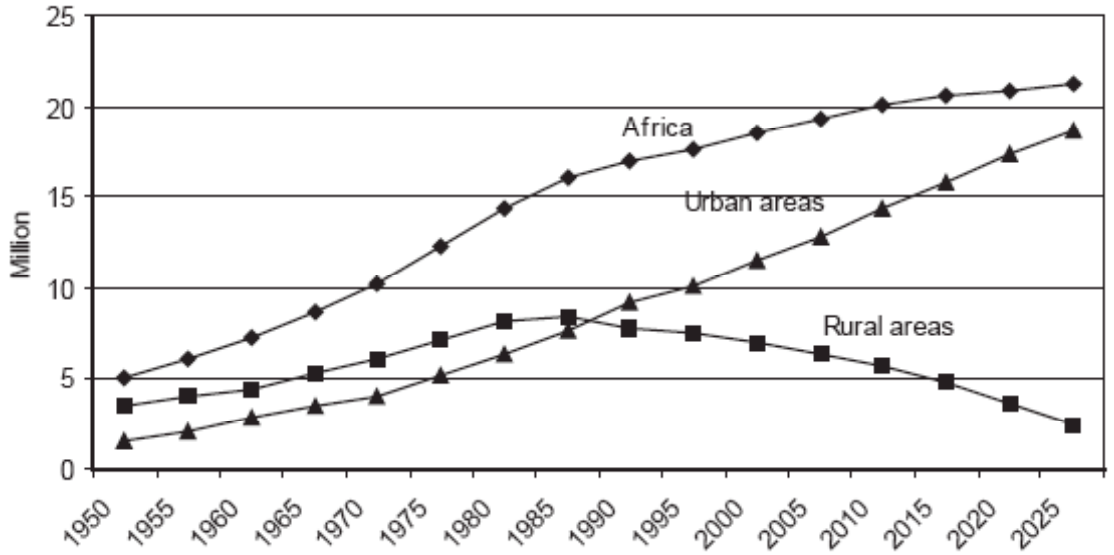

Figure 13: Dynamics of Urban and Rural Population Growth in Africa 1950 – 2025 (Hassan 2005)

Despite Africa being long thought of as one of the least urbanized continents, some projections anticipate that over half the population will be urban by 2020 (UN 1993). Population growth as well as national and international migraion trends have led to urban areas increasing their populations more rapidly than rural areas, and in some cases

directly at the expense of rural populations. Figure Thirteen illustrates the increasingly divergent growth rates in rural and urban areas in Africa.

Cities have traditionally been thought of as locations for non-agricultural economic activity, and are therefore directly linked to the economies of their hinterlands, and the wider global economy (Rakodi 1999). Globally, urban development and growth has consequently been closely linked to processes of industrialization and economic growth.

> The largest cities "serve simultaneously as national and regional engines of economic growth, centres of technological and cultural creativity, homes of the poor and deprived, and the sites and sources of environmental pollution" (Fuchs 1994).

Urbanization in sub-Saharan Africa is no exception, and trends in growth rates and the spatial orientation of cities across the sub-continent are directly related to the economic processes of the last few centuries. However, the last three decades of urban growth, and rural-urban migration, have not conformed to traditional patterns of formal economy driven processes, and some anomalies in trends have left both governments and academics at a loss as how to interpret trends and drivers. Most significantly, the well documented economic decline of urban centres across the continent following their economic and demographic growth spurts in the 1950's, 60's and 70's, and the failure of almost all sub-Saharan African countries to develop manufacturing sectors, is a seeming contradiction to the continued growth of urban centers.

Rakodi (1999) argues that much of the confusion regarding anomalies in the trends is due to the lack of accurate and reliable information on demographic and migratory trends across the sub-continent. Stren (1994) attributes this to the influence of economic decline, political difficulties and bad governance on the availability of resources and expertise for data collection in both government and academic institutions. Potts (1995) illustrates that in many African countries rural-urban migration projections have been lower than expected, and in some cases negative rather than positive. She argues that this is due to the effects of structural adjustment and IMF policies on urban real income and the reliance of global data sources on projections rather than census data. Cohen (2004), on the other hand, argues that incorrect projections are the result of inconsistencies in how 'urban' and 'urbanization' have been defined, and the lack of available census data.

The extreme dearth of up to date information has been veiled by the reliance of international organizations such as the World Bank, the African Development Bank and the United Nations on statistical projections, which have enabled them to continue producing yearly summaries of urban growth trends in sub-Saharan Africa. Cohen (2004:27) illustrates, for example, how in the 1999 revision of *World Urbanization Prospects,* in 43% of the cases the United Nations relied on data between three and eight years old, and in 38% of the cases data used was more than eight years old. In the study, 56% of the data on African countries was more than eight years old. In some countries, particularly those ravaged by long civil conflicts, such as Sudan and Ethiopia, no new census data has been collected since the 1970's (Cohen 2004), meaning that 'more than eight years', can mean anything up to thirty years.

In effect, most recent studies on urbanization in Africa have been conducted in the absence of reliable and up-to-date demographic information (Rakodi 1999), which has resulted in skewed projections and contradictory conclusions regarding the nature and rate of urbanization over the last 20 years. On a highly varied sub-continent, part of the disagreements can be attributed to the high levels of spatial and temporal variability, which buck against efforts to make broad sweeping generalizations. In an effort to move beyond this, this report will attempt to highlight some of these contradictions and variability, but as the data used in this report must rely on these same sources, conclusions cannot be expected to be more accurate than those reached by other authors. Rather than accuracy, this report will focus on complexity, and attempt to utilize contradictions and inconsistencies to highlight key issues facing urbanization, and thus the Desakota phenomenon, on the continent.

The key difficulty faced by any desktop analysis of Desakota trends in sub-Saharan Africa is that the two contradictory schools of thought regarding whether urban growth rates are positive or negative. Analyses based on statistical projections, such as those compiled by the World Bank, African Development Bank and United Nations, argue that urbanization rates in Africa are at an all time high, even going so far as to argue that sub-Saharan Africa currently has the highest urban growth rates in the world (African Development Bank 2007). These projections, even when criticized for their inaccuracy, are generally believed to indicate an overwhelmingly positive growth rate, exceeding normal population growth rates, and indicating a high rate of rural-urban migration.

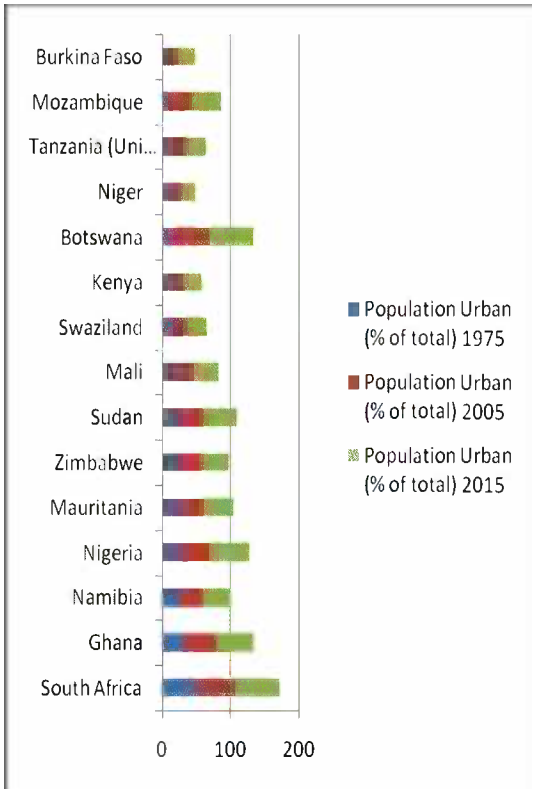

Figure 14: Urban Populations (% of total) 1975, 2005, 2015

In West Africa, there can be no doubt about the high rate of urbanization, and increases in population density. Data mapped by the *West Africa Long Term Perspective Study* show major increases since 1960 not only in densities but also in urbanization. This process has led to a network of 3,000 towns and cities, which, between 1960 and 1990 had 'taken in 66 million new inhabitants and provided them with income and housing' (WALTPS 1994).

This urban expansion is giving an increasing share of the rural population access to markets; more than 50% of West Africa is considered to be 'strongly linked to markets', and this change is active in the Sahel, with major urban systems linked, for example, to Kano and Dakar. Road infrastructure expansion provides an indicator of this revolution. Urbanization is supported by

high rates of natural increase (often in excess of 3%/yr) in rural areas, but despite the rapid growth of cities, it has not yet brought about absolute decline in rural populations and densities.

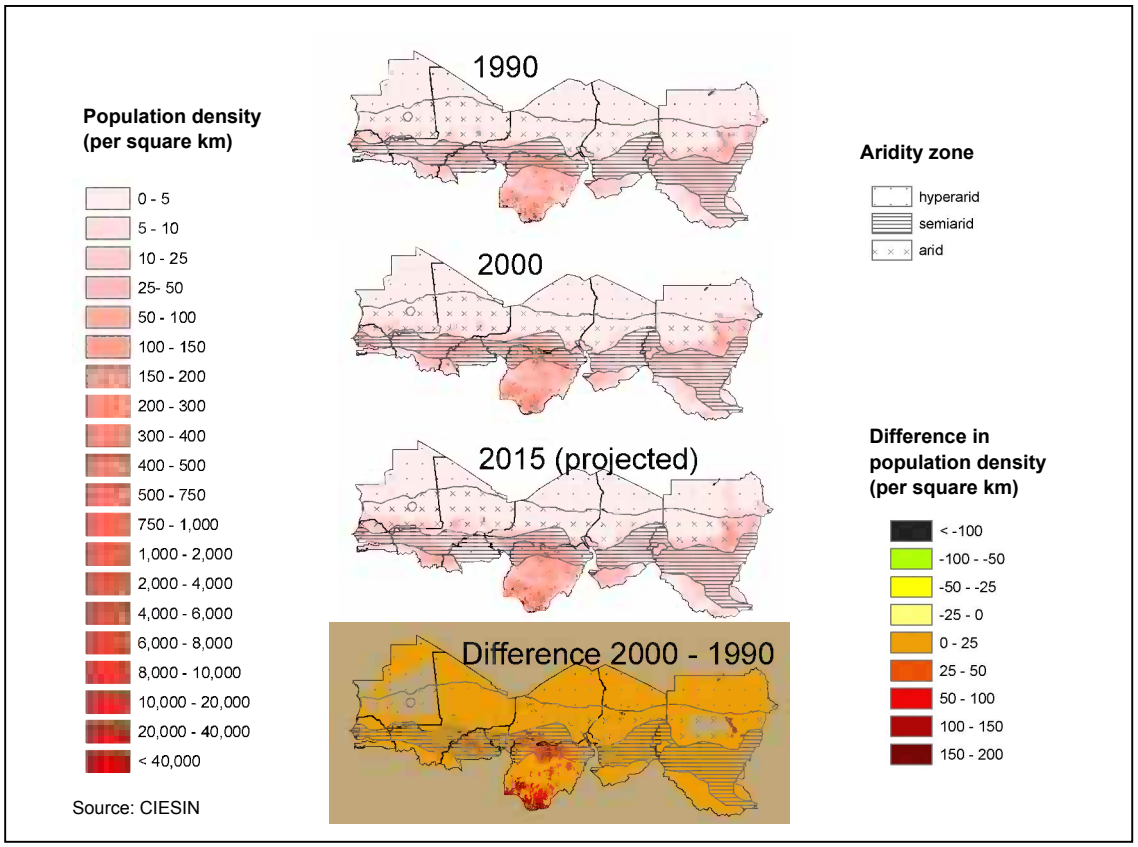

Figure 15: Changing Population Densities in West Africa, 1990 – 2015 (CIESIN)

Potts (1995), on the other hand, bases her analysis on a combination of census data (where available) and economic trends and shows a different picture, illustrating negative or flat trends in urban growth rates in some areas, and arguing that there has been a surge in urban-rural migration due to the increasing costs of urban living and the decreasing availability of waged employment.

Potts' (1995) argument is somewhat limited in that it focuses on the effects of structural adjustment and IMF policies on urban real income, arguing that with the demise of the formal urban economy, people are forced to consider returning to rural areas where real incomes, based on less market oriented livelihood strategies, are higher. She does not give proper consideration to the development of informal markets and economies in urban and peri-urban areas. Her failure to properly analyze the development of informal economies, particularly in urban and peri-urban slums, weakens the economic basis of her argument, which is based on an assessment of people's inability to generate the cash incomes needed to survive in urban slums. However, the strong case studies she presents illustrate that in some cities as least, urban growth rates are indeed negative, and the urban poor are increasingly turning to their rural linkages for survival.

Country	1957 - 1967	1968 - 1978	1979 - 1989
Uganda	29	100	60
Zambia	56	128	83
Tanzania	100	206	37
Ghana	-	149	18

Figure 16: Declining Urban Incomes in Select African Countries, 1957 – 1989 (Potts 1995)

The informal economy plays a key role in sustaining urban centers in an otherwise volatile economic climate that should have led to rapid ruralization. It plays a particularly important role in the livelihoods of the peri-urban poor, who are the most marginalized from access to the formal economy. Unfortunately little in depth information is available regarding the exact extent and role of the urban informal economy in sustaining the urban and peri-urban poor.

Despite these divergent analyses, there can be no doubt, from a spatial and demographic perspective, that urban centers in sub-Saharan Africa are growing, and in many cases rapidly. While there may be some instances of ruralization because of crashing urban economies, the emergence of a strong and vibrant informal sector across the continent has allowed urban dwellers to continue to thrive, and attract migrants to their markets, services and opportunities. West Africa is a clear example of urbanization, whereby the emergence of the market economy and subsequent concentration of investments in urban trading centres has encouraged migration from rural to urban areas (Club du Sahel 2000). Lagos in Nigeria has had a kinetic expansion of urban regions, with a population of only 75 000 in 1940, to now having a population of 13-16 million (Dreschel et al 2006).

These trends are an important facet in the quest to unravel the mysterious drivers of the Desakota phenomenon in sub-Saharan Africa, as the swelling, or shrinking, of cities has important ramifications for those whose livelihoods are based on straddling the so-called urban/rural divide. What is not clear from the debates, is what is happening to the peri-urban areas, where the height of Desakota characteristics are located? The dichotomous debates focus their attention on drawing strict boundaries, effectively 'erasing' from the debate the role of Desakota zones in helping people negotiate economic and demographic trends. What they do highlight, however, are the strongly maintained linkages between rural and urban residents as people move between them to negotiate their livelihoods.

3.2 Migration and Change

Internal and international migration trends in sub-Saharan Africa are difficult to track as little reliable data is available. Some data is available on international immigrants who move officially – either as refugees, or as registered migrants, but an increasing number of people move illegally between countries, and in many regions even those who enter countries legally are not properly documented, or clear records kept. Despite this, a fair amount of literature has been generated on the nature of both national and international migration across the region, and some trends may be noted. There have been some

significant changes in the nature and patterns of migration in the last few decades, and these in particular are worth noting.

Traditionally migration within and between countries on the subcontinent had been driven by labour demands, and conflict. Extraction based economies often faced labour shortages and largely male migrants have been involved in patterns of both circular labour migration and immigration since the last century. This pattern is noted to have been changing over the last two decades, as high population growth rates, failing economies and the inability of most countries to develop sound manufacturing sectors has led to a labour surplus in most regions, rather than a deficit (Adepoju 2004, Zlotnik 2004). Economically motivated migration has not, however, decreased, it has just changed. Adepoju (2004) argues that entrepreneurs and informal traders in search of markets have replaced labour migrants. Commercial migrants, as they have been dubbed, rely on a combination of trading traditional African clothing, handicrafts and medicines, and cheap exports – mostly from the East. There is an increasing number of female migrants, as they are no longer limited by the specifications of the labour market.

International Migration

Estimations of the number of international migrants across the region illustrate a general increase in the number of migrants since the 1960's and 1970's, with number peaking in East, Middle and North Africa in the 1980's and 1990's. In West and Southern Africa, however, there has been a steady increase into the 2000's. The peaks in East, West and North Africa can be attributed to the civil conflicts in those regions during that time, and the dramatic increase in the refugees as a percentage of international migrants in those areas during the 1980's and 1990's.

Political unrest and civil conflicts have traditionally led to the movement of large numbers of people across the continent, and refugees comprise a significant portion of migrants. While this number has declined significantly as the number of civil conflicts has decreased, political refugees still play an important role in the nature of international and national immigrants.

There is a high degree of variability across the region, and international migrants are not uniformly spread. West Africa is noted as being home to 42% of international migrants on the continent, East Africa 28%, North Africa 12% and Middle and Southern Africa each holding 9% (Zlotnik 2004).

The feminization of migrants in Africa is not limited to the shift from labour based to commerce based migration, and can also be linked to the increasing number of educated and trained women entering into national and international migration in search of better pay. Doctors, nurses and teachers are amongst the increasing number of women leaving their homes to work, either in regional urban centres, or in the increasing number of countries facing skills shortages (Adepoju 2004).

The increasing number of regional economic organizations have also affect migration trends, as they have developed policies which have facilitated higher degrees of labour and goods mobility, allowing labor and commercial migrants easier access to neighbouring markets. The Common Market for Eastern and Southern Africa, the Economic Community of West Africa and NEPAD, have all contributed to the easier flow of goods and people across border in the region.

The degree to which revenues earned abroad are sent home in the form of remittances and goods are difficult to track, but they are estimated to play a significant role in people's livelihood strategies. Some migrants immigrate permanently, but continue to send money home, while others disassociate themselves with old economic and social responsibilities. There is no clear data tracking these trends.

Internal Migration

As noted, data on internal migration is scarce. Where census data does exist, it often fails to capture the place of origin of people, and in the informal settlements where many migrants settle, census data is more often based on projections than door-to-door surveys. Internal migration, usually from rural to urban areas, but sometimes between rural areas, or from urban to rural areas, is particularly difficult to quantify, as people are usually transient, and do not always spatially identify with the areas in which they live and work. People may be gone for 11 months a year from their rural homestead, but are still counted, and consider themselves, members of their rural household.

Internal migration is generally estimated based on urbanization trends, as the majority of migration is assumed to occur from rural to urban areas. As noted in the section on urbanization (Potts 1995), there are an increasing number of urban – rural migrants, but they generally fall below the data radar.

Across the sub-continent cities have increased rapidly in size and connectedness with rural producing areas over the last four decades. The high levels of migration and commuting between them and their hinterlands and the associated financial flows have greatly increased the complexity of rural-urban systems, for example in turning many bi-local households into rural producers and urban consumers at the same time.

The diversification of household livelihoods, however, is not an entirely new phenomenon, and an example from the Sahel illustrates that the diversification of incomes outside crop and livestock production has been embedded in livelihood strategies of risk-prone and opportunistic ecosystem users for centuries. Inaccurate myths surround it: such as the notion of 'environmental refugees' which ignores the deprivations of poor people through structural, social or political disadvantage and places the 'blame' for what is seen as a malignant process firmly at the door of the environment. It is overly influenced by images of refugee camps set up by donors during the drought cycles of the 1970s and 1980s (De Waal 1989). It has also been understood as a component of a continent-wide process of de-agrarianisation (Bryceson et al 2000). The desire to find supplementary or alternative incomes to those available from farming or

livestock is a major driver of rural-urban migration (whether permanent or seasonal), and naturally increases rapidly during times of food insecurity in drought-affected rural areas. Studies have shown how complex, goal-driven and rational income diversification is (Watts 1983; Mortimore 1982; Davies 1996; Faye and Fall 2001).

An example of adaptive migration from Sahelian villages in Kano State, Nigeria, illustrate the extend to which rural residents were actively engaging in income diversification to buffer against hardships in the 1970's already.

Farmers in four villages, who reared goats and sheep in addition to farming millet, sorghum, cowpeas, and groundnuts, were faced with two successive years of major crop failure in 1972 and 1973. Using knowledge sourced from previous years, they began to migrate to Lagos, >1000 km away, to work as security guards, bringing back their pay. An opportunity to supply goats to the booming urban markets of Lagos, especially at religious festivals, became apparent and within a few years the farmers of Dagaceri (none of whom had visited Lagos before 1973) were chartering a truck to fill with goats and accompanying it south for several weeks' retailing activity, and they continue to do this at least once a year at time of writing. Other migrants chose other destinations, and the map shows the associated flows. It also illustrates the principal that Sahelian ecosystem services are in demand from distant markets within the Sahel as well as overseas. The behaviour of these markets drives change in ecosystem service provision.

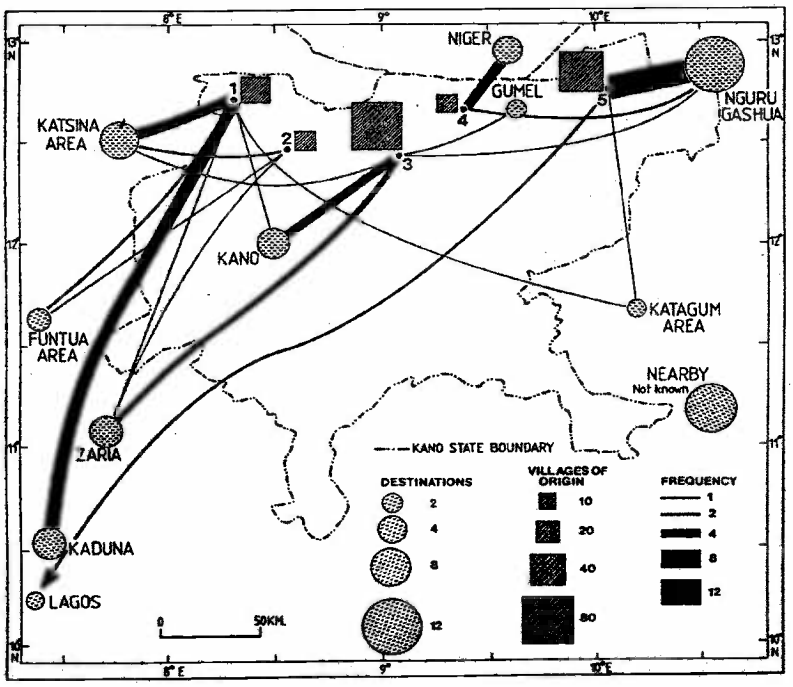

Figure 19: Regional Migration in Kano State, Nigeria

3.3 Economic Decline and the Rise of the Informal Economy

The most significant impact of the low economic growth rates across the continent can be seen within, and along the peripheries of urban centres, which, unlike other developing

countries, have experienced rapid growth rates without a growth in manufacturing sectors, or the economy in general, usually associated with urbanization. Urban growth rates have far exceeded the growth of urban formal economies, and consequently governance and infrastructural development have not been able to keep up with the growing number of urban and peri-urban dwellers. In real terms, economies have not only had slower growth rates, urban real incomes have significantly decreased, leaving urban dwellers increasingly marginalized from formal economies. This has affected the livelihood strategies of urban and peri-urban dwellers, and people have increasingly turned to blending traditionally rural and traditionally urban livelihood strategies to survive. Strong rural-urban linkages have also played an important role in maintaining urban and peri-urban households, with contemporary households in both rural and urban areas in a constant state of flux, thus influencing the current Desakota phenomenon. In sum, Deskaota areas in SS Africa are therefore characterized by rapid change, mixed landuse and blended traditional/contemporary livelihood strategies.

The informal economy has boomed under these conditions, with urban and peri-urban dwellers increasingly substituting their cash needs with informal trading, as wages drop and the number of formal jobs available decline, an inevitable coping strategy under these stressed conditions.

It has been estimated that up to 80% of Africa's non-agricultural workforce work in the informal economy (Charmes 1998). The term has been loosely used to describe a range of different activities, including informal trading, informal service provision and waged employment in unregulated businesses, and is often used to describe any economic activity that falls outside of the formal sector. This makes the usefulness of the definition questionable in terms of describing the actual work that is being done, but as a broad category it remains important due it's scale and significance in African livelihood strategies.

The development of informal economic activity is usually driven by little or no economic growth, economic restructuring or crisis and the globalization of the world economy, all of which have negative effects on the low end workforce, who are the first to loose their jobs and suffer the consequences of no job availability. In these situations, people with few economically valued skills or financial capital find other ways to sustain their livelihoods. In cases of economic regression, even employed workers turn to the informal economy to subsidize their income. The widespread role of the informal economy on the sub-continent, can thus be directly linked to the economic pressures and structural adjustment processes over the last three decades. Political instability and conflict has further weakened economies, driving even small-holder agriculturalists increasingly into the informal economy.

3.4 Increased Connectivity: Transport, Technology and Telecommunications.

Changing patterns of transport and telecommunications technologies have led to a greater mobility of capital, goods, and people (Dickens 1992). The African economy, and the volume of trade and the movement of people is larger than ever before. The affects of

these patterns, however, and their impact on different regions and their inhabitants are highly uneven over time and space (Rakodi 1999).

Increased mobility of capital and production has been one of the main driving forces behind the evolution of many national economies. For these countries, globalization is generally regarded as a positive stimulus to economic growth, although this does not mean that the results for all regions and social groups or for the environment are positive (Rakodi 1999). The globalization of the Perch fishing industry in Tanzania, for example, illustrates the extent to which increased connectivity and the penetration of the global market economy have negatively affected small scale informal fishermen who are unable to capitalize on the technological changes and are increasingly marginalized from the growing fishing industry. The divide between these fishermen and the increasingly modernized multinationals entering the industry is deepend by their inability to access better transport, communication and technology. Like many other informal traders who depend on natural resource harvesting for their livelihoods, they make what use they can of the increasingly connected markets, but the enormous benefits enjoyed by those able to properly capitalize on new developments places them in an increasingly marginalized position.

The *West African Long Term Perspective Study* showed that between 1960 and 1990 there a major improvement in connectedness in the sub-region, including the Sahel, owing to the construction of roads (Figure 20) and market infrastructure. Access to world markets for cotton and groundnuts had been achieved largely by rail construction in an earlier era. Consequently the state had played a major part not only in provision of infrastructure but in buying and exporting (and later in processing) produce.

Food commodity production for the growing cities, fed by the increasingly dense road systems, opened the door to informal marketing systems which grew largely beyond government control, especially in Nigeria (Ariyo et al 2001). Thus the reach of urban markets extended further into the countryside where it competed for ecosystem services with the export crops. It is likely that market demand will soon exceed the subsistence needs of rural populations as a driver of ecosystem change. These growing informal economies, and the increasing number of people dependent on them, have directly impacted the growth of the Desakota phenomenon in the region as accessing these markets is significantly easier than breaking into formal markets, and has allowed an increasing number of people to draw on informal trading to subsidize their other livelihood activities. Similar trends can be seen across the sub-continent

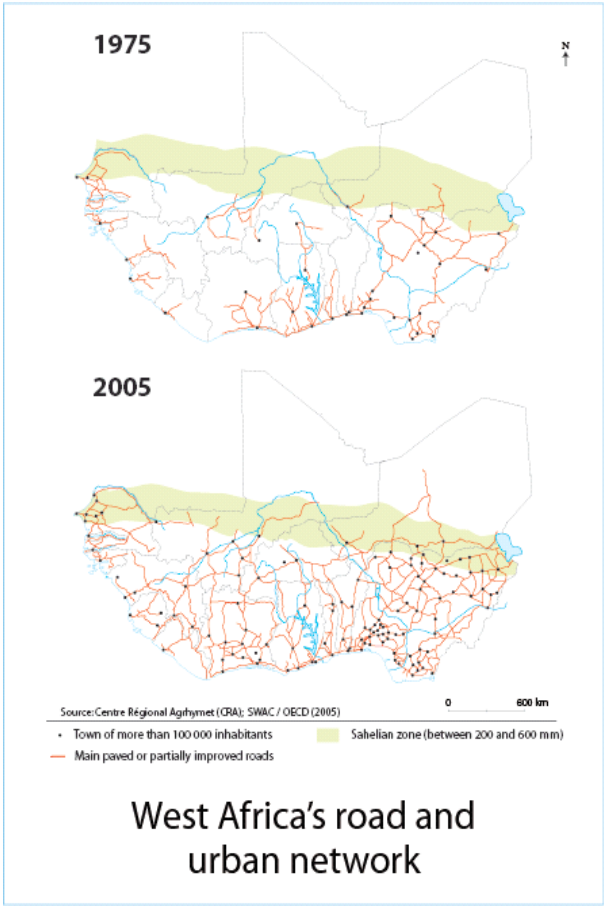

Figure 20: West Africa's Road and Urban Network
(OECD 2007)

A key feature of increased connectivity is the dramatic increases in access to communications services over the past three years, with the proportion of the population living under the mobile telephone footprint rising from 3 percent in 1999 to 50 percent in 2006. This has been matched by an equally rapid increase in the use of communications services. By the end of 2006 there were 123 million mobile subscribers. Average penetration rates in the region doubled between 2004 and 2006 to reach 16 percent. (World Bank 2007).

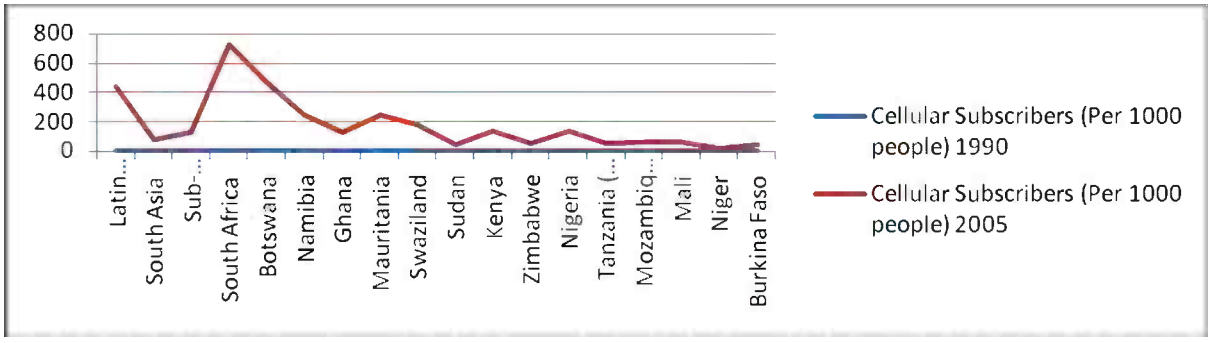

Figure 21: No of Cellular Subscribers in sub-Saharan Africa 1990 - 2005

Cellular technology has revolutionized communications access in areas where infrastructure intensive communications systems (such as cable based telephone systems) have failed to develop. In many remote regions of the sub-continent, difficult terrain, lack of political will and lack of capital to invest have prevented previous communications technologies from being assessable to economically and spatially marginalized people. For this reason, internet usage has not penetrated the region to the same degree as cellular networks, but there has nevertheless been a dramatic increase in internet usage in the region in the last 15 years (Figure 22).

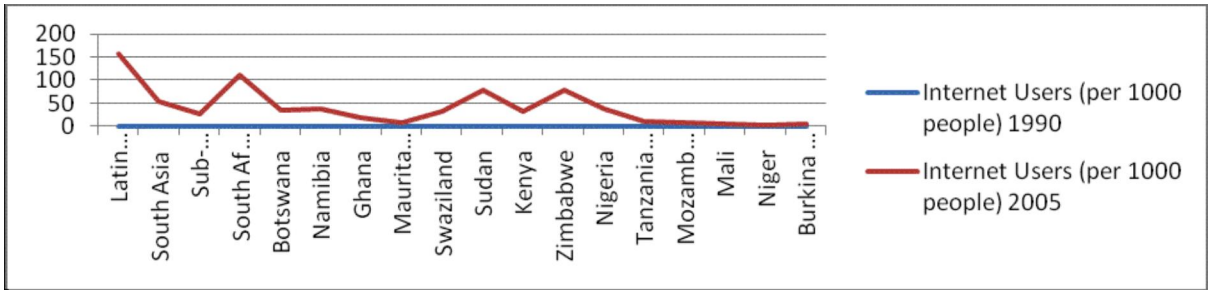

Figure 22: No of Internet Users in sub-Saharan Africa 1990 - 2005

Ecosystem services are harvested by a combination of labour and technology, and for smallholders in the Sahel, the scarcity of labour, until relatively recently in history, constrained the intensification of ecosystem service harvesting. With increasing supplies of family labour (under a growing population) and a scarcity of capital to invest in labour-saving technology, extra labour is given to operations designed to maximise output of crops (four weedings/yr), and to harvest weeds, browse, boundary plants (such as thatching grass) and NFTPs. Manure from dense animal populations is carefully recycled on the fields (normally in plant-by-plant 'microdoses').

A number of studies (Borlaug and Dowswell, 1995; Ongaro, 1990) have tried to respond to the question of why farmers in sub Saharan Africa have been slow to adopt production-increasing technologies. Inadequate access to markets, and thus to cash income, have been cited as key reasons for the lack of technological uptake in the region, as has the fact that few people have the means to protect themselves from risk, and so any extra capital is usually spent dealing with the aftershocks of various social, political and environmental risks. Carter (1997) argues that risk decreases people's ability to adopt new technologies and specialize. Groups unable to deal with risk are exposed to deepening poverty and food insecurity (African Development Bank 2007).

In Kenya, Evans (1992) argues that the most innovative households were the ones that were able to diversify their incomes sources, particularly those able to capitalize on proximity to urban markets. As is seen in many Desakota areas, increased interaction with urban markets and services encourages a greater flow of information and exposure to the benefits of new technologies. If farmers are able to generate extra cash by utilizing these markets, they are more likely to invest in new technologies and improved harvesting methods. Education, however, and the ability to access information and understand it's significance, is another important factor in determining the extent to

which farmers utlize new technologies. Lockheed et al. (1980) argued that a dynamic agricultural environment can be taken advantage of only by farmers with some education, while in environments not supportive of agricultural innovations, traditional knowledge intellectual foundation farmers have (African Development Bank 2007).

The greater connectivity experienced by rural and urban populations across sub-Saharan Africa is revolutionizing social and economic relations. These changes, however, are not always positive for everyone, as increasing disparity in access can deepen the knowledge and wealth divide, further disadvantaging those unable to capitalize on new advancements. People without significant access to education or capital that are nevertheless engaged in diversified livelihood activities, and particularly those living in Desakota areas that are able to capitalize on proximity to urban markets and rural natural resources, are arguably the more able to benefit from these changes than their more spatially and economically marginalized neighbours. The impacts of these changes on ecosystem usage, however, need to be explored if the environmental tradeoffs of increased productivity are to be properly understood.

3.5 HIV/Aids

One of the key drivers of risk and vulnerability on the continent is HIV/AIDS. Out of the 36 million people infected with HIV/AIDS worldwide, 70 % of the worst effected, are found in Sub-Saharan Africa (US Census Bureau, 2004). In 2005, HIV prevalence was 6.1% in sub-Saharan Africa, compared to the world level of 1.0 % (UNAIDS, 2006). The high prevalence's of HIV in Southern and East Africa are unprecedented. Africa contains 19 of the 20 countries with the highest infection rates in the world (UNAIDS, 2006). What could be causing these high rates remains elusive, as investigation of trends and commonalities is difficult, due to the highly varied historical contexts across the continent (Williams *et al.,* 2002).

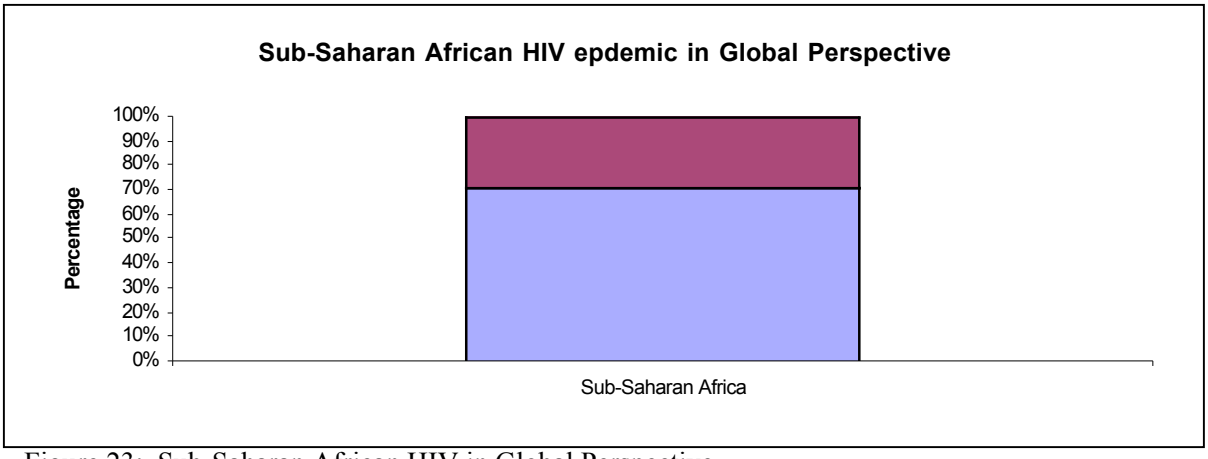

Figure 23: Sub-Saharan African HIV in Global Perspective

Proposed drivers for these exceptionally high rates include: poverty; economic marginalization; HIV strain variability; presence or absence of male circumcision; migration; food insecurity; natural resource scarcity, among other possibly hidden drivers

(Descosas et al., 1997; Mabey and Mayaud, 1997; Williams *et al.,* 2002, De Waal & Whiteside DATE; Lachaud, 2007). The dynamic interactions of these drivers further confound the investigation into the cause of Africa's high spread and prevalence of HIV.

The relationship between these causes and the spread of HIV prevalence has been found to be "bidirectional" (Lachaud, 2007). For example; poverty can intensify the prevalence of the epidemic, while prevalence is likely to exacerbate the incidence of poverty (Lachaud, 2007). Similarly migration is seen to be a particularly influential driver in the spread of HIV/AIDS (Bloom et al., 2002; Williams *et al.,* 2002; Lurie, 2004), yet migration is often induced by poverty, as people move around to find work to improve their income and quality of life.

3.6 Drivers of Ecosystem Change

Changes in ecosystems and thus ecosystem services often result from interactions among drivers across space, time and biological levels of organisation. Nelson *et al.* (2006) give examples of these interactions that result in unpredictable and non-linear changes in ecosystem services. An example of interactions among drivers in southern Africa is the practice of assisting poor farmers after severe droughts. Many governments in the region usually assist poor small-scale farmers to re-stock after severe droughts such as the one that occurred in the early 1990s. Unfortunately, these policy actions interact with the adverse impacts of droughts on rangeland ecosystems to cause further rangeland deterioration and thus hamper their natural recovery. This example demonstrates the interaction between a direct driver (drought) and an indirect driver (policy action) that influences rangeland condition and thus the supply of ecosystem services such as forage. For example, Stuart-Hill & Danckwerts (1989) showed that re-stocking after drought reduced the rate of recovery of communal rangeland compared to large-scale commercial farms where re-stocking was gradual. There are many other policy initiatives that have unintended consequences on ecosystems.

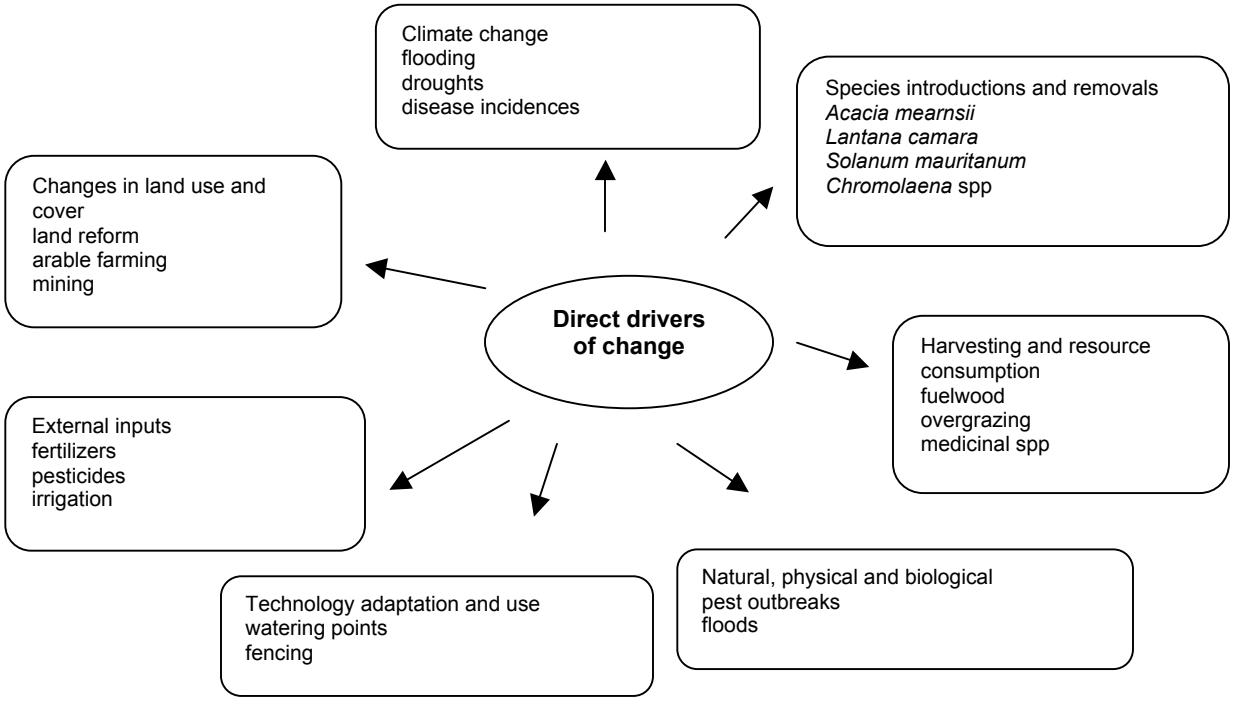

Figure 25: Examples of global direct drivers influencing ecosystem changes (adapted from MA 2005a)

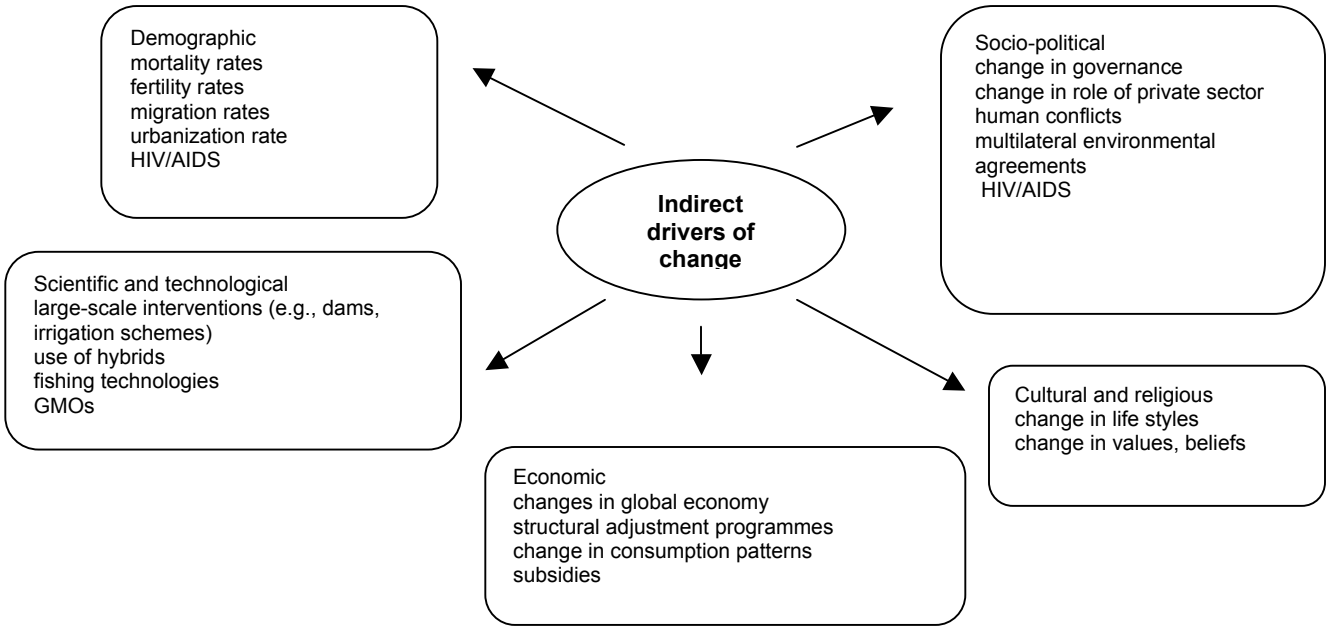

Figure 26: Examples of global indirect drivers influencing ecosystem changes

The climate change scenarios for Africa indicate varying patterns of impacts on both temperature and rainfall. However, the already arid and semi-arid areas are, on the whole, likely to become drier still. In itself this poses a significant added pressure to already vulnerable livelihoods.

The impact of climate change on specific ecosystem services has not been extensively modelled. However, given that rainfall in arid and semi-arid lands is the single most important factor affecting plant (including crops) and animal (including livestock, wild animals and fisheries) productivity, and decrease in rainfall, or increase in variability, will certainly reduce the growth and recruitment rates of key resources such as fodder for livestock, medicinal and edible plants. Consequently, if these ecosystem services are already experiencing negative trends from other drivers, the impacts of climate change can be expected to accelerate those trends.

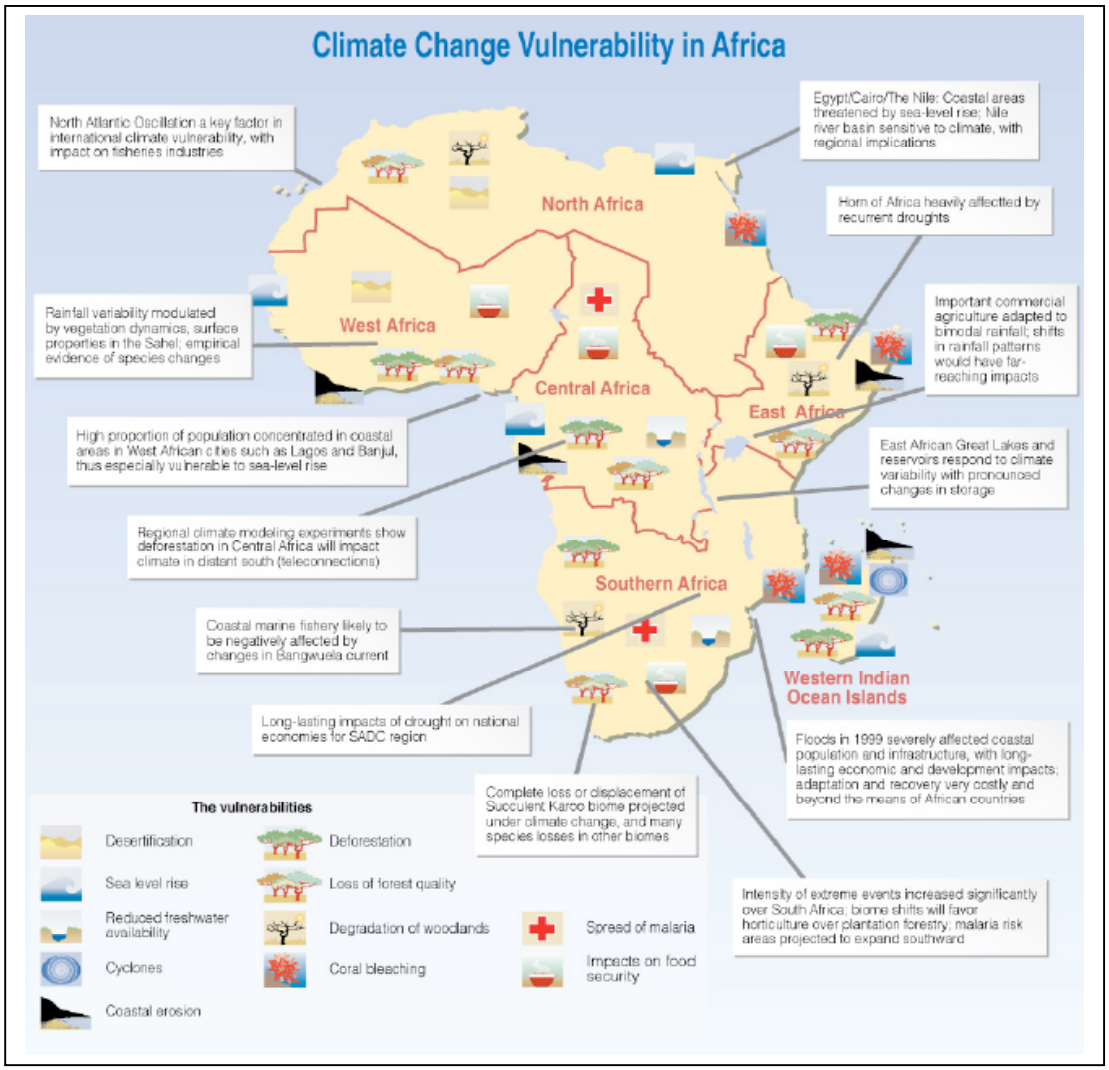

Figure 24: Climate Change Vulnerability in Africa

Climate change will inevitably affect river and wetland ecosystems through changes to catchment hydrology, but the direction and degree of change will be locality specific and is difficult to predict. Indications are that an already variable climate is likely to become even more variable, with increased swings between drought and flood. The most effective interventions will be those that allow adaptation to variability through increased flexibility.

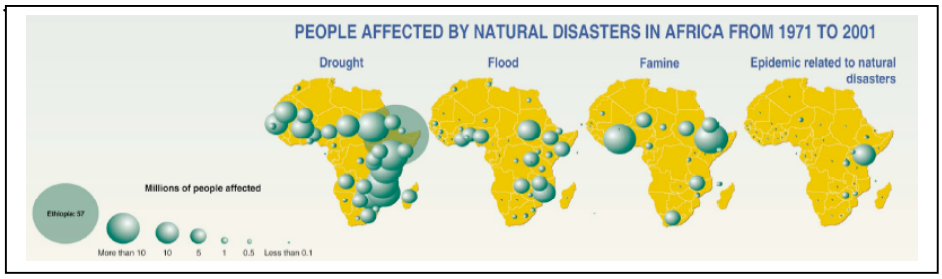

Figure 30: Increasing Incidence of Natural Disasters in Africa

Drivers of Change in Water Quantity

River and wetland ecosystems depend first and foremost on the quantity and timing of water that is received by the system. In semi-arid and arid areas floods are seen to be especially important due to their role in recharging water levels in the wetland and riparian zones and in ground water supply. Floods also redistribute sediments and organic materials, spread seeds and through disturbance create new spaces for recruitment. Floods are the main geomorphological drivers that create the river and wetland morphology, thus determining the quality and distribution of habitat for both plants and animals. The importance of low flows cannot be discounted, as it is the low flow that provides the 'normal' habitat for aquatic organisms.

Factors that affect the quantity and timing of water include the hydrological balance of the upstream catchment as affected by climate change, especially in relation to the frequency of droughts and floods, or by landuse, upstream dams, and water abstraction for agricultural or urban use.

Dams impact on both flood frequency and volume leading to a reduction in recharge of riparian and wetland aquifers. Water regulation by Kariba and Cahora Bassa dams has reduced wetlands in Zambezi delta from 18 000 to 15 000 ha, has impacted negatively on wetland productivity and shrimp catches and has increased salt water intrusion inland (Chenge 2000). Smaller dams for urban water supply or farming activities can also seriously impact flow if their number is great enough. The riparian ecosystems of the ephemeral rivers of western Nambia are threatened by reduced flooding resulting from numerous farm dams in their upper catchments.

Box 17 Zambezi delta (Mozambique) (information from Chenge (2000) unless otherwise indicated)

The Zambezi Delta in Mozambique covers an area of 15 000 km^2. It begins 120 km from the sea at Mopeia and is tidal for the last 80 km. Elevated areas are formed by levees along the main Zambezi and minor tributaries and old channels, plus relict beaches. The Mozambique coastal plain consists of extensive grasslands, freshwater swamps, dunes and mangroves.

The delta supports a thriving shrimp fishery and crop farming, with an estimated annual net income of per household of US$77 per ha (Chenge 2000). The wetlands of the Zambezi Delta have been significantly impacted by the combined effect of the upstream dams, Cahora Bassa and Kariba. Water regulation has reduced the wetland area from 18 000 ha to the current 15 000 ha. This has impacted negatively on wetland productivity and shrimp catches and has resulted in increased salt-water intrusion due to lower flows and reduced flooding. The environmental impact of dams and flow regulation on the lower Zambezi and its delta had not been fully assessed at the time of writing (Chenge 2002).

The town of Tete lies upstream from the delta. It has been identified as one of the urban growth points that is impacting on the water quality of the Zambezi through increased raw sewage outflows. Other threats to the delta wetland ecosystems include development of sugar

Water abstraction has most impact on low flows. The Save river in Mozambique is severely impacted by water abstraction in Zimbabwe, being dry for long periods of time.

Drivers of Change in Water Quality

The quality of river water is impacted by pollution from upstream users, with faecal waste being the most serious for human health. An important service provided by the river ecosystem is to cleanse the water of organic and faecal materials. Wetlands further enhance this purification process. Thus, good river health engenders good human health. Not only does this improve the quality of water for those who depend directly on

the river, but it also reduces the cost of treatment of a reticulated supply.

For those who depend on river water for domestic use, the seasonal flow of water is an important consideration. In semi-arid or arid areas a perennial river whose source is the humid upland areas is clearly a crucial resource. Upstream developments that reduce the dry season flow have a negative impact on downstream users. In areas fed by seasonal or ephemeral rivers, an important dry season source of water is the riverbed itself. Wells dug into the riverbed or adjacent wetlands are used to extract water. Recharge of riverbed aquifers and wetlands often depend on flood flows. Upstream developments that reduce the magnitude and frequency of floods impact negatively on these recharge processes and therefore on dry season water supplies.

Since the 1970s an increasing number of large and small dams have reduced the frequency of moderate sized floods that are key drivers of ecosystem processes. A number of cases are cited indicating a reduction in the total wetland area (Linyata-Chobe and Zambezi Delta). This has had a negative effect on the provision of services by wetland ecosystems to the poor. It has also encouraged encroachment of settlement on to floodplains where people become vulnerable to the most extreme events that are not significantly impacted by dams (cf the 2000 floods). The rate of increase in large dams is beginning to decline due to the lack of suitable sites and the recent focus of water managers on water conservation measures rather than relying on increasing supply.

Lake Chad is an extreme example of the effects of damming, and decreasing rainfall, on water-based ecosystems. Lake Chad borders Chad, Niger, Nigeria and Cameroon. All four countries have conducted several large scale dam building projects over the last forty years, effectively cutting of the supply of fresh water to the Lake. These sources, diverted for use in urban and more densely populated areas, illustrate some of the tradeoffs involved in human water usage patterns. The combination of damming and decreased rainfall in the region has resulted in the lake shrinking to a tenth of it's original size. There has been a marked increase in availability of potable water in urban areas near the dams, but the Lake, and the people dependent on it for their livelihoods, has suffered irreparable damage, with an estimated nine million farmers, fishermen and livestock herders having lost their livelihoods base, and a very important Lake ecosystem having been all but destroyed.

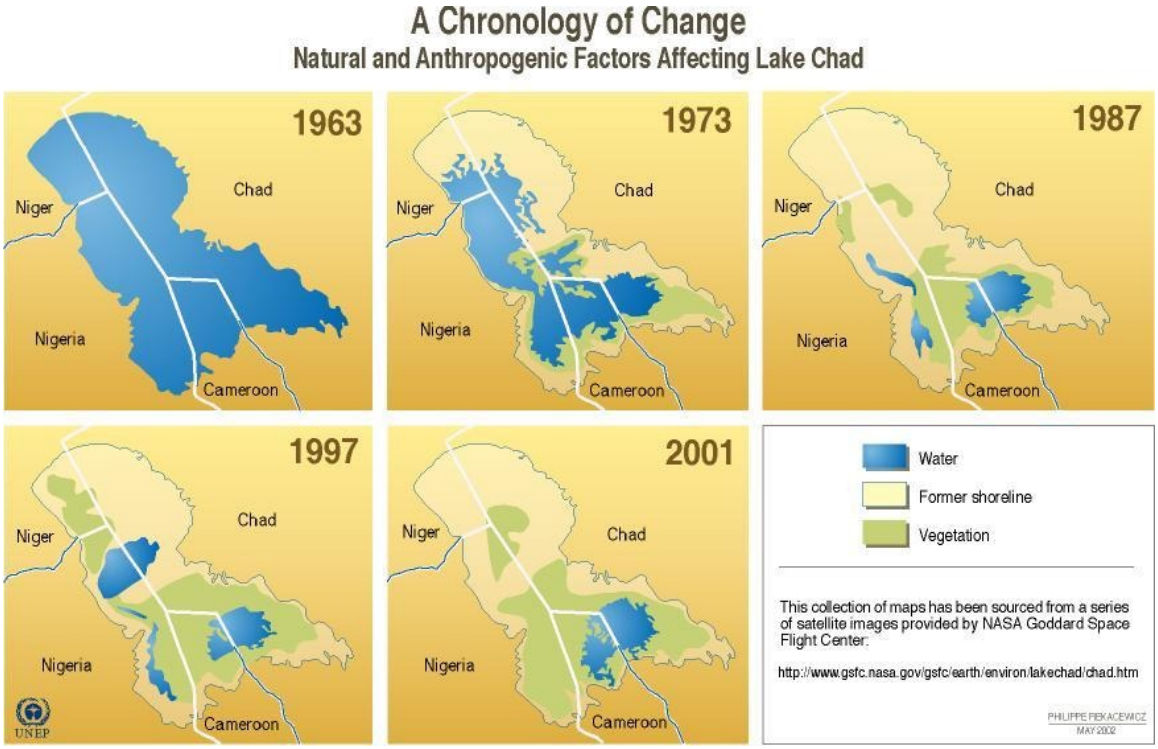

Figure 28: Natural and anthropogenic factors affecting Lake Chad

Water abstraction for agriculture continues to be the major user of water in all sub-Saharan African countries and is likely to continue to be so in the future. The increased demand for potable domestic water and water requirements for economic development will add to current water scarcity. This will lead to increased periods of low or no flow in dryland rivers as is already the case for the Save and Limpopo rivers. Poor communities relying on river flow for domestic water supply and food production will suffer. The impact of climate change is difficult to predict but is likely to exacerbate the above trends. Masundire & MacKay (2002) see pollution as the most critical factor affecting the sustainability of water resources in the region. They point to a serious downward trend in water quality that will impact all water users in the area, but especially the poor who do not have access to treated water supplies.

There are a variety of human activities that directly affect the quality and quantity of water, each of which are exacerbated by their likelihood of having to interact with other drivers in the dense Desakota areas, where mixed landuse practices often lead to several activities impacting directly on single water sources. Some of these activities, their potential impacts, and the ecosystems functions at risk are detailed in Figure 29.

Human Activity	Potential Impact	Function at Risk
Population and consumption growth	Increases water abstraction and acquisition of cultivated land through wetland drainage. Increases requirement for all other activities with consequent risks	Virtually all ecosystem functions including habitat, production and regulation functions
Infrastructure development (dams, dikes, levees, diversions)	Loss of integrity alters timing and quantity of river flows, water temperature, nutrient and sediment transport and thus delta replenishment, blocks fish migrations	Water quantity and quality, habitats, floodplain fertility, fisheries, delta economies
Land conversion eliminates key components of aquatic environment, loss of functions, integrity, habitat & biodiversity, alters runoff patterns, inhibits natural recharge, fills water bodies with silt	Natural flood control, habitats for fisheries and waterfowl, recreation, water supply, water quantity and quality	
Overharvesting and exploitation	Depletes living resources, ecosystem functions and biodiversity (groundwater depletion, fisheries collapse)	Food production, water supply, water quality and water quantity
Introduction of exotic species: outdoes competition of native species, alters production and nutrient cycling, loss of biodiversity	Food production, wildlife habitat, recreation	
Release of pollutants to land, air or water	Pollution of water bodies alters chemistry and ecology of rivers, lakes and wetlands. Greenhouse gas emissions produce dramatic changes in runoff and rainfall patterns	Water supply, habitat, water quality, food production. Climate change may also affect hydropower, dilution capacity, transport, flood control

Figure 29: Human Activities and their Potential Impacts on Water Quality and Quantity (African Water 2007)

3.6 Rural-Urban Water Linkages

Rural Urban Water Linkages

Few urban areas in Africa are located directly adjacent to large rivers, dams or lakes. Subsequently, most towns and cities depend on water from their rural hinterlands for their water uses. This relationship mirrors the larger relationship between rural ecosystem goods and services and urban requirements, with large amounts of fresh water being

transported landing up in urban 'nutrient sinks', with at best polluted and untreated water flowing back into rural basins, oceans, or lakes. However, urban water users are also at the mercy of rural water pollutants, particularly those – such as the peri-urban dwellers and the poor - that rely on untreated sources of urban water supplies.

Showers (2002) conducted a comprehensive survey of rural-urban water linkages in sub-Saharan Africa, examining longitudinally (1970 – 1990) sources of municipal water supplies, domestic and industrial water treatment and disposal processes and the dependence of urban electricity supplies on water. Due to the dearth of information on this topic, Showers presents the first comprehensive overview of water relationships between sub-Saharan African urban areas and the water-based ecosystems they depend on. The only other continent wide survey of groundwater was conducted in 1973 by the United Nations Department of Economic and Social Affairs. Drawing on published and grey literature, Showers illustrates the extent to which urban water sources depend on rural ecosystems, and the growing footprint of urban centers with regard to the variety of water sources being harvested for their use.

Figure 27 illustrates the rising numbers of rivers and ground water sources being used to feed urban water demands. It further illustrates the increasing reliance on water sources further away from the city, and the lack of recycling of water sources in many areas. This can be attributed to the extreme lack of water treatment facilities on the sub-continent, resulting in most water used in cities only being used once, and leaving the city untreated.

Water	**Selected Urban Areas**				**Self-Comparisons**			
	Early 1970s (sample: 70)		**1990s (sample: 67)**		**Early 1970s (sample: 38)**		**1990s (sample:38)**	
Ground Water								
Total users	51	73	36	54	22	58	18	47
Near only	48	93	28	78	21	95	14	78
Far only	1	2	4	11	1	5	1	6
Near and far	1	2	4	11	0	0	3	17
IBT	3	6	8	22	1	5	4	22
Incomplete data	2	3	10	15	0	0	0	0
Do not use	19	27	29	43	16	42	20	53
Rivers								
Total users	28	40	38	57	21	55	26	68
Incomplete data	2	7	0	0	0	0	1	4
Near	18	64	16	42	13	62	11	42
Far	7	25	13	34	6	29	9	35
Near and far	2	7	9	24	2	10	6	23
IBT	10	36	20	53	9	43	14	54
National	17	61	20	53	15	71	15	58
International	9	32	11	29	6	29	7	27
Nat. & international	0	0	7	18	0	0	4	15

Water	**Selected Urban Areas**				**Self-Comparisons**			
	Early 1970s (sample: 70)		**1990s (sample: 67)**		**Early 1970s (sample: 38)**		**1990s (sample:38)**	
Depend on 1 river	23	82	24	63	16	76	16	62
National	12	52	13	54	10	63	9	56
International	9	39	11	46	6	38	7	44
Depend on > 1 river	5	18	14	37	5	24	10	38
National only	5	100	7	50	5	100	6	60
Nat. and international	0	0	7	50	0	0	4	40
Do not use	33	47	25	37	15	39	12	32
Unknown river use	9	13	4	6	2	5	0	0
Groundwater + river (s)	9	13	7	18	5	13	6	16
Collection								
Total users	20	29	31	46	16	42	25	66
No data	16	23	18	27	9	24	3	8
Dam, reservoir	17	85	27	87	15	94	22	88
Desalination	3	15	3	10	1	6	3	12
Reuse, liquid	0	0	4	13	0	0	3	12
Reuse, solids	0	0	2	6	0	0	1	4
Do not use	34	49	18	27	13	34	10	26
Deficit	No data		24	49	No data		17	47

Figure 27: Rural – Urban Water Linkages in sub-Saharan Africa (Showers 2002)

The increased interdependence of rural and urban water systems has led to local changes in ecosystems and water quality having increasingly wide footprints. Previously more isolated systems localized the impacts of flow regime change and pollution on water-based ecosystems and users more further afield were less at risk. Increasing population densities and mixed landuse patterns are exposing an increasing number of people to risks associated with changes in water quality and quantity.

4. Water-based Ecosystems, Poverty and Desakota – Meso Level Links

4.1 Ecosystem Services and Desakota Livelihoods

Urban and Desakota systems deliver a range of goods and services to their residents. These are similar to those found in rural areas, but are more limited and include additional, secondary goods and services, such as waste. Figure 31 (Tacoli 2001) illustrates the four main categories of peri-urban ecosystem goods and services, namely land, water, biological resources and non-biological resources. While Desakota areas are not limited to the peri-urban fringe, peri-urban areas exhibit the same characteristics as Desakota areas, and thus can be used to give examples of the kinds of natural resources utilized in such areas. The figure provides examples of what such resources could include, and illustrates how they interact with each other.

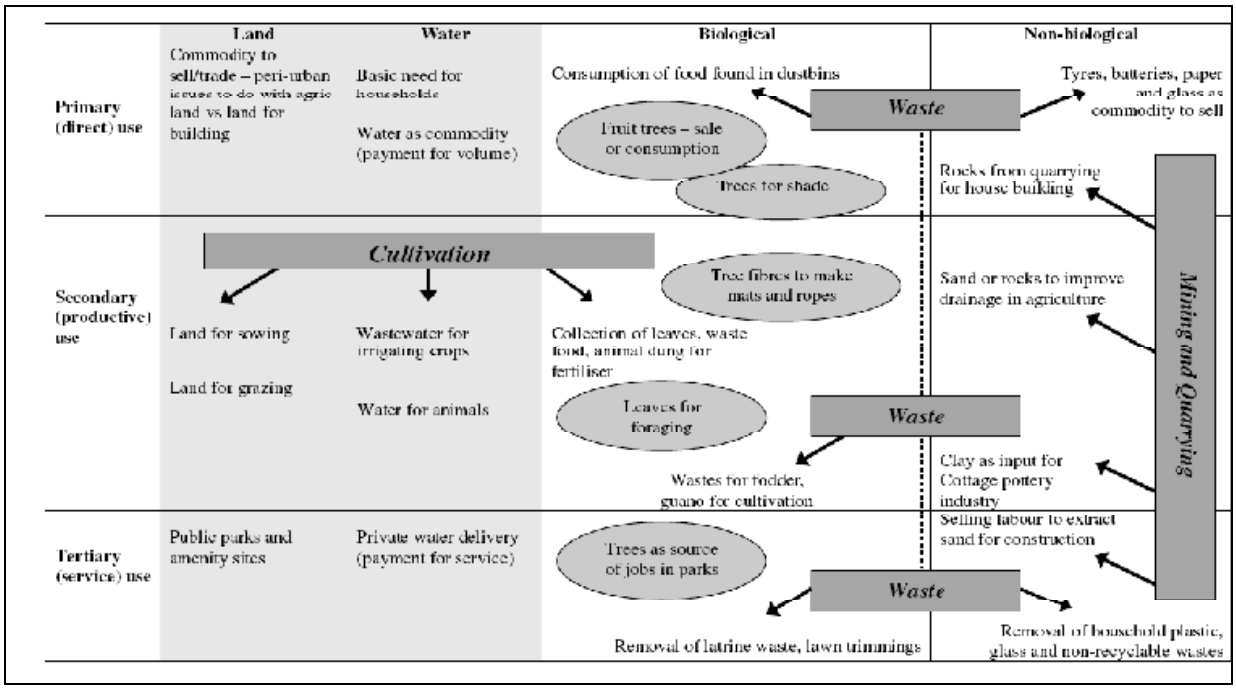

Figure 31: Peri-Urban Natural Resource Use Patterns (Tacoli 2002)

There are a variety of constraints that hinder people's ability to access ecosystem services and utilize other inputs such as skills, income and physical capital assets. These constraints range from broad constraints such as availability of services/resources; land tenure; policy obstacles; and access to appropriate technologies; to more specific barriers such as labour shortages, rural or urban context, and/or gender (see figure 32).

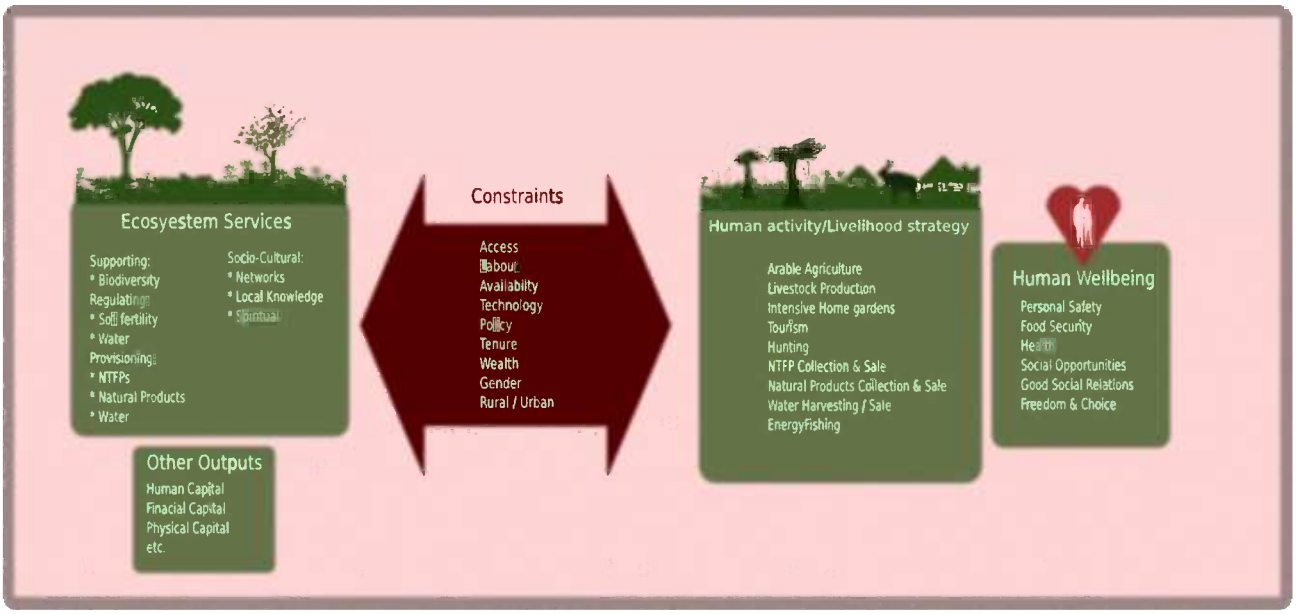

Figure 32: Ecosystems services, human activity and wellbeing: Considering constraints

Access to ecosystem services including those in common property, while affected by social barriers or exclusion, is primarily determined by the ability of a poor person to command the necessary labour and skills. The labour constraint has dominated West African production systems in the past. In densely populated areas (e.g., Kano), more family labour is available than in sparsely populated areas (Mortimore & Adams 1999), but is increasingly prone to absence on seasonal migration. Inequality is expressed in the ability of wealthier persons to command the labour of others, and poverty is summed up in the dilemma of having to work for others to the detriment of one's own capacity to harvest ecosystem services (Hill 1977).

The ability of ecosystem services to buffer the poor in times of difficulty, while visible and valued, is therefore constrained by land use change and by labour capacity. Trade-offs (e.g., loss of biodiversity when woodland is transformed into farmland) are the result of past actions taken in pursuit of livelihood objectives, often by those enjoying greater resources, and may operate against the interests of poor people (especially women) who switch to common pool resources when farming or livestock production cannot provide all their needs. Ownership of land and what is on it, security of tenure on common property, and availability of common resources, were attested to be critically important by the stakeholders. Thus, contributory factors are good social relations and (especially in Sudan) peace and stability.

Markets, a key feature of the Desakota, are not intrinsically either good or bad for the ecosystem. All depends on regulatory environments, investment incentives, and prices. Research initiatives are currently under way into market chains (Fr. *Filières*), which follows the logic of the West Africa Long Term Perspectives Study. Both in East and West Africa, positive linkages have been found between sustainable ecosystem management and markets, with stakeholders (when given voice at workshops attended by

government officials) adamant on their needs for better and cheaper market access (Tiffen et al., 1994; Mortimore and Tiffen, 2004). Yet development policy, until recently, has been overly concerned with supply side factors, and when markets were considered, they were usually export markets (Wiggins, 2002). West African markets, and the constraints they face, provide an example of some of the issues facing the effective utlization of ecosystem services in market related activities in Desakota areas:

- Rent-seeking practices by traders or agents of the state
- Poor quality control of commodities and livestock
- Little access to credit by producers or traders
- Poor rural transport and communications infrastructure
- Policy instability and inconsistency
- Fragmented market information
- Weak service delivery to producers
- Poorly developed institutions

The provision not only of ecosystem services but also of social and technical services may offer untried opportunities for the private sector.

Many services across categories are closely linked and interdependent, for example the provision of clean water depends on the water purification service provided by wetlands. Indeed, many provisioning services are highly influenced by the state of regulating services. The reverse is also true, in that overexploitation of ecosystem goods (provisioning services) can have negative impacts on the regulating services that maintain water, soil and air quality. This makes it difficult to discuss and assess the importance of any single service in isolation from others. Furthermore, because of the links that exist between services, actions directed at improving one service often have synergistic effects on other services, e.g. the protection of natural forests for biodiversity can also reduce carbon emissions and regulate water supply (MA 2005a).

In terms of making the conceptual link between ecosystem services and poverty (or well-being) more work has been done on provisioning services than any of the other categories. This is because provisioning services are more obvious in their role in assisting poor people meet their everyday needs for food, energy, shelter and income. Regulating, supporting and cultural services, on the other hand, are more indirect in their benefits and consequently have rarely been valued in terms of their contribution to society and to poverty reduction. Cultural services, in particular, are seldom considered, and were rarely mentioned during the in-country consultations process.

In relation to exploring the link between ecosystems and poverty in Desakota areas, almost no work has been done in the sub-Saharan Africa that explicitly explores these issues in relation to the social, economic and ecological factors affecting Desakota areas. Some work has been done on natural resources and poverty in peri-urban areas and some on the interrelationship between urban systems and their social and ecological interactions with their rural hinterlands, but the field remains largely unexplored. As noted in the report on ecosystem services and poverty alleviation in the Sahel (Mortimore 2008), ecosystem services are significantly affected by dense rural populations, markets

and cities, and very few natural landscapes survive without some degree of transformation. Simliarly, very few social landscapes remain unaltered in the face of increasing population density, mobility and globalization common to Desakota areas. The importance of understanding the particular manifestations of the relationships between poverty alleviation and ecosystem services is thus vitally important if the dynamic and changing contexts of the Desakota are to be properly understood and governed.

Because the poor are so reliant on ecosystem goods and services, any change in the supply of these services, or access to them, can have profound impacts on the sustainability of local livelihoods, vulnerability and human well-being. If the change is a decline in availability or access, then the impacts on livelihoods will be negative and could potentially force people deeper into poverty. Understanding what changes are occuring in ecosystem services, and thus being able to anticipate or respond to their effects on peoples livelihoods, is not a simple as it seems. There are numerous factors that underpin such an activity, including issues relating to scale of collection, which variables to monitor, over what duration, what ecosystem services, how to differentiate trend from background variability, how to deal with synergistic or cascading effects, and so on. These are challenges facing monitoring agencies world-wide, but are particularly pronounced in the peri-urban areas of sub-Saharan Africa, which are characterised by inherently high environmental variability and limited human and financial capacity.

4.2 The Importance of a Safe Water Supply for the Desakota Poor

While some progress has been made in recent years to provide access to safe water in Africa, the level of access still lacks significantly behind the rest of the world. The increasing scarcity of clean water is becoming an issue of serious concern in Africa. There is a fear that future regional conflicts may result from competition over water use. Partly owing to long spells of drought, Africa has less water today than in the 1970s (UNEP/OAU, 1991). For example, the Congo basin, which incorporates one of the largest river systems in the world, has seen a significant reduction in water resources. Associated with falling water supplies is the issue of water pollution. In rural areas and Desakota zones, the population draws water from unprotected sources, such as wells and rivers. Many of these sources have been exposed to serious pollutants from industry, the infiltration of agricultural chemicals and fertilizers, and raw sewage. It has been estimated that in most of Africa sewage is discharged untreated into surface waters. These are often sources of drinking water for downstream communities, making populations vulnerable to 'environ-mental' diseases like cholera, typhoid, diarrhea and dysentery. The limited access to health services further compounds the vulnerability of these communities. (African Development Bank 2007)

Because water is essential for life, the ecosystems associated with rivers and wetlands acquire special significance in sub-Saharan Africa's dryland areas, being green corridors in an otherwise arid landscape. Water ecosystems supply a range of services that are of value to people which Masundire & Mackay (2002) and Turpie & van Zyl (2002) list as follows:

- Water supply for household use, agriculture, industry and power generation.
- Dilution, transport and purification of biodegradable wastes.
- Harvesting of wild plants and wild animals including fish.
- Transport routes.
- Aesthetics, leisure and tourism.
- Cultural customs and spiritual values.
- Flood attenuation.
- Moderation of microclimate.
- Maintaining terrestrial ecosystems through groundwater recharge.

With specific reference to poverty, Hirji & Molapo (2002) show the importance of water (Figure 33).

Dimensions of poverty	**Examples of water and environmental linkages**
Income and consumption	Access to water for productive use. Access to natural resources, sustainable growth
Inequality and equity	Secure tenure and access to natural resources, water rights and entitlements
Sustainable livelihoods	Sustainable land and water practices
Health	Water quality, safe drinking water and sanitation. Protection against water borne disease
Security and vulnerability	Improved disaster preparedness and response, water harvesting and conservation
Inclusion and empowerment	Participation, devolution of ownership. Right and responsibilities to water users, community groups, basin organizations, local governments

Figure 33: Linkages between water, environment and poverty. (Hirji & Molapo 2002)

Fresh water is the most obvious provisioning service provided by rivers and wetlands. Water is essential for domestic purposes (drinking, cooking and personal hygiene) and for watering crops and livestock, as well as a range of other productive activities. Water is thus important for maintaining health and for supporting livelihoods. When water supply and sanitation is improved, there is a direct reduction in susceptibility to the severity of HIV/Aids and other major diseases (UNESCO 2006). In urban areas water is also used by industry and for power generation.

In urban and more developed communities treated water for household use is normally delivered via a reticulated system either to the house or to a nearby standpipe. Water for irrigated agriculture is delivered to fields via a sophisticated infrastructure that may

include pumps, canals and off-channel storage dams. Whether water is for household use or irrigation, the reliability of supply is enhanced by the construction of storage dams, sometimes linked to inter-basin transfer schemes and other engineered structures.

The poor are most likely to belong to those communities that do not have developed household supplies and are excluded on economic grounds from being able to afford the necessary infrastructure for a formal irrigation scheme. They therefore depend more directly on the natural water sources for domestic water supply, flood irrigation and other productive uses. The quality and quantity of water in the river/wetland is therefore of great importance for the well-being of poor communities.

Water must be understood as both a productive, and a reproductive asset essential to the livelihoods of all, but particularly important to the peri-urban poor, who have limited access to water sources, and have been marginalized from formal water distribution systems in rural and urban areas. Due to the rapid growth of African town and cities, which outstripped their infrastructural development, the peri-urban poor seldom, if ever, have basic water infrastructure in or near their homes or places of work. Unlike urban or rural residents who have more structured water supplies, they are forced to rely on multiple water sources to meet their basic water needs. These sources include both formalized, municipally supplied water (through taps, wells or boreholes), water harvested from roofs and streets, waste water, and water collected from unprotected 'natural' water sources, such as rivers, dams and springs.

The peri-urban poor are doubly excluded from formal water supplies, through lack of infrastructure and a lack of cash. Living in spatially marginalized 'fringe' areas, on undemarcated land, often illegally, leaves them particularly vulnerable to unusually high opportunity and labour costs in accessing water; health and safety costs related to the quality of the water accessed; unreliability of water sources; and in some instances, high cash costs if they have to buy water from informal water vendors.

Slaymaker (2002), illustrates that the water concerns of the poor have to date predominantly been addressed through a health focused lens, advocating for safe water supplies. This has led to a barrage of health and sanitation based water interventions across the sub-continent, which, despite some successes, have still to dent the extreme lack of clean water and sanitation available to the poor.

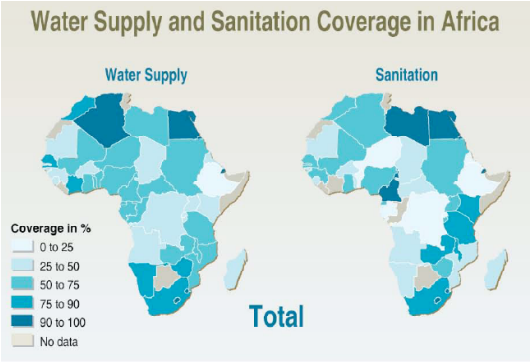

Figure 34: Water Supply and Sanitation in Africa (REF)

Figure 34 illustrates a generalized picture of the dearth of water supply and sanitation coverage in Africa. Darker blue shades found in countries like South Africa which have some infrastructure indicate 75 –100 % coverage, but the light blue shades across the majority of the continent show only 0 – 60% of the continent having access to proper water infrastructure.

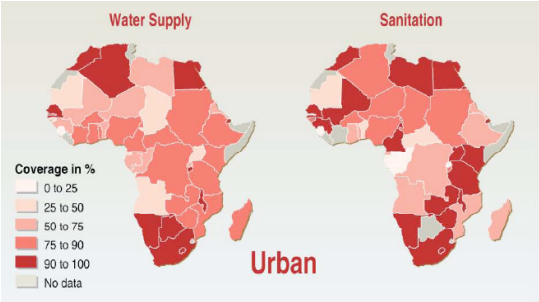

Figure 35: Urban Water Supply and Sanitation (REF)

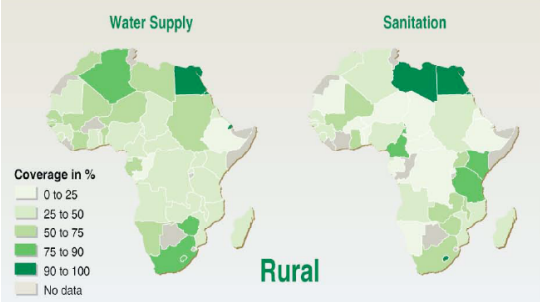

Figure 36: Rural Water Supply and Sanitation (REF)

The generalized trends in Figure 34 are, however, somewhat misleading, as they mask the diversity within countries. Figures 35 and 36 attempt to illustrate the differences between rural and urban areas, illustrating that the coverage rates in Figure 34 may have been skewed by higher portions of urban infrastructure. Even in countries like South Africa, who exhibited high rates of coverage, rural coverage is below 60%, and even this is something of an over estimate. Differences within and between urban areas are also not properly reflected, masking the high inequality in access to water and sanitation services across the continent. Nevertheless, they portray the general trends, and highlight the need for a continued focus on these basic services.

Whilst this is an important aspect of water concerns for the poor, still largely ignored, and of equal importance, is the productive role of water in the livelihood strategies of the poor, and the direct impact of restricted access to, and poor quality of water, on people's ability to lead economically productive lives. Safe and secure access to water for productive uses would decrease labour, opportunity and financial costs, freeing up capital and labour to be invested in more productive activities.

Many Desakota livelihood activities that have been noted as being significant across the sub-continent rely directly on access to water, and water based ecosystem services. Peri-urban agriculture and livestock farming, natural resource harvesting activities (fishing, fuelwood, wildfoods, etc), as well as a host of small businesses, depend on water and are directly affected by the labour and opportunity costs incurred in efforts to access safe and reliable water sources. In sum, access to water is a crucial determinant of livelihood security, analysis of the dynamics between water and livelihoods guides interventions on how to place water in the hierarchy of livelihood needs of various target groups (Slaymaker 2002).

The poor are the hardest hit by these costs, and amongst them women and girls are particularly vulnerable. Despite the diversity of cultures and peoples across the sub-continent, water collection is traditionally a female activity. Women and girls bear the brunt of reproductive and productive water collection, and spend a disproportionate amount of time and energy collecting water. This directly affects their ability to participate in educational, wage earning and productive activities, as well as the amount of time available for childcare and other domestic activities. Women and girls are also

particularly vulnerable to opportunistic crime associated with water collection, as they often have to walk long distances unaccompanied at all times of the day and night (Joshi 2002, Cleaver & Elson 1995).

There are numerous benefits that poor people living on urban fringes derive from water based ecosystem services. In an effort to highlight some of the complex relationships between these services and poverty alleviation, the relationships between water based ecosystem services and food security, fuelwood and disease will be looked at in more detail. The importance of water based ecosystem goods and services are by no means limited to these three categories of use, but they do stand out as being of particular importance to the livelihoods, and thus poverty reduction, of the peri-urban poor.

4.3 Desakota Water-based Ecosystem Services and Food Security

Food security may be defined as "access by all people at all times to the food needed for a healthy life" (FAO 1997). In order to achieve this, the Food and Agricultural Organization outline the following three basic aims for countries to achieve:

(a) Ensure adequacy of food supplies in terms of quantity, quality and variety of food;
(b) Optimize stability in the flow of supplies;
(c) Secure sustainable access to available supplies by all who need them.

Throughout most of the arid and semi-arid regions of the sub-continent rainfall is inadequate and unreliable for widespread agriculture. Consequently, large-scale agricultural production is confined to moister regions, or is supported via irrigation water. This may be for crop farming or to provide fodder for livestock. Despite the fact that agriculture is the main user of water across the sub-continent, only South Africa comes near to developing its full irrigation potential. Also telling is the high prevalence of undernourished people in all countries but South Africa. The FAO strongly promote irrigation as the way forward to reduce malnourishment.

Resource poor farmers may not be able to afford access to irrigation infrastructure, or may have been excluded from irrigation schemes for political reasons. These farmers often have to rely on the natural flow of the river for irrigation, depending on seasonal flooding. Floods not only bring water, but they also supply nutrient rich sediments, reducing the needs for inorganic fertiliser. In some countries and districts flood irrigation and cultivation of wet-lands is more prevalent than equipped irrigation, for example, Botswana. Cultivation of wetlands is widespread in Zimbabwe. Headwater wetlands known as dambos are important areas of smallholder cultivation in the upper Zambezi basin.

Formal irrigation is not the only form of water harvesting practices in farming, and informal irrigation, particularly in urban and peri-urban areas where rainwater and waste water are harvested, contribute significantly to the percentage of water harvested.

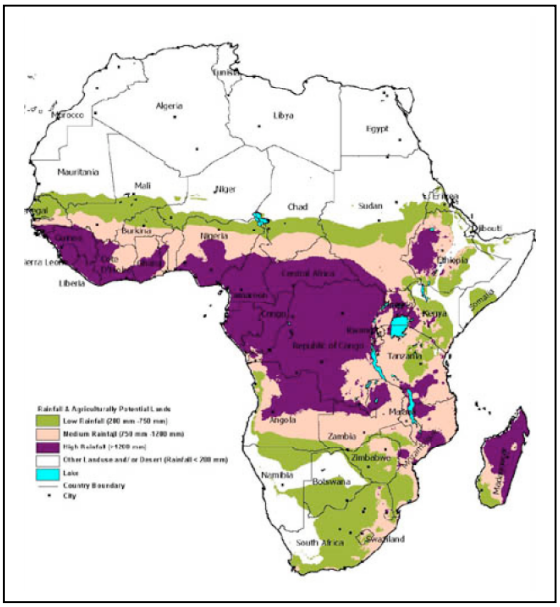

Figure 37: African Development Domains for Rainwater Harvesting

Informal irrigation in Ghana, for example, covers an area greater that the areas under formal irrigation in the whole country (Dreschel et al 2007). Water access issues in peri-urban areas, informal irrigation can include anything from collecting water in watering cans, to harvesting roof and street runoff and diverting it to fields or pastures located on roadsides and amongst buildings. Accessing clean water is increasingly difficult, particularly in areas located downstream of cities or industries, and many farmers are forced to rely on polluted water sources and runoff. The health risks of waste water irrigation are significant, and severely impact the benefits gained from the increased food security of peri-urban agriculture.

Location	**Farming system**	**Typical farm size (ha)**	**Net revenue (US$) per farm holding per year**
Rural/Peri-urban	Rain-fed maize or maize/ cassava	0.5 – 0.9	200 – 450
Peri-urban	Dry-season vegetable irrigation only (garden eggs, pepper, okro,cabbage)	0.4 – 0.6	140 – 170
Peri-urban	Rain-fed combined with dry season, irrigated vegetables	0.7 – 1.3	300 – 500
Urban	Year-round irrigated vegetable farmig (lettuce, cabbage, spring onion)	0.05 – 0.2	400 – 800

Figure 38: Comparison of revenue generated in rainfed and irrigated farming systems (Cofie & Dreschel 2002)

As shown in Figure 38, the benefits to farmers of irrigation far outweigh the costs, which are less immediate and not always so obvious. Farmers that irrigate year-round can double their income compared to relying solely on rain-fed agriculture.

Farmers themselves are not the only people to benefit from peri-urban agriculture, and there is a fast growing informal market which sells produce – either as primary produce, or in the form of street food. Most urban agriculture of any scale, usually target highly perishable fast food vegetable markets, as they command a high price and a steady demand. The sale of fruit and vegetables, unlike farming, is dominated by women.

Country	City	Female (%)	Male (%)
Benin	Cotonou	25	75
Burkina Faso	Ouagadougou	38 (0-72)	62
Cameroon	Yaounde	16	84
Cote d'Ivoire	Abidjan, Bouake	5-40	60-95
Gambia	Banjul	90	10
Ghana	Accra, Kumasi, Takoradi, Tamale	10-20	80-90
Guinea	Conakry, Timbi-Madina	70	30
Mali	Bamako	24	76
Mauritania	Nouakchott	15	85
Nigeria	Lagos, Ibadan	5-25	75-95
Senegal	Dakar	5-30	70-95
Sierra Leone	Free Town	80-90	10-20
Togo	Tsevie, Lome	20-30	70-80

Figure 39: Gender Ratio in Open Space Farming in West African Cities (Dreschel et al 2002)

In West Africa, there are an estimated 20 million people participating in different forms of urban and peri-urban agriculture. More than half of perishable vegetables consumed within cities are produced in peri-urban areas (Dreschel et al 2006). Whilst illustrating the extreme importance of peri-urban agriculture to livelihoods and food security, these figures also indicate the number of people at risk from the use of wastewater for irrigation. This issue not only affects the people involved in, and drawing on, peri-urban agriculture, but also the policy context in which it is viewed. As yet governments and city officials are still largely against this kind of agriculture, because of the risks involved and it's highly unregulated nature.

City	Net monthly income / farm (US$)	GNI per capita (US$ / month)
Accra	40 – 57	27
Bamako	10 – 300	24
Bangui	n.d. – 320	22
Banjul	30 – n.d.	26
Bissau	24	12
Brazzaville	80 – 270	53
Cotonou	50 – 110	36
Dakar	40 – 250	46
Dar Es Salaam	60	24
Free Town	10 – 50	13
Kumasi	35 – 160	27

City	Net monthly income / farm (US$)	GNI per capita (US$ / month)
Lagos	53 – 120	27
Lome	30 – 300	26
Nairobi	10 – 163	33
Niamey	40	17
Ouagadougou	15 – 90	25
Takoradi	10 -30	27
Yaounde	34 - 67	53

Figure 39: Monthly net income from irrigated mixed vegetable farming in West and East Africa (US$ per actual farm size) (Dreschel et al 2006:18)

Flood recession irrigation depends on seasonal inundation of the flood plains adjacent to the river. Flow regulation by upstream dams often inhibits regular flooding and, while it expedites formal irrigation, it has a negative impact on those farmers who rely on floods for irrigation of crops and pasture. Formal irrigation schemes also tend to be fixed in location, giving rise to tensions between crop farmers who are part of schemes and pastoralists who rely on dry season grazing on flooded areas.

Farmed ecosystems are thus at the epicentre of a nexus between population increases and the diverse range of food producing strategies in rapidly urbanizing areas. These strategies are dependent on water-based ecosystem services, and the ability of small scale producers to lift themselves out of poverty is directly proportional to their degree of access to a safe and steady supply of water. In Desakota areas, where producers are competing with industries and residents for access to, and impact on, local water sources, food producers are increasingly vulnerable. Market demands, which are driving producers to search for higher value products that can valorise investments in increasingly scarce land, are also affecting the ability of people to use peri-urban agriculture as a means of poverty alleviation.

4.4 Desakota Water-based Ecosystem Services and the Fuelwood Economy

Close to five million hectares of natural forest were claimed by deforestation in sub-Saharan Africa between the period 1981 to 1990. It has been estimated that the annual deforestation rate has risen from 0.5 per cent in the 1970s to 0.8 per cent in the 1980s and 0.9 per cent in the 1990s, averaging out at roughly four million hectares of forest per year (FAO 1986, 1993, 2004). This has had a significant effect on Africa's remaining virgin forests (African Development Bank 2007). Given that few African countries have vibrant timber trades, and that the majority of households rely heavily on fuelwood (Lufumpa 1995), the fuelwood economy is the most important direct driver of deforestation on the sub-continent (African Development Bank 2007). Land use change, and in particular clearing land for agriculture and settlement, are also important factors driving deforestation.

There are marked differences across the countries and ecoregions with respect to fuelwood supply and demand, and hence their role as a safety net for the poor. In the deserts and dwarf shrublands, relatively little fuelwood is produced. Consequently, local communities and individual households (i) consume less fuelwood, (ii) rely more heavily

on what would be deemed as poorer quality biomass resources such as twigs, dung and dwarf shrubs, and (iii) collect and transport wood from key resource areas such as wooded riparian fringes (Solomon 2000). Such strategies will suffice for the short-term because human population densities are relatively low. However, as they increase, the communities in the arid regions will be vulnerable to increasing energy insecurity and the attendant affects on poverty and well-being. The overall trend in the capacity of the arid ecoregion ecosystems to provide the existing low supplies of fuelwood in less densly populated areas is stable, but there are areas, particularly those near or adjacent to urban areas, where it is declining.

The higher rainfall of the savanna ecoregion results in higher densities and biomass of trees. Where human population densities and land transformation are low, there are usually adequate stocks of trees such that local communities can harvest deadwood with no impact on the productive capacity. But where human populations increase, along with land transformation for agriculture, then the productive capacity of the tree component declines, and households may resort to cutting live wood. If this progressively worsens then energy insecurity deepens, and is only ameliorated by one of more of the coping responses exacerbating poverty. The savanna ecoregion as a whole provides an excess of fuelwood, which is frequently exploited by local entrepreneurs to supply urban markets with fuelwood. However, there are many localised areas and communities where demand exceeds supply, which contributes to declining woodland exacerbating loss of other goods and services, such the provision of wild fruits, carbon sequestration, erosion control, and ecotourism potential. Conversely, there are areas where tree abundance is increasing via the process known as bush-encroachment. This includes alien and indigenous tree and shrub species. Reasons for encroachment of indigenous species are widely debated, including climate change, poor rangeland management, or stochastic interactions of a number of factors including drought and soil nutrient status (Ward 2005). These areas of local enrichment of woody resources are useful supplies of fuelwood, and local communities can become dependent on alien or indigenous encroaching species. However, this frequently comes with trade-offs such as loss of land for grazing, loss of biodiversity and if in riparian areas, reduced water availability (Shackleton *et al*. 2007a).

Deforestation is at it's worst in peri-urban areas, where trees are cut down to supply the burgeoning fuelwood economy in the surrounding urban areas. The use of these forests is largely unregulated, and trees are usually cut down without replacement, often before they mature. The extreme lack of electricity infrastructure, and the high costs of other fuel alternatives such as paraffin, mean that most of the urban, peri-urban and rural poor on the sub-continent rely on fuelwood for their cooking, heating and lighting needs. The World Resources Institute (2005) estimate that only 24 percent of the African population have access to electricity. Of this, the poorer countries, and the poor in general, comprise a disproportionate number of those living without electricity, or other fuel alternatives. Figure X illustrates the relationship between GDP and access to electricity in some southern African countries, while figure Y illustrates how the poor are disproportionately dependent on fuelwood, drawing on an example of fuelwood use in and around Maputo, Mozambique.

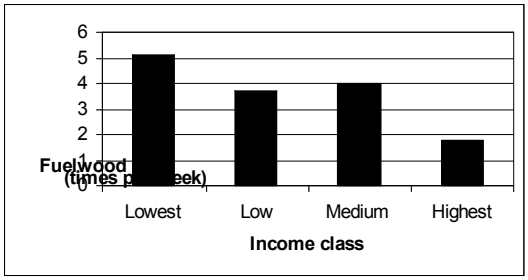

Figure 40: Frequency of use of fuelwood per income class in Maputo city (Brouwer & Falcão 2004)

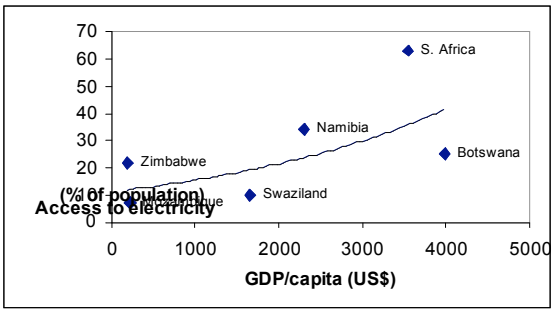

Figure 41: Increasing access to electricity with GDP for the six arid and semi-arid countries in southern Africa (ISES 1999)

In Mozambique, and to a lesser extent in Zimbabwe, the harvested fuelwood resource is first transformed into charcoal before being used or sold. Amounts of fuelwood or charcoal used per household depends upon the local context in terms of local fuelwood availability, price and availability of alternative energy sources, household income, cultural preferences and taboos, but ranges from less than 1.5 tons per year to over 8 tons per year. The dynamic nature of many of these attributes means that modeling fuelwood demand and scarcity is problematic. At both sub-continental (e.g. SAfMA 2005) and local (e.g. Shackleton 1994, Banks *et al*. 1996) scales various modelling approaches have identified widespread areas with acute shortages of fuelwood juxtaposed with areas of seemingly adequate or plentiful supplies. Even in electrified villages and urban areas, use of fuelwood remains prevalent a decade or more after electrification (Campbell *et al*. 2003, Madubansi & Shackleton 2006).

Globalization and Fuelwood – The Chinese in Mozambique

"The Chinese are a really big problem for forestry in Mozambique, because they have cash and they pay straight away, in contrast to the government who will try to conscientise you to conserve, etc. The Chinese will go to local communities and say 'we have this amount of money and we will give it to you tomorrow. All you have to do is pile up 100 logs next to the road.' So it's a very big problem and it is not easy to get rid of the Chinese because they are strategically linked up very high, have agreements with the government, have built a big conference centre. But there is also the unofficial side to the Chinese business ... they know the weaknesses of the politicians here, they are good at establishing joint venture businesses with politicians. It becomes complicated because when a forest guard finds someone out there not abiding by the rules, it will be the politician calling you to tell you not to interfere. If we could be stronger and control them, we could get much bigger benefits out of them. But we are happy with the peanuts they give us."

Globalization is also taking it's toll on fuelwood supplies and deforestation, with strong external

actors, with available capital and high resource needs, such as China, putting additional pressure on local forests. This pressure not only impacts deforestation, but the local informal fuelwood economy, and attempts to regularize and constrain fuelwood consumption patterns. The following quote from an in-country consultation in Mozambique, provides an example of this:

At a macro-scale the links between poverty and use of fuelwood are clear, with a strong relationship between increasing GDP and access to electricity (Fig. 41). Access to adequate energy supplies and security of supplies underpins many aspects of development and the MDGs. Fuelwood is a poor country's fuel.

At a local level, because fuelwood is a poor person's fuel, insufficient access to adequate fuelwood supplies has been shown to disadvantage the poor in a number of ways - thereby exacerbating poverty:

- Increased walking distance to find supplies which results in increasing opportunity costs, especially for women, (e.g. Brouwer *et al*. 1997, Madubansi & Shackleton 2007), and risk of attack whilst collecting in the wilds (Shackleton *et al*. 2007a).
- Increasing use of poor quality species, meaning more fuelwood has to be collected to generate sufficient energy (Solomon 2000, Madubansi & Shackleton 2007).
- Use of species that may be traditionally protected or culturally taboo (Madubansi & Shackleton 2007).
- Increasing use of substitute energies such as dung, dwarf shrubs and crop residues (e.g. Shackleton & Gambiza in press).
- Reduced cooking time for meals, or fewer cooked meals per day, undermining nutritional status, and consequently jeopardising health (e.g. Brouwer *et al*. 1997).
- Purchase of what has been usually been regarded as a free resource, thereby reducing already limited cash resources. The corollary of this is that harvesting and marketing of fuelwood is an important livelihood option for the poor, with most sellers of fuelwood being poor households rather than more well-off ones (Table 14; Shackleton *et al*. 2006).
- Swapping to commercial fuels, impacting scarce cash resources.
- Progressive reduction of vegetative cover in the landscape, potentially contributing to environmental decline, depending on overall management and governance of the harvested areas.

4.5 Desakota Water-based Ecosystems and Health

Water quality and availability play an important role in diseases prevention and care in Desakota areas. Waterborne diseases continue to cause millions of death each year, and remain one of the most serious threats posed by untreated water sources. Lack of proper water supply and treatment infrastructure are reported by the World Health Organization as being closely linke to 70 percent of disease episodes in the developing world. Millions

of children continue to die unnecessarily from gastro-intestinal diseases, while lack of clean water and hygiene exacerbate the symptoms of numerous other diseases, in some cases leading directly to death. Contaminated drinking water serves as a major source of infectious diseases, and a host of water-borne diseases such as cholera, typhoid and dysentery are still common in sub-Saharan Africa, particularly in overcrowded informal residential areas which have little or no water and sanitation infrastructure. The three most important diseases affecting the sub-continent, which have particular relevance for water-based ecosystems and poverty in Desakota areas, are Malaria, Diarrhoea and HIV/Aids. The spread of Malaria and Diarrhoea are directly related to poor water quality, while the spread of HIV/Aids is not caused by poor water quality, but is exacerbated by the poor living conditions associated with the lack of clean water supplies.

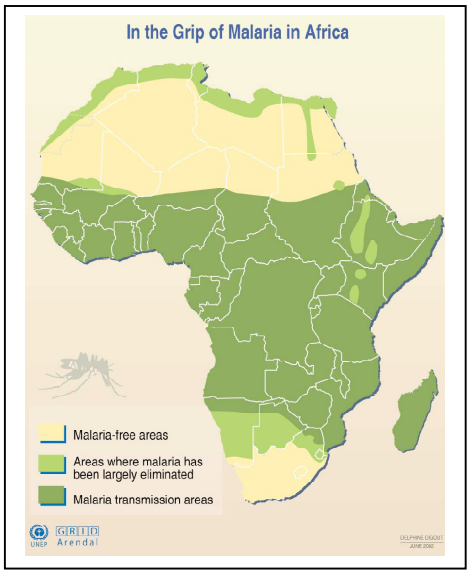

Figure 42: Malaria in Africa
(Platt Migin 2002)

Vector-borne diseases such as Malaria are cited by the World Health Organization as being the most sensitive to changes in climatic and environmental conditions, as they are directly affected by changes in water quality. Globally, Malaria affects over 500 million people in 90 different countries, and causes between 1.5 and 2.7 million deaths a year (Africa Water 2007). The distribution of the disease in Africa is illustrated in Figure 42, indicating the extreme threat it still poses to the continent.

Devereux and Maxwell (2001) provide evidence that sub-Saharan Africa has some of the highest populations of people facing chronic food insecurity as well as persistent threats of famine. So too is the region plagued by the highest HIV/AIDS prevalence in the world (UNAIDS/WHO, 2006). While we are beginning to understand that HIV/AIDS is affecting households as yet another shock event that jeopardizes household food security, Baylies (2002) claims that HIV/AIDS is a "shock like no other", because its systematic impacts disrupt all aspects of rural livelihoods (Haddad and Gillespie, 2001; de Waal and Tumushabe, 2003; Drimie, 2004).The long term costs of selling or compromising valuable household assets and indebtedness to cope with current difficulties induced by HIV/AIDS are often not considered (de Waal and Tumushabe, 2003). With the weakening of household investments through the various impacts of HIV/AIDS and thus a reduction of necessary household assets, family members find it more difficult to meet their daily basic livelihood requirements. The afflicted households weaken even further, through the demoralizing and disempowering psychological effects felt by household members witnessing the illness and death of loved ones as well as observing the erosion

of assets and livelihoods within their home (Rugalema, 2000; Baylies, 2002; Beisel, 2002; de Waal and Tumishabe, 2003; de Waal and Whiteside, 2003; Drimie, 2004). Productivity is reduced, with the loss of key skilled individuals and with them is lost valuable knowledge, thus breaking down the transfer of knowledge between user groups and generations (Mutangadura et al., 1999; IFAD, 2001; de Waal and Tumishabe, 2003; Harvey, 2003; Drimie, 2004). Woman and children are the most vulnerable demographic, and are left to adopt old or develop new responses to cope with these severe changes (Save the children UK and Oxfam, 2002). Therefore, within the context of HIV/AIDS, households have a variety of responses to the loss of skills, reduction in labour and diminished food quality and quantity. These range from reducing meal portions to relocating household members to extended families; often these members are children (de Waal and Tumushabe, 2003).

While we are beginning to understand some of the complexities HIV/AIDS is playing in weakening households and livelihoods, there are more present and short-term demands placed on individuals as food becomes more difficult to access. The most significant of these is reduced nutrition, in the form of micronutrient (iron, zinc and vitamins) and protein-energy deficiencies (Barnett and Whiteside, 2002). HIV/AIDS places heavy demands on the micro and macro nutritional requirements of infected individuals. Improved nutrition decreases the risk of primary infection and prevents secondary infection (Friss, 1998; Gillespie et al., 2001; Vorster et al., 2004), and afflicted individuals have an increase in protein requirements of up to 50 %, as well as a 15 % increase in energy requirements (Friss, 1998; Piwoz and Preble, 2002). Infected individuals also have greater water requirements than non-infected individuals (Piwoz and Preble, 2002). Barnett and Whiteside (2002) argue that in much of the HIV/AIDS interventions within rural areas, the value of nutrition has been overlooked.

Despite this dire picture, livelihoods are resilient, and diversification is often evident as a strategy for decreasing risk and coping with hardship (Bryceson, 2002; Campbell et al., 2002). Typically people engage in a range of livelihood activities such as arable agriculture, migrant labour, remittances, livestock husbandry and the collection of wild resources. The latter is potentially of increased importance in AIDS-effected households. It is well appreciated that surrounding ecosystems provide a variety of natural products for local people, including fuel wood, medicines, timber, and importantly, a source of nutritious food (Barany, 2003, Frison et al., 2005; Shackleton and Shackleton, 2004a; 2006). A diverse body of literature has highlighted the wide utility of wild foods from natural areas, including fruits, herbs, honey, mushrooms, fish, birds, small mammals, reptiles and insects which may be important in jeopardised food security (High and Shackleton 2000; FAO, 2002; Manika and Trivedi, 2002; de Merode et al., 2004; Lowassa et al., 2004; Swallow et al., 2004; Takasaki et al., 2004; Barany et al., 2005).

A case study of HIV/Aids and household water use in Ngamiland, Botswana (Ngwenya & Kgathi 2006) illustrates some of the direct effects of access to water on people's abilities to cope with the side effects of HIV/Aids.

The majority of households (73 %) in Ngamiland have access to piped water from community standpipes. However, water supply can be erratic, leaving households without

piped water for several days. Reasons for the failure of supply include, amongst others, breakdown of the pump, as well as "high absenteeism from work by the water officials due to HIV/AIDS related illnesses and attendance at funerals". The two most common coping strategies to deal with interrupted waters supplies are to (i) use less water and (ii) collect water from nearby dams or streams. The unreliability of supply compromises local livelihoods – 66 % of households complained of the inconvenience.

This unreliability has other impacts, especially in view of the high incidence of HIV/AIDS in the region ($\pm$ 35 % of pregnant females presenting at clinics are HIV+; overall prevalence in the adult population is $\pm$ 15 %). Mean daily consumption rates of water are 30 l person. However, in households with AIDS sufferers, the amount of water required increases by 67 – 165 %. Consequently, households with AIDS sufferers experience severe and potentially life-threatening difficulties when the water supply is interrupted. Firstly, the use of water from dams or rivers potentially makes the AIDS patient more vulnerable to opportunistic infections derived from water-borne micro-organisms. Secondly, the inability to bath the patient increases their discomfort. Thirdly, the inability to wash soiled clothes presents unhygienic conditions in the household. Lastly, family care givers face social sanction and exclusion for not looking after patients properly when they fail to bath them regularly or wash their clothes. The majority (96 %) of care givers stated that the unreliability of water supply increased the burden of caring for AIDS sufferers.

5. Conclusions and Possible Research Questions

This review has illustrated that the role of ecosystem services in poverty alleviation differs according to the degree to which a household is dependent on ecosystem services for their basic livelihood strategy; and the opportunities for ecosystem services to offer alternative/diversified livelihood strategies to complement existing ones, or generate cash income. These relationships are complicated by markets, political context, access to resources, land tenure; and the availability of labour, knowledge, skills, technology and capacity. They are also affected by extreme event, such as floods, droughts and political collapse.

Key determinants of the degree to which households find themselves dependent on ecosystem services, are where household members find themselves on the Desakota continuum from rural to urban, and on the wealth continuum from rich to poor. Whilst these are not linear dichotomies bearing polar opposites, thinking of them as continuum's allows the notion of gradual and varied degrees of influence of either end of the spectrum to be expressed. These continuums affect peoples ability to access alternative goods and services, the technology required to harness goods and services, the infrastructure available to facilitate the integration of ecosystem goods and services into markets, the ability to diversify their livelihoods, and the availability of both waged and communal labour pools.

It is important to understand where, and how, people locate themselves along the rural – urban continuum, and to take note that this is seldom a static, or unidirectional process. Increasingly people move between rural and urban areas to buffer against negative environmental or economic processes, and to diversify their livelihood strategies to buffer themselves against vulnerability. Ecosystem goods and services, as well as economic and socio-cultural goods and services, also circulate along this continuum (Figure 43). The general trend is that ecosystem goods and services generated in rural areas feed into urban economies, while urban cash remittances feed into rural households and urban waste feeds into rural ecosystems; but the degree to which this flow is unidirectional depends largely on the context. In stable urban economies with high rates of migrant labour, such as in South Africa, there is a clear flow of labour, food, raw materials, crafts and water from rural areas into urban centers, with few ecosystem services found in urban areas flowing out to meet rural needs. In this same scenario, cash earned in urban economies circulates back to rural areas in the form of remittances. However, this cash is seldom invested in the rural primary products economy, and is predominantly used to purchase commodity goods produced in urban, industrialized centers, circulating the cash directly back into the urban economy (Reynolds 2007).

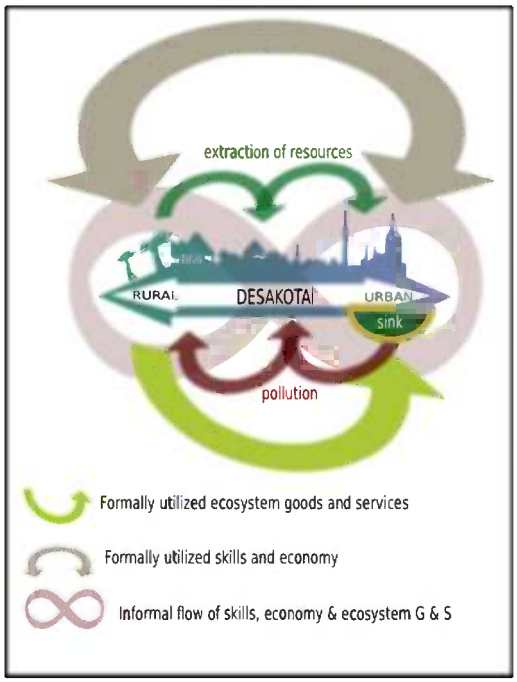

Figure 43: The movement of people, ecosystem goods and services and waste along the Desakota continuum

There is, however, an increasing role for ecosystem goods and services produced in urban and peri-urban areas, particularly in West Africa, for example, where cities are starting to generate more and more of their own food supplies through urban agriculture (see Chapter 4.3). In instances, such as in Ghana, where food and other ecosystem services are harvested or produced within urban boundaries, these are generally consumed by urban dwellers and not fed back into rural areas. Urban developed commodity goods, however, do find their way back to rural markets, but most raw produce is consumed within urban and peri-urban areas.

Rural needs to earn non-farm incomes are also driving urban labour markets. This cash, if fed back into the rural economy, is often the main source of investment in the intensification and diversification of agriculture. But it is also important for another reason: it reduces the vulnerability of farmers, especially small-scale ones, to the risks associated with changing farming practices and extreme weather or disease events (Tacoli 2008).

Given the increasing incidence of the Desakota phenomenon in sub-Saharan Africa, and the increasing scarcity of water, and water-based ecosystem goods and services, understanding how these various factors along the rural-urban continuum is of increasing importance. The refusal of African economies to replicate formalized western markets, and the increasing incidence of informal settlements, are fast making conventional concepts based on westernized dichotomies redundant. As the rural blends into the urban, and people become increasingly mobile, new frames of reference are needed to understand the complex realities of a continent in constant flux.

In relation to the regional context, a proper understanding of how national and international socio-economic, political and environmental factors have led to the development of the Desakota phenomenon on the sub-continent is needed. While much literature is available on the history and current context of the region, very little is available which actively seeks to correlate seemingly unrelated processes in search of new insights into old problems.

At the same time, most theoretical explorations of the Desakota phenomenon are based on South Asian case studies, and few studies have been conducted exploring the exact manifesation of this phenomenon in sub-Saharan Africa. While ample evidence exists to suggest the phenomenon is increasingly dominant in the region, as traditional boundaries between rural and urban areas erode, detailed analysis that moves beyond the investigation of the peri-urban is needed. In areas where urbanziation rates are still relatively low, the significance of understanding the Desakota phenomenon is particularly high, as it will directly affect the ability of governments and municipalities to prepare for the rapid changes that occur once the mobility of people, goods and information reaches a critical mass.

Chapter Three's exploration of the general socio-economic and ecosystem trends highlight some of the more important drivers of Desakota livelihoods in the region. A better understanding of the nature of these drivers, and their effects on water-based ecosystem services and poverty alleviation is urgently required. Suprisingly little literature exists which moves beyond a statistical analysis of trends and drivers such as urbanziation, migration, HIV, the informal economy and ecosystem change, and while some data does exist, correlations between previously unrelated bodies of knowledge which reflect the complex realities of millions of people are needed. Unless a broader range of data is collected, our understanding of these trends will continue to be limited to projections and deductions based on questionable data.

Figure 44 outlines some of these drivers, provides examples thereof, and indicates what sort of research questions would deepen our understanding of the affects of these drivers on the health and well being of people and ecosystems in sub-Saharan Africa.

Figure 44: Drivers of the Desakota Phenomenon in sub-Saharan Africa

Driver	**Example**	**Possible Research Question**
Demographic Change	Increase in birth rates or a decrease in infant mortality	Data that moves beyond statistical projections and reflects demographic trends based on a triangulation of census data, spatial mapping and case studies.
Major Epidemics	HIV, Malaria	A better understanding of the relationship between water quality, poverty and disease is urgently needed.
Migrations Processes	Internal circular migration	Very little information is available regarding internal migration trends, making urbanization rates and the expanding Desakota phenomenon difficult to predict. Research is needed which addresses the methodological and conceptual constraints of collating such data.
Economic Reform	Structural adjustment	Economic processes are increasingly recognized as playing a major role in the manifestation of Desakota characteristics. If the effects of changes in landuse, livelihoods strategies and technology on water-based ecosystem goods and services are to be properly understood, the economic processes driving these changes must be explored in relation to these issues.
Environmental Change	Climate change, sudden climatic events such as droughts or floods	Very little information is available on the exact effects of climate change on the sub-region. A diverse range of scientific and social scientific research is needed which examines not only bio-physical trends, but people's abilities to buffer against shocks and negative changes

		must be better understood.
Political Change	End of Apartheid in South Africa lead to a major increase in rural-urban mobility	The effects of political change on changes in transport infrastructure, for example, illustrates the need to better understand political processes in relation to changing demographic and natural resource harvesting patterns.
Conflict	Refugees seeking refuge from rural or urban conflict	The effects of conflict on ecosystems is poorly understood, as are the socio-economic consequences of displacement and change in the context of violent conflict. As a major driver of demographic and economic trends in the region, and a possible scenario if proper water management is not instituted, the role of conflict in determining people's natural resource use patterns is very important.
Transport & Communication	Introduction of cellular telephones and improved road systems	Little is known of the effects of the communications revolution on people's ability to buffer themselves against shock, and the dissemination of technology. A better understanding of how transport and communications infrastructure affects people's livelihood choices, and the options available to them, is urgently needed.

Bibliography

Adell, G. 1999. *Literature Review: Theories and Models of the Peri-Urban Interface: A Changing Conceptual Landscape. Draft for Discussion.* Strategic Environment and Management for the Peri-Urban Interface Research Project. Development Planning Unit. University College London: London.

African Development Bank 2007 *Gender, Poverty and Environmental Indicators on African Countries: 2007.* Economic and Social Statistics Division, African Development Bank.

Allen, A.(2001). Environmental Planning and Management of the Periurban Interface. Key note Paper for the Conference Rural-Urban Encounters: Managing the Environment of the Periurban interface, London 9-10 November 2001.

Ariyo, J., 2008 Contribution to Sahel Sub-Regional Workshop at Katsina, 11-12 December. 2008

Ariyo, J.A., Voh, J.P. and Ahmed, B. 2001, Long-term change in food provisioning and marketing in the Kano region, 1960-2000. *Drylands Research Working Paper 34.* Crewkerne: Drylands Research

Baker, J., 1995, "Survival and Accumulation at the Rural-Urban Interface in North-West Tanzania", Environment and Urbanization, Vol. 7, No. 1, pp. 117-32.

Baker, J., ed. 1990. *Small Town Africa: Studies in Rural Urban Interaction.* Scandinavian Institute of African Studies, Uppsala.

Banks, D.I., Griffin, N., Shackleton, C.M., Shackleton, S.E. & Mavrandonis, J. 1996. Wood supply and demand around two rural settlements in a semi-arid savanna, South Africa. *Biomass and Bioenergy*, 11: 319-331.

Barany, M., A. L. Hammett, R. R. B. Leakey, K. M. Moore (2003). Potential income generating opportunities for smallholders affected by HIV/AIDS: linking agro-ecological changes and non-timber forest products. *Journal of Management Studies,* 18: 97-114.

Barnett, T and Whiteside, A (2002). *Aids in the Twenty-First Century: Disease and Globalisation.* Palgrave/Macmillan, New York.

Baylies, C. (2002). The Impact of AIDS on Rural Households in Africa: A Shock Like Any Other? *Development and Change,* 33(4): 611–632.

Barany. M.E. (2003). *Non-Timber Forest Products in the Livelihood and Coping Strategies of Households and Communities Afflicted by HIV/AIDS.* Masters Thesis. Virginia Polytechnic Institute and State University. USA, 1-126.

Beisel, W. R. (2002). *Nutritionally acquired immune deficiency syndromes*. In: Micronutrients and HIV Infection (Ed. by H.Friss). Boca Raton, Florida: CRC Press, 24-42.

Briggs, J. and Mwamfupe, D. 2000. 'Peri-Urban Development in an Era of Structural Adjustment in Africa: The City of Dar es Salaam, Tanzania'. *Urban Studies* 37 (4): 797-809

Brouwer, I.D., Hoorweg, J.C. & van Liere, M.J. 1997. When households run out of fuel: responses of rural households to decreasing fuelwood availability, Ntcheu district, Malawi. *World Development*, 25: 255-266.

Brouwer, R. & Falcão, M.P. 2004. Wood fuel consumption in Maputo, Mozambique. *Biomass & Bioenergy*, 27: 233-245.

Bryceson, D. F. (2002). The scramble in Africa: reorientating rural livelihoods. *World Development,* 30: 725-739.

Bryceson, D.,Kay, C. and Mooij, J., 2000 *Disappearing peasantries? Rural labour in Africa, Asia and Latin America.* London: Intermediate Technology Publications

Bryceson, D., and Jamal, V., 1997, "Farewell to Farms" in D. Carney (ed.) Sustainable Rural Livelihoods. What Contribution Can We Make?, DFID, London.

Campbell, B.M., Jeffery, S., Kozanayi, W., Luckert, M.K., Mutamba, M. & Zindi, C. 2002. *Household livelihoods in semi-arid regions: options and constraints*, CIFOR, Bogor. 153 pp.

Campbell, B. M., S. Jeffrey, W. Kozanayi, M. Luckert, M. Mutamba, and C. Zindi. 2002. *Household livelihoods in semi-arid regions*. Jakarta, Indonesia: SMK Grafika Desa Putera; Centre for International Forestry Research, 1-153.

Campbell, B.M., Vermeulen, S.J., Mangono, J.J. & Mabugu, R. 2003. The energy transition in action: urban domestic fuel choices in a changing Zimbabwe. *Energy Policy*, 31: 553-562.

Chenge, M. (ed.) 2000 *State of the Environment Zambezi Basin 2000*, SADC/IUCN/ZRA/SARDC. Maseru/Lusaka/Harare

Cofie, O.O (et al).2007. *Planning urban water-dependent livelihood opportunities for the poor in Accra, Ghana*. Switch: University of Birmingham

Cofie, OO and Drechsel, P. 2002. 'Water for Food in the Cities: The Growing Paradigm of Irrigated (Peri)-Urban Agriculture and its Struggle in Sub-Saharan Africa', *African Water Journal (1) 1*

Cohen, B. 2004. 'Urban Growth in Developing Countries: A Review of Current Trends and a Caution Regarding Existing Forecasts'. *World Development.,* 32 (1): 23-51.

Cox, K. and others. 2004, 'Urbanisation in South Africa and the Changing Character of Migrant Labour'. *South African Geographical Journal.* 86(1): 7-16.

Daily, G.C.,1997 *Nature's services.* Washington, DC: Island Press

Davies, S., 1996 *Adaptable livelihoods. Coping with food insecurity in the Malian Sahel.* London/ New York: Macmillan/ St martin's Press

Dávila, J. 2001. 'Guidelines for Strategic Environmental Planning and Management of the Peri-Urban Interface'. *Appropriate Methodologies for Urban Agriculture*, October 2001, Nairobi, Kenya

De Waal, A., 1989 *Famine that kills.Darfur, Sudan, 1984-85.* Oxford: The Clarendon Press

de Merode, E., K. Homewood, and G. Cowlishaw. (2004). The value of bushmeat and other wild foods to rural households living in extreme poverty in Democratic Republic of Congo. *Biological Conservation,* 118: 573-581.

Devereux, S and S. Maxwell. (2001). *Food Security in Sub-Saharan Africa*. London. ITDG Publishing, 1-12.

de Waal. A, and J. Tumushabe. (2003). *HIV/AIDS and Food Security in Africa*. DFID, 1-22.

de Waal, A. and A. Whiteside. (2003). New variant famine: AIDS and food crisis in southern Africa. *The Lancet,* 362: 1234–37.

Drimie, S. (2004). *The underlying causes of the food crisis in the Southern Africa region: Malawi, Mozambique, Zambia and Zimbabwe*. Oxfam-GB policy research paper. 1-39.

Drechsel, P, Graefe, S and Fink, M. 2007. 'Rural_Urban Food, Nutrient and Virtual Water in Selected West African Cities'. *IWMI Research Report 115.*

Drechser, A and Laquinta, D.L. 2006 'Defining Periurban: Understanding Rural-Urban Linkages and their connection to institutional context.' E-Conference: Urban Agriculture on the Policy Agenda

Drechsel, P (et al). 'Informal Irrigation in West Africa: AN Overview.' *IWMI Research Report 103*. International Water Management Institute: Colombo.

Drechsel, P. et al. 2001.*Technology Development for Municipal Organic Waste Recycling for Urban and Peri-Urban Agriculture - A Holistic Approach*. Paper for the Workshop: Appropriate Methodologies for Urban Agriculture. Nairobi: Kenya

Drechsel, P; Cofie, O.O; Vázquez, R and Danso, G.P. 2001. 'Technology development for municipal organic wasterecycling for urban and peri-urban agriculture - A holistic approach.' Paper for the Workshop: *Appropriate methodologies for urban agriculture*. Nairobi: Kenya.

Drechsel, P,Quansah, C and Penning De Vries, F. 2003. *Rural-urban interactions: Stimulation of urban and peri-urban agriculture in West Africa*. International Development Research Centre (IDRC):Canada.

Enwonwu, C., and R. Warren (2001). *Nutrition and HIV/AIDS in sub- Saharan Africa.* In Nutrition and AIDS, 2nd edition. ed. R. R. Watson. Boca Raton. Florida: CRC press, 175-92.

Eastwood, R. and Lipton, M. 2000. 'Rural-Urban Dimensions of Inequality Change'. *WIDER Working Papers* (UNU), no. 200 / World Inst. for Development Economics Research. Helsinki: Finland

Egziabher, A.G (et al.). 1994. *Cities feeding people: an examination of urban agriculture in East Africa*. International Development Research Centre: Ottowa, Ontario (Canada).

Ellis, Frank and Sumberg, James. 1998. 'Food production, urban areas and policy responses.' *World Development* 26(2), pp. 213-225.

Faye, A. and Fall, A., 2000 Région de Diourbel: diversification des revenus et son incidence sur l'investissement agricole. *Drylands Research Working Paper 22.*Crewkerne: Drylands Research

Food and Agricultural Organization (FAO). (2002). *HIV/AIDS, agriculture and food security in mainland and small island countries of Africa.* Egypt.

Frison, E., I. F. Smith, J. Cherfas, P. Eyzaguirre and T. Johns (2005). Using biodiversity for food, dietary diversity, better nutrition and health. *South African Journal of Clinical Nutrition*, 18 (2): 112 – 114.

Friss, H. (1998). The possible role of micronutrients in HIV infection. *SCN News,* 17: 11-12.

Gari, J. A . (2003). *Agrobiodiversity strategies to combat food insecurity and HIV/AIDS impact in rural Africa: advancing grassroots responses for nutrition, health and*

sustainable livelihoods. Population and Development Service (SDWP), FAO, Rome, Italy, 1-144.

Gari, J. A. (2004). *Plant diversity, sustainable rural livelihoods and the HIV/AIDS crisis*. UNDP and FAO, South East Asia HIV and Development Project. Bangkok, Thailand, 1-16.

Gillespie, S., Haddad, L and Jackson, R. (2001). *HIV/AIDS, food and nutrition security: impacts and actions.* Paper presented at a consultation on HIV/AIDS and Rural Livelihoods, International Food Policy Research Institute, Washington.

Ghirotti, M. 1999. 'Making better use of animal resources in a rapidly urbanizing world: a professional challenge.' *World Animal Review.* FAO. (92). pp. 2-14.

Gordon, A. et al. 2000. 'The Role of Natural Resources in the Livelihoods of the Urban Poor'. *Policy Series - Natural Resources Institute* no. 9 / Natural Resources Inst., Chatham: United Kingdom.

Grossman, David; Berg, Leo van den; Ajaegbu, Hyacinth I (1999). Urban and peri-urban agriculture in Africa. xviii, 335 p.

Haddad, L. and S. Gillespie (2001). *Effective food and nutrition policy responses to HIV/AIDS. What we know and what we need to know.* Food Consumption and Nutrition Division. Discussion Paper 112. Washington DC: International Food Policy and Research Institute. 1-79.

Harvey, P (2003). *HIV/AIDS: what are the implications for humanitarian action?* Draft report, Humanitarian Policy Group, Overseas development Institute, United Kingdom.

Hardoy, J. and D. Satterthwaite, eds. 1986. *Small and Intermediate Urban Centres: Their Role in National and Regional Development in the Third World.* Hodder & Stoughton, London.

Hassan Y. 2005 Rapid urbanization in Africa: Perspectives on housing and urban poverty, *SDD Bulletin* No. 2, UNECA

High, C. and C. M. Shackleton (2000). The comparative value of wild and domestic plants in home gardens of a South African rural village. *Agroforestry Systems,* 48(2): 141-156.

Hill, P.,1972 *Rural Hausa. A village and a setting.* Cambridge University Press

Hill, P.,1977 *Population, prosperity and poverty. Rural Kano, 1900 and 1970.* Cambridge University Press

Hirji, R. & Molapo, J. 2002. Environmental sustainability in water resources management: a conceptual framework. In Hirji, R., Johnson, P., Maro, P. & Matiza C.T.,

2002. Defining and Mainstreaming Environmental Sustainability in Water Resource Management in Southern Africa. SADC, IUCN, SARDC, World Bank: Maeru/Harare /Washington DC. pp. 1-20.

HSRC. (2004). *Food Security in South Africa. Key policy issues for the medium term. Pretoria: Integrated Rural and Regional Development.* South African Regional Poverty Network. Human Sciences Research Council, Pretoria.

IANA, Saferworld and Oxfam 2007 Africa's Missing Billions: International Arms flows and the cost of Conflict. Briefing paper 107.

IFAD (2001). IFAD strategy paper on HIV/AIDS for East and Southern AfricaThe International Fund for Agricultural Development. http://www.ifad.org/pub/index.htm. Retrieved January 2008.

ISES 1999. Renewable energy technologies in southern Africa: a guide for investors. ISES/DBSA.

Lowassa, A., S. Magimbi and B. Kaltenborn (2004). *The Effect of Wildlife Conservation on Food Dependency of Local People around Serengeti National Park, Tanzania.* Tanzania Wildlife Research Institute, Arusha Tanzania.

MA (Millennium Ecosystem Assessment). 2005a. *Ecosystems and human well-being: Synthesis*. Island Press, Washington D.C.

MA (Millennium Ecosystem Assessment). 2005b. *Ecosystems and human well-being: Desertification synthesis.* World Resources Institute, Washington D.C.

MA (Millennium Ecosystem Assessment). 2005c. Ecosystems and human well-being. Volume 3. Policy responses. Findings of the responses working group. Island Press, Washington, Covelo, London.

Madubansi, M. & Shackleton, C.M. 2006. Changing energy profiles and consumption patterns following electrification in five rural villages, South Africa. *Energy Policy*, 34: 4081-4092.

Madubansi, M. & Shackleton, C.M. 2007. Changes in fuelwood use and species selection following electrification in the Bushbuckridge lowveld, South Africa. *Journal of Environmental Management*, 83: 416-426.

Mattingly, M. 1999. *Institutional Structures and Processess for Environmental Planning and Management of the Peri-Urban Interface.* Strategic Environment and Management for the Peri-Urban Interface Research Project. Development Planning Unit. University College London: London.

Manika, S, and M. Trivedi (2002). *Links between biodiversity consumption, livelihoods and food security: the sustainable use of wild species for meat*. The IUCN species survival commission, Gland, Switzerland.

Mbiba, B. 2001. 'The Political Economy of Urban and Peri-*Urban Agriculture in South and East Africa: Overview, Settings and Agenda.' In Proceedings on the MDP/IDRP Conference on the Political Economy of Urban and Peri-Urban Agriculture in Southern Africa, Annex 1.*

Mortimore, M., 1982 Framework for population mobility: the perception of opportunities in Nigeria, in: J.I.Clarke and L.A.Kosinski (eds.), *Redistribution of population in Africa,* 50-57. London: Heinemann

Mortimore, M. and Adams, W.M., 1999 *Working the Sahel. Environment and society in northern Nigeria.* London: Routledge

Mutangadura, G., D. Mukurazita, and H. Jackson (1999). *A review of household and community responses to HIV/AIDS epidemic in rural areas of Sub-Saharan Africa*. UNAIDS Best Practice Collection. Geneva: UNAIDS.

Muwowo, Paul. 2001. 'Political economy of urban agriculture in Eastern and Southern Africa: the case of Zambia'. *The political economy of urban and peri-urban agriculture in East and Southern Africa*. Municipal Development Programme for Eastern and Southern Africa Conference, Harare, Annex 5.

Ngwenya, B.N. & Kgathi, D.J. 2006. HIV/AIDS and access to water: a case study of home-based care in Ngamiland, Botswana. *Physics and Chemistry of the Earth*, 31: 669-680.

OECD, 2007 *Web Atlas of Regional Integration in West Africa.* Paris: OECD

Piwoz, E. and E. Preble (2002). *HIV/AIDS and nutrition: a review of the literature and recommendations for nutritional care and support in sub-Saharan Africa.* U.S. Agency for International Development, Washington D. C.

Platt McGinn, A. 2002 *Malaria, Mosquitoes and DDT*, World Watch, 15(3) May-June

Pedersen, P. O., ed. 1991. The role of small and intermediate urban centres in planning in Africa. *African Urban Quarterly* 6(3/4): 171-303.

Philip Franks, Contribution to Eastern Africa Sub-Regional Workshop, Nairobi, 10 January, 2008

Potter, RB. and Unwin, T. 1995. 'Urban-Rural Interaction: Physical Form and Political Process in the Third World'. *Cities.* 12 (1): 67-73.

Potts, D. 1995. 'Shall we go home? Increasing urban poverty in African cities and migration processes.' *The Geographical Journal* 161 (3), pp. 245-26

Potts, D. and Mutambirwa, C. 1990. 'Rural-Urban Linkages in Contemporary Harare: Why Migrants Need Their Land'. *Journal of Southern African Studies.* 16 (4): 677-698.

Rabinovitch, J.(2001). Challenges and Opportunities for Rural-Urban Interface Approaches; an Overview from the United Nations. Paper for the Conference Rural-Urban Encounters: Managing the Environment of the Periurban Interface, London 9-10 November 2001.

Rakodi, C., 1999, Poverty in the Peri-Urban Interface, Report for the DFID Natural Resources Systems Research Programme, Research Advances No. 5.

Reynolds, J.E. and Stafford Smith, D.M (eds.), 2001 *Global desertification: do humans cause deserts? Dahlem Workshop Report 88.* Berlin: Dahlem University Press

Reynolds, J.E., Stafford Smith, D.M et al., 2007 Global desertification: building a science for dryland development. *Science,* 316, 11 May 2007: 847-851

Rugalema, G. (2000). Coping or Struggling? A Journey into the Impact of HIV/AIDS on Rural Livelihood in Southern Africa. *Review of African Political Economy,* 27(86): 537–45.

Sahn, DE. and Stifel, DC. 2003. 'Progress Toward the Millennium Development Goals in Africa'. *World Development.* 31 (1):23-52.

Satterthwaite, D. and Tacoli, C. 2003. *The Urban Part of Rural Development: The Role of Small and Intermediate Urban Centers in Rural and Regional Development and Poverty Reduction*. International Institute for Environment and Development (IIED).

SADC FANR Vulnerability Assessment Committee (2003). *Towards Identifying Impacts of HIV/AIDS on Food Insecurity in Southern Africa and Implications for Response: Findings from Malawi, Zambia and Zimbabwe.* Harare, Zimbabwe.

Save the Children UK and Oxfam (2002). *HIV/AIDS and food insecurity in southern Africa. How can we break the vicious circle of HIV/AIDS and food insecurity in southern Africa?* Save the Children UK, Oxfam. United Kingdom.

Sen, A. 1999 *Development as freedom.* New York: Random House

Shackleton, C.M. & Gambiza, J. in press. Trade-offs in combating land degradation resulting from invasion of a woody shrub (*Euryops floribundus*) at Macubeni, South Africa. *Land Degradation & Development*.

Shackleton, C., Shackleton,S., Gambiza, J., Nel, E., Rowntree, K. and Urquhart, P, 2008 *Links between ecosystem services and poverty alleviation: situation analysis for arid and semi-arid lands in Southern Africa. Report to the Consortium on Ecosystems and Poverty in Sub-Saharan Africa.* Grahamstown: Rhodes University

Shackleton, C.M., McGarry, D., Fourie, S., Gambiza, J., Shackleton, S.E. & Fabricius, C. 2007a. Assessing the effects of invasive alien species on rural livelihoods: case examples and a framework from South Africa. *Human Ecology*, 35: 113-127.

Shackleton, C.M. and S.E. Shackleton (2006). Household wealth status and natural resource use in the Kat River Valley, South Africa. *Ecological Economics,* 57: 306-317.

Shackleton, C.M., McConnachie, M., Chauke, M.I., Mentz, J., Sutherland, F., Gambiza, J. & Jones, R. 2006. Urban fuelwood demand and markets in a small town in South Africa: livelihood vulnerability and alien plant control. *International Journal of Sustainable Development and World Ecology*, 13: 1-11.

Shackleton, C.M. and S.E. Shackleton (2004[a]).The importance of non-timber forest products in rural livelihood security and as safety-nets: evidence from South Africa. *South African Journal of Science,* 100: 658-664.

Shackleton, C.M. 1994. Growing more trees for fuelwood in the Northern Transvaal or redistribution after sustainable harvesting? *Development southern Africa*, 11: 587-598.

Showers, Kate B. 2002.'Water Scarcity and Urban Africa: An Overview of Urban–Rural Water Linkages.' *World Development.* 30 (4), pp. 621-648

Solomon, A. 2000. The use and valuation of natural fuelwood resources in Paulshoek, Namaquland and the ecological impacts on rangeland dynamics. M.Sc thesis, University of Cape Town, Cape Town. 129 pp.

Stren, R., ed. 1994. *Urban Research in the Developing World, Vol. 2 Africa.* University of Toronto Press, Toronto.

Stren, R. F. and R. R. White, eds. 1989. *African Cities in Crisis: Managing Rapid Urban Growth.* Westview, Boulder, Colo.

Swallow, B., P. H. Thangata, S. N. Roa and F. Kwesiga (2004). *Agroforestry Responses to HIV/AIDS in East and Southern Africa.* (World Agroforestry Centre (ICRAF): Gigri, Nairobi, Kenya, 1-46.

Tacoli, C.(2001). Livelihoods Impacts and Strategies of the Periurban Poor. Key note Paper for the Conference Rural-Urban Encounters: Managing the Environment of the Periurban Interface, London 9-10 November 2001.

Tarver, J. D., ed. 1994. *Urbanization in Africa: A Handbook.* Greenwood Press, Westport, Conn.

Takasaki, Y., B.L. Barham, and O.T. Coomes (2004). Risk coping strategies in tropical forests: floods, illness and resource extraction. *Environment and Development Economics,* 9: 203-224.

Tiffen, M., Mortimore, M. and Gichuki, F.,1994 *More people, less erosion: environmental recovery in Kenya.* Chichester: John Wiley

Touré Fall SA Salam Fall, Ibrahima Cisse (2000) Urban livestock systems in the Niayes zones in Senegal. In: *Urban Agriculture Magazine*, no 2, Urban Livestock, October 2000, RUAF, Leusden The Netherlands.

UNAIDS and WHO. (2006). Joint the United Nations Programme on HIV/AIDS (UNAIDS) and the World Health Organization (WHO). *Global AIDS report.* Geneva.

UNEP/IISD, 2004 *Human well-being, poverty and ecosystem services. Exploring the links.* Winnipeg: International Institute for Sustainable Development

Vorster, H., A. Kruger, B. M. Margetts, C. S. Venter, H. S. Kruger, F. J. Veldman, and U. E. MacIntyre. (2004). The nutritional status of asymptomatic HIV-infected Africans: directions for dietary intervention? *Public Health and Nutrition,* 7(8): 1055-1064.

Walker, B.H. and Meyers, J.A., 2004 Thresholds in ecological and sociological systems: a developing database. *Ecology and Society,* 9/2, 3

WALTPS, 1994 *Preparing for the future: a vision of West Africa in the year 2020. Summary Report of the West Africa Long Term Perspective Study.* Paris: OECD/Club du Sahel

Watts, M.J., 1983 Silent violence: food, famine and the peasantry in northern Nigeria. Berkeley: University of California Press

Wilhelm, L. 2000. 'Supply Networks and How Markets Work in Africa and Madagascar'. *Food into Cities. Selected papers. FAO Agricultural Services Bulletin (FAO).*no. 143 / FAO, Rome: Italy

Wiggins, S., 2002 Smallholder farming in Africa: stasis and dynamics, in: D. Belshaw and I. Livingstone (eds.) *Renewing Development in Sub-Saharan Africa: Policy, performance and prospects,* 101-120. London: Routledge.

World Bank 2007 *African Development Indicators Report, 2007.* Washington, DC: The World Bank.

World Bank, 2000 *World Development Report, 2000/2001.* Washington, DC: The World Bank.

WRI 2007. Restoring nature's capital. An action agenda to sustain ecosystem services. WRI, Washington DC.

Zlotnik, H. 2004 International Migration in Africa: An Analysis Based on Estimates of Migrant Stock. United Nations DESA/Population Division http://www.migrationinformation.org/USfocus/display.cfm?ID=252