Rehabilitation of Degraded Lands in Sub-Saharan Africa: A Synthesis

(Background Paper on Dryland Ecosystems)

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Introduction

Drylands are, by definition, areas where the ratio of mean annual precipitation (P) to potential evapo-transpiration (PET) (i.e. index of aridity) is less than 0.65 [Middleton and Thomas (Eds.), 1997]. Drylands are classified into four climatic zones on the basis of aridity index (AI) values. The categories of aridity using the AI index are as follows;

Hyper-arid	<0.05
Arid	0.05-0.20
Semi-arid	0.20-0.50
Dry Sub-humid	0.50-0.65

Globally, drylands cover 40% of the earth's total land surface excluding hyper arid lands, which cover another 8% (UNSO/UNDP, 1997). Out of this total area, the arid, semi arid and dry sub-humid zones covers 12%, 18% and 10% respectively. Drylands in Africa covers 43% of the landmass with about 65% of the countries classified as dryland.

The above categorization is by no means approximate. Dryland boundaries are said to be neither static nor abrupt (Tucker, et al, 1991; Helden, 1991) arising in part from high inter-annual variability in mean rainfall and occurrence of drought which may last for periods of several years at a time. Delineation of boundaries therefore requires to proceed with caution because of the dynamism inherent in dryland climatic regimes on the one land and effects arising from human induced activities, on the other hand. The need for regular monitoring of the extent and distribution of drylands in a given region cannot be over-emphasized.

One distinct phenomenon of drylands is that of desertification with its underlying causes and consequences. Desertification is now well understood as land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities [Middleton and Thomas (Eds.), 1997][1]. Thus it can rightly be stated that drylands and desertification are constrained by factors related to natural causes and threatened by factors related to man made causes. The consequences of desertification are obvious taking both bio-physical and socio-economic dimensions. A clear understanding of the bio-physical and socio-economic factors causing desertification is therefore important for sound intervention in mitigating its effects.

The regional synthesis on the "Rehabilitation of degraded lands in Sub-Saharan Africa" was initiated in an effort to bring together scientists working on tropical forest, woodlands and allied natural resources from Africa and around the world through networking to discuss pertinent issues and chat the way forward on sustainable management of the resources. This paper focuses on the dryland ecosystem of the arid and semi arid lands. A component on the dry sub-humid will be covered in a related paper on the sub-humid ecosystem. The synthesis covers three main sections. Section 1 highlights main issues with a focus on causes and consequences of degradation, extent and dynamics of degradation and the international context. Section II covers lessons from case studies: factors for success or failure. The section considers cases of initiatives made in rehabilitation with emphasis on tree-based approaches. Section III identifies gaps in knowledge on issues and interventions and proposes recommendations for policy, management and research. The final output will be a synthesized document which will form the basis for the production of popular press articles for stakeholders. Main beneficiaries of the synthesis will be students, trainers, researchers and development actors (Governments/NGOs) involved in dryland management.

[1] Hyper arid lands or true deserts are not prone to desertification because of their naturally very low biological productivity resulting from low rainfall and high rates of potential evaporation which restrict plant growth and settlement by human population.

Section 1: Main Issues

Causes and Consequences of Land Degradation

Causes of Land Degradation

Degradation and desertification are sometimes used interchangeably though the two terminologies are distinct. To appreciate their meaning, it would require that the two be defined. Desertification, as previously defined, means land degradation in arid, semi arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities. Land degradation has been defined in different ways but a more comprehensive definition describes it as "the aggregate diminution of the productive potential of the land, including its major uses (rainfed, arable, irrigated, rangeland, forest), its farming systems (e.g. small holder subsistence) and its value as economic resource" (Stocking and Murnaghan, 2001). While both are processes, the former is more applicable in a clearly defined ecosystem – the drylands. We would like to stress that the two terminologies are the same in as far as drylands are concerned.

There are many publications on the causes of desertification/degradation. Recent understanding now acknowledges that while the root causes are highly complex and site specific, the driving forces fall in two broad categories; natural and human related factors. The two forces operate in a complex interplay with each having influence on the other.

Natural Factors

Climate, and especially, climatic variability is an important natural phenomenon because of its direct impact on ecosystems and, in this case, the drylands (Cardy, 1993). Changes in climate have great influences on other environmental attributes besides imparting limitations on human activities. Climatic parameters have both direct and indirect impact on many land degradation processes, especially through their severe impact on vegetation and soil condition.

Rainfall variability is an important aspect in dryland climates (Middleton and Thomas (eds.), (1997). Drought has been shown as one of the extreme climatic stresses that contributes the worst impact on land degradation processes (Ogallo, 1997). Drought triggers mass exodus of people and animals, overgrazing, shortages of water, energy and food, diseases and other socio-economic stresses which lead indirectly to losses in economic and biological productivity of the

land. A comprehensive study on the impact of drought on water resources, forest, fisheries, wildlife, wetlands and land in general in Kenya shows just how devastating drought effects can be (UNEP, 2000).

Temperature variability, especially the maximum, minimum and range values has also significant impact on land degradation in the drylands (Ogallo, 1997). The effects of temperature are becoming more pronounced at a global scale through human actions of generating green house gases in the atmosphere, which are contributing to global warming (IPCC, 1990). Indeed there is evidence of global warming (Hulme, 1996). Meanwhile, dryland areas are globally important stores of carbon and land degradation in these areas is said to be contributing between 5-10% of total green house gas accumulation (Williams and Balling, 1996). Africa's contribution to green house gases is believed to be upto 7% (Silveira, 1994). Much of the emissions is attributed to soil disturbance, biomass deterioration and burning, land use change and pre-industrial forms of energy production and use. Global warming is likely to further reduce the already limited moisture availability in the drylands.

Wind, is an important agent of land degradation in the drylands. However, it is usually preceded by human activities especially, those that change or remove vegetation cover and/or destabilize natural soil surfaces. Wind effects are apparent in areas, where climatic, soil and vegetation conditions are conducive (Karanja, 1997) like loose, dry and finely divided soils; sparse or absent vegetative cover with some smooth soil surface; a sufficiently large field; and sufficiently strong wind to initiate soil movement. The effects of human activities as precursors for wind as a land degrading agent underlies most studies carried out (Khatteli, 1998, Wassif, 1998, Koala and Bielders, 1998). The effects of wind erosion are more or less the same i.e. entail removal of the most loose and often fertile portion of the soil and hence lowering of land productivity. Other effects include air pollution, losses to human habitation, communication and transportation. However, it is its effect to rural livelihood that is the more significant in this context.

Human Related Factors

Land degradation due to natural causes is believed to occur at a rate which is in balance with the rate of natural rehabilitation. However, human related factors are responsible for the accelerated forms of land degradation (Stocking and Murnaghan, 2001). The most frequently recognized human causes of land degradation include;

- Overgrazing of rangelands,
- Over cultivation of croplands,
- Water logging and salinization of irrigated lands,
- Deforestation, and
- pollution and industrial causes.

These causes manifest in two main biophysical forms of degradation; physical loss of the resource as determined from various indicators and loss in productivity as determined from indicators of production constraints.

Our present knowledge of land degradation/desertification reveals that the underlying human causes are firmly rooted in the socio-economic, political and cultural environment in which they operate. An understanding of these social dimensions and impacts, besides the physical factors, are necessary before any meaningful interventions are proposed or undertaken (Evers, 1996). An attempt has been made to highlight some of these socio-economic, political and cultural factors.

Population growth and land use changes

Drylands in Africa are generally characterized by high population densities [UNDP/UNSO, 1997]. 37% of the world's population live in the drylands, areas that are prone to drought and susceptible to desertification. Africa has 41% of the population living in the drylands with the greatest proportion found in the semi arid (18%) and dry sub-humid (17%) zones. A growing population puts greater demands on the land. The fragility of the underlying resource base in the drylands implies a limited capacity to absorb increased numbers of people, resulting in overgrazing, over cultivation, deforestation and over irrigation (Campbell, 1984). An indirect effect of land pressure is the requirement for more extensive infrastructure, which has the

potential to lead to increased land degradation (Stocking and Murnaghan, 2001). However, evidence for a direct link between increasing populations and degradation is ambiguous. Some studies have shown that in certain situations increased populations have spurred sustainable intensification and development (Tiffen et al, 1993). Careful analysis and interpretation of the effects of population on land degradation is needed before judgment is made.

Instability, conflict and insecurity.

Political and social instability has a strong bearing on land degradation in most parts of the dry Sahel. Civil wars and/or banditry have displaced and/or confined communities within limited areas than traditionally available resulting in over-use and hence degradation. Civil strife in Southern Sudan and Somalia for example, has led to displacement of large populations into Kenya. Some of the populations are settled in refugee camps increasing population in the affected areas (e.g. Kakuma and Dadaab) while others are integrated with the local communities. Occasionally, cases of resource use conflicts arise. In other circumstances neighboring communities, for various cultural reasons, engage in acts of banditry and/or cattle rustling. These later activities limit movement of local populations resulting in over-use of the available resources and hence degradation. Examples of cattle rustling and banditry are found among the Pokot, Marakwet and Turkana communities in North Western Kenya (sometimes involves the Karamajong of Uganda) and the Rendile, Gabbra and Boran communities of Central-northern Kenya (sometimes involves Oromiya from neighboring Ethiopia).

Land Tenure, Property Relations and Conflicts

Land tenure is one of the most widely discussed topics in the drylands but least addressed regarding specific action plans. We see land tenure as a multi-dimensional issue whose approach is site specific. Land ownership in the drylands takes three distinct forms; communal, group ranch and individual. As population increases and, in some cases, governments attempt to centralize and unify land tenure arrangements, there is an increasing shift towards individual ownership. On the one hand, security of tenure affects farmers' willingness to invest resources in land improvement and protection against degradation. This is quite true for large scale ranches owned by wealthy individuals. It is also true for small scale farmers who have adopted new technologies of land conservation. This is contrary to communally owned land, especially

so, in the face of increasing population. Common property resources are more vulnerable to land degradation (Stocking and Murnaghan, 2001).

Nevertheless, shift to individual ownership is not always panacea. Communal ownership with well defined structures based on traditional institutions are still appropriate in many situations in the dryland sahel. A distinction needs to be drawn between "open access" and "common pool" resources under communal tenure arrangement. The former is where land users have free access to use whatever resources they can grab and this can enhance degradation while under "common pool", access to resources is controlled to avoid overuse and hence degradation. Understanding indigenous land tenure systems and traditional institutions is necessary before deciding on appropriate interventions. A participatory approach involving local communities in formulating plans of action is called for.

Poverty

Poverty is both an indicator and cause of land degradation. In this context, it is examined as a cause. Poverty usually drives those affected to rely more on the natural resources for survival. As they do so the focus is more on immediate needs rather than those whose benefits may materialize only in the long term. Secondly, lack of relevant resources reduces options available for application of proper conservation practices. The end result is inappropriate use of land and hence degradation.

Government and/or Donor Directed Programmes

The intentions of governments, donors and allied development actors in the development of drylands are usually good. However, they become impediments and agents of degradation when approached from a purely technical perspective and implemented from above i.e. a "top-down" approach (Evers, 1996) without taking into consideration the local situation where the main impacts of the problems take place. For example, government interventions aimed at developing water resources and improving herd management have, to the contrary, caused damage to the environment. The damage mainly arise from the negative impact of sedentarization. Where mixed agriculture is practiced, emphasis has sometimes been placed on improved cropping techniques e.g. high yielding varieties without incorporation of traditional land use systems. These examples highlight one issue; that local communities are not adequately consulted and

their input incorporated resulting in the erosion of communities institutional capacity to govern resource use properly (FAO, 2000). Because of occasional un-coordinated planning, government approaches/policies fail to integrate important natural resource components e.g. forestry and livestock that characterize the farming systems of such regions (Shephard, 1992).

Consequences of Land Degradation

Consequences and causes of degradation seem to occur in a vicious cycle; one being responsible for the other. The main consequence of land degradation in the drylands is desertification which manifests itself in various biophysical and socio-economic conditions. Degradation affects a wide array of people differently. Stocking and Murnaghan (2001) have summarized categories of people affected by land degradation. They range from an individual farmer, whose farm is undergoing or has undergone degradation, neighboring farmer down hill, organizations (e.g. those responsible for hydroelectric power generation or ports), to national governments in terms of incomes accrued or costs incurred.

The biophysical effects of land degradation include soil degradation, reduction in available water including its quality, diminution of vegetation sources (including biological diversity) as well as urban and related industrial problems, amongst others. Of the above, soil degradation (both biological and physical) provides the best indicators of land degradation since it is the medium through which most changes in landscape status occur. Of the various soil degradation processes, soil erosion is said to act as the single best proxy for most of the other aspects of degradation (Stocking and Murnaghan, 2001).

A greater impact of land degradation manifests to mankind in different forms. Availability of land to support meaningful production results in reduced crop yield or crop failures, famine and hence poverty (UNEP, 1991). Desertification is considered as one of the main factors that causes migration of rural populations (subsistence farmers and pastroralists) to urban centers, thus creating the so called environmental refugees. It is estimated that there are today some 25 million environmental refugees around the world, majority of these in developing countries (Horstmann, 2002). The poor and environmentally displaced are desperate populations vulnerable to diseases, natural disasters and are prone to crime and civil strife. Another effect

resulting from environmental refugees is decline in food production leading to food imports and thereby raising the level of indebtedness of the poor countries.

At macro-economic level, desertification has a significant bearing on overall economic performance of the affected countries since a majority rely heavily on their drylands as the major resource base. Per capita agricultural production per capita has shown a declining trend since the 1970s and so is the average annual growth of gross national product (UNEP, 1991).

Status, Extent and Dynamics of Land Degradation

The Global Perspectives

Vegetation is the buffer between soil surface and the processes that can cause degradation by soil displacement. Once vegetations of various types have been removed, several factors come into play in destroying the soil mantle, which is the precursor to desertification. The extent of degradation of vegetation followed by degradation of natural resources in general is of great concern and has a direct implication to the development and livelihood of mankind. It is estimated that some 1,035 million ha or 20% of the earth's arid zones, arising from serious degradation of vegetation cover, are affected by human-induced soil degradation. Of this 45% is caused by water erosion, 42% by wind erosion, 10% by chemical impacts and 3% by physical destruction of the soil structure (Horstmann, 2002).

UNEP estimates that income lost globally as a result of degradation to the extent of causing desertification amounts to around USD 42 billion per annum (Horstmann, 2002). Furthermore over 250 million people in over 110 countries are directly affected by desertification and more than 1 billion people, mostly in developing countries, are at risk.

The African Perspectives: status of aridity and degradation vulnerability

Status of Aridity

Degradation of natural resources that eventually lead to desertification is more pronounced in Africa than any of the other contents of the world. Africa is dominated by the Sahara Desert in the north and the Namibian and Kalahari Deserts in the south, and hosts a preponderance of hyper-arid and arid lands, which are mostly unsuitable for agricultural activities. About 43% of

the landmass in Africa is dryland and is comparable only with Asia, which has 39% of its landmass as dryland indicating that Africa is the driest of the world continents. Aridity zones for Africa have been calculated using the high-resolution climate data (Corbett at al. 1996; UNSO/UNDP, 1997). The regional level statistics are summarized in Table 1 below.

Table 1: Area per aridity zone by sub-region for Africa (Area numbers are in thousands of km^2)

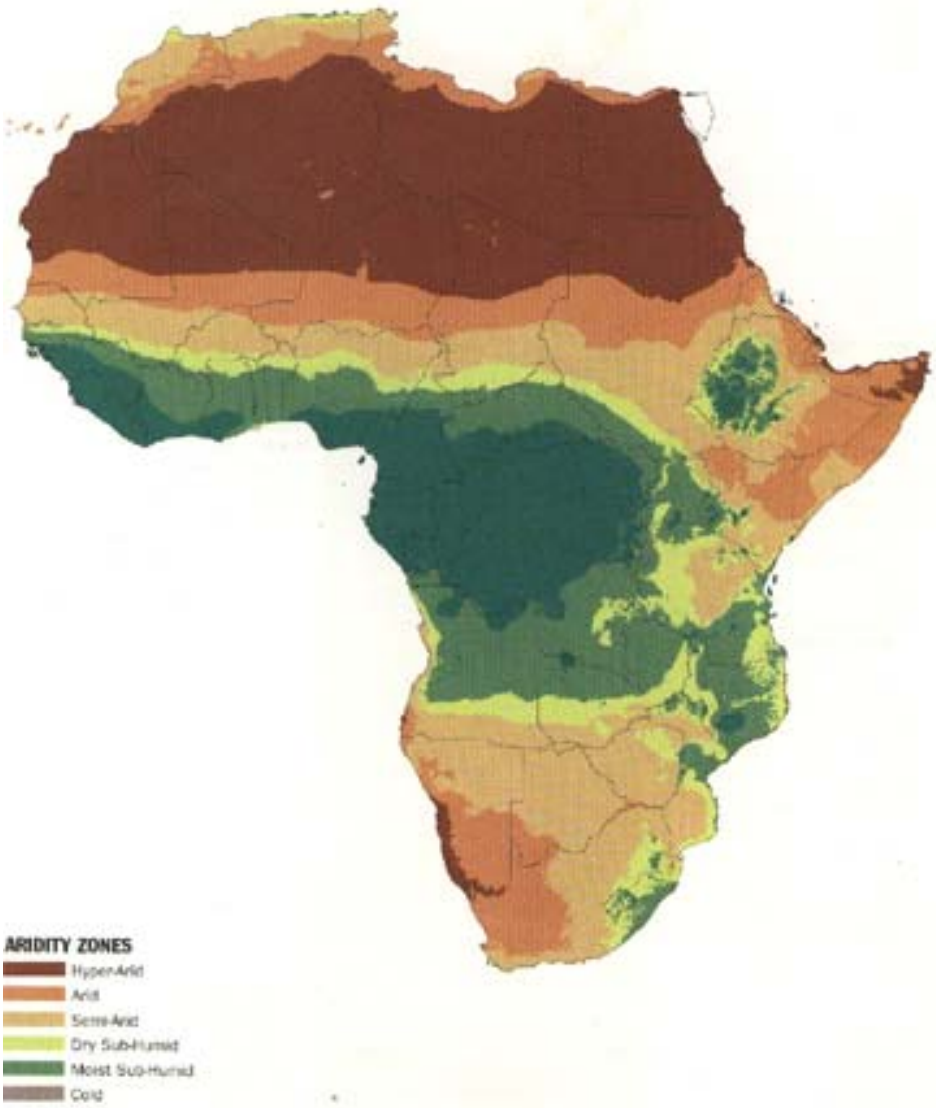
	Hyper-arid		**Arid**		**Semi-arid**		**Dry Sub-humid**		**Total**
Sub-region		%		%		%		%	
Northern Africa	4,736	81	640	11	410	7	43	0	**5,829**
Western Africa	2,363	33	1,465	20	1,278	18	514	7	**5,620**
Central Africa	0	0	6	0	66	2	144	4	**216**
Eastern Africa	878	14	1,670	27	1,768	28	767	12	**5,083**
Southern Africa	96	2	823	13	2,579	42	924	15	**4,422**
Africa Total	**8,072**	**27**	**4,604**	**16**	**6,100**	**21**	**2,392**	**8**	**21,170**

Source of data: Corbett, 1996; UNSO/UNDP, 1997

The total African aridity cover according to high-resolution assessment used to produce Table 1 is about 21.2 million ha. 38% of this area is, however, occupied by the hyper-arid category, which is largely located in the Northern region. The second in importance of the aridity categories is semi-arid which takes up 29% of the total aridity area of Africa. With the exception of the Central African region and slightly lagging behind, the Southern Africa, the other three regions, i.e. Northern, Western and Eastern regions have almost equal total cover of aridity areas (Table 1). Central Africa is largely forested and contributes to only 1% of the total aridity zone of Africa.

African countries with substantial covers of aridity zones include; Chad, Mali, Mauritania and Niger. Cote d'Ivoire, Guinea-Bissau, Liberia, Sierra Leone and Togo, also in Western region, have none or very little cover occupied by the arid zones. Benin, Gambia, Ghana, Nigeria and Senegal have some of their areas covered by semi-arid categories [Fig. 1].

Figure 1: Aridity Zones for Africa (High Resolution Data)



Source: An Assessment of Population Levels in the World's Drylands (UNSO / UNDP)

Central African countries include; Cameroon, Central Africa Republic (CAR), Congo, Equatorial Guinea, Gabon and Central Republic of Congo (CCR). Cameroon is 1% arid, 8% semi-arid. CAR is 5% semi arid. The other three countries of Central African region have no aridity zones.

The Eastern African countries include; Burundi, Djibouti, Ethiopia, Kenya, Rwanda, Somalia, Sudan, Tanzania and Uganda. Hyper-arid, arid and semi-arid zones largely occupy Sudan, Djibouti and Somalia. Kenya and Ethiopia have large areas occupied by the arid and semi-arid zones while Tanzania and Uganda have largely semi-arid zones. About 51% of Tanzania is relatively dry while over two thirds of Kenya falls within arid and semi-arid zones where 33.3%, 51.8% and 12.3% of this land experience slight, moderate and severe hazard levels of land degradation respectively (UNEP, 1997).

Namibia and South Africa have large areas of arid and semi-arid categories but also have 8% and 1% occupied by hyper-arid zones respectively. Also covered by the two arid categories are Angola and Botswana. Lesotho, Malawi and Mozambique have between 50 –55% of their land covered by the semi-arid and dry sub-humid zones. Zambia and Zimbabwe are largely covered by semi-arid and dry sub-humid dryland categories.

Extent of land degradation

Removal and degradation of vegetation cover is common in the dry areas of Africa and this directly leads to soil degradation. Deforestation and removal of natural vegetation is increasingly caused by various human activities. The status of natural resources and degree of impact on them by human and other biotic factors are important to understand. The extent of land degradation as a result of such human activities is shown in Table 2.

Table 2: Extent of land Degradation due to Deforestation and de-vegetation in Africa (million ha)

	Aridity		
Factor	**Arid**	**Semi-arid**	**Total**
Overgrazing	119.9	61.9	**181.8**
Agricultural activity	11.1	33.8	**44.9**
Over exploitation	42.0	11.7	**53.7**
Deforestation	3.9	7.6	**11.5**
Total	**176.9**	**115.0**	**291.9**

Source: World Atlas of Desertification, 1997

Overgrazing is the most notable factor in causing de-vegetation and hence degradation. The heaviest impact of overgrazing takes place in the Sahel countries especially areas falling within the arid and semi-arid zones (Table 2). Overgrazing is concentrated around settlements and is often related to recent sedentarisation of nomadic herders. The extent of degradation in semi-arid zones is more influenced by agricultural activities than in arid zones while over exploitation in arid zone is more important in natural resource degradation. A total of about 291.9 million ha of land in dryland zones has its soils eventually degraded through the four human activities (Table 2). Human activities in areas surrounding the drylands help to extend areas that become more vulnerable to soil erosion. Table 3 better illustrates the role of deforestation, especially for purposes of agricultural activities and new settlements.

Table 3: Net Forest Area changes (1990-2000) in Africa by Sub-regions (area in '000)

Sub-region	Area change	%	Remarks
North Africa	33	0.5	Increase
West Africa	1,351	1.5	Decrease
Central Africa	852	0.4	Decrease
East Africa	1,357	1.0	Decrease
Southern Africa	1,741	0.9	Decrease
Net change	**5,268**	**3.3**	**Decrease**

Data source: FAO 2001

In Western Africa only Gambia had a net forest cover gain of 1.0% during the decade. This sub-region experiences one of the highest growth of urban population and this has caused deforestation in the immediate vicinity because of increased forest exploitation for fuel wood and building materials while settlements continue to increase (Bellefontaine et al. 2000; FAO 2001). Swaziland in the Southern Africa region had a net forest gain of 6000 ha or 1.2% during the decade. Countries in the south lost much land through deforestation and few efforts were made to compensate the losses through afforestation programmes. A country like Tanzania has continued to loose about 500,000 ha annually through deforestation (Munyanziza, 2001). In the 1980s annual deforestation in Burkina Faso was 50,000 ha for the purpose of expanding agricultural land (Middleton and Thomas 1997). Deforestation in Niger has been so high that this has contributed to serious threat on the population of giraffes, which numbered only 100 individuals in mid 1990s from a much higher population (Ciofolo, 1995).

The extent of deforestation of forests, and therefore initiation of land degradation to the extent described above, has been largely attributed to the rising need for agricultural land especially around the fringes of dry areas. Analysis by FAO (2001) revealed that 4% of forests were deforested thorough shifting cultivation into undisturbed forests, 8% through intensification of agriculture in already shifting agricultural areas, 60% as direct conversion of forest area to small-scale permanent agriculture, 12% as direct conversion of forest area to large-scale permanent agriculture and 17% for other purposes like settlements etc. In the whole African continent only 8% is considered as gain in forest area during the last decade and this included also open areas that gained in canopy cover through shrub layer regeneration, as reflected by satellite image analyses (FAO 2001). It is apparent from this analysis that the so common small–scale farming activities in the dryland areas has a serious impact in initiating and accelerating land degradation to the extent shown in Tables 2 and 3 above.

In general and in addition, the combination of overgrazing, droughts, human population and choice of land use have been argued to play an important role in the extent of degradation of vegetation and soil conditions (Middleton, 1997; Middleton and Thomas, 1997). The contribution of population in degradation of natural resources is more apparent in Table 4, when

the effects of drought incidences and various types of land uses reported in Tables 2 and 3 above are taken into consideration.

Data on fire incidences and intensities in Africa is inadequate to facilitate useful and comprehensive analysis of its contribution to land degradation (FAO 2001). Information on forest, woodland and grassland fires is therefore grossly missing yet fire is an important factor in the maintenance of vegetation cover and degradation in drylands. Although areas burnt by fire may sometimes recover after the onset of rains, a combination of fire and drought, which is a common phenomenon in drylands of Africa, will usually lead to serious degradation of vegetation and eventually to land degradation. Fire incidences, some of them very bad, are common in the entire African continent but more so in the dryland zones. During the 1986-87 dry season, for example 120,000 ha of forest and woodlands (which is 30% of total area of Burkina Faso) was burnt in Burkina Faso and such caused a heavy loss in terms of plant and animal resources and, induced land degradation.

Table 4: Human Population by aridity and sub-region in Africa (numbers in thousands)

	Hyper-arid		**Arid**		**Semi-arid**		**Dry Sub-humid**		**Total**
Sub-region		%		%		%		%	
Northern Africa	53,122	43	17,820	15	38,781	32	11,230	9	**120,953**
Western Africa	1,165	0	10,804	6	52,894	28	19,,939	11	**84,802**
Central Africa	0	0	23	0	2,164	3	1,945	3	**4,132**
Eastern Africa	4,397	2	21,507	12	36,429	20	28,616	16	**90,949**
Southern Africa	80	0	1,463	1	42,696	41	26,452	25	**70,691**
Africa Total	**58,764**	**9**	**51,617**	**8**	**172,964**	**26**	**88,182**	**13**	**371,527**

Source of data: Corbett et al. (1996) and Tobler et al (1995)

On the overall, 41% of the African population lives in the arid, semi-arid and dry sub-humid areas while an additional 9% live in the hyper-arid areas, mainly in North Africa. Of the total population living in the hyper-arid areas, 90.4% are in North Africa and almost all of the lot in Egypt (92%) live along the River Nile and exclusively depend on the Nile delta. The semi-arid areas attract the highest population followed by the dry sub-humid zone. In Tanzania, for

example, which is largely semi-arid and dry sub-humid, 51% of its population lives in the drylands. This dryland area of Tanzania also occupy about 51% of the total land area. Population in the semi-arid areas in Africa is almost equally distributed regionally except in Central Africa, which has a low cover of the dryland area. A total of about 371.5 million people live in the dry areas of Africa.

The major soil degradation processes in the African dry zones are wind erosion (52%) followed by water erosion (30%), loss of chemical nutrients and salinisation (10%) and physical (8%) degradation (Table 5). Water logging plays only a small role in soil degradation of the semi-arid. Erosion by wind is more prominent in the arid areas while it has about the same effect in the semi-arid zone. Due to high population of livestock in the semi-arid zone, soil compaction is greatest here than in the other dry zones. Some 480.5 million ha of drylands in Africa are thus exposed to degradation by wind and water erosion in addition to loss of nutrients, physical compaction and to a less extent water logging.

Table 5: Effects of Physical Agents on extent of soil Degradation in Africa (million ha)

	Aridity Zones		
Physical Agents	**Arid**	**Semi-arid**	**Total**
Wind erosion	189.4	53.4	242.8
Water erosion	48.3	68.2	116.5
Loss of nutrients	3.6	25.1	28.7
Salinisation	3.4	2.0	5.4
Compaction/crustin	5.5	24.7	30.2
g	0.0	0.2	0.2
Water logging			
Total	**250.2**	**173.6**	**423.8**

Source: GLASOD; World Atlas of Desertification,

Land Degradation Rates and vulnerability

In very few cases are annual rates of land degradation in Africa been reported with certainty. This is mainly because only a few case studies have been followed for sufficient number of years that would allow evening out of the annual variations in records. In most of the cases reported gaps of information have been pointed out and more data and improvement of methodologies have been urged (UNEP, 1992; Middleton and Thomas, 1997; FAO, 2001).

As a result of variability of methodologies used and prevailing conditions of natural resources, estimates of rates of degradation are generally very different even in areas close together. Table 6 attempts to summarize reported estimates of desertification/degradation rates for several countries and areas.

Table 6: Estimates of Annual Degradation/Desertification Rates in Several Countries of Africa

Country	Site/Locality	Aridity zone	Rate %	Remarks
Kenya	Baringo Marsabit	Semi-arid Arid	0.6 1.3	Two study sites using the same methodology
Mali	Nara Mourdiah	Semi-arid Dry sub-humid	0.03 0.2	Two study sites using the same methodology
Mauritania, Mali, Niger	Sahel	Sahel	0.6	2 million ha was the collective annual rate of degradation for the three Sahel countries between 1961-1987

Source of data: UNEP 1992; Middleton and Thomas 1997; FAO 2001

As observed briefly in Table 6, the rates of degradation vary greatly, from 0.03 to 13%. What is more apparent from the results is that the more arid the area the higher the rate of desertification.

In a more general study conducted in 50 countries affected by desertification in 1989 by UNSO through a questionnaire, half of the countries reported to have experienced significant worsening situations – falling ground water levels, evaporation of surface waters, rangelands degradation, rainfed and irrigated crop deterioration and deforestation. 17% of the countries rated the

desertification situation as being slightly worse. A similar study by UNEP in Southern Africa in 1989 concluded that the situation is worsening through out the entire Southern Africa region (UNEP, 1992). In both situations it is more likely that the situation is presently even much worse, one decade later.

Assuming that countries with a high proportion of their agricultural land located in dry areas will be prone to drought and dryland degradation and similarly that those countries with high proportion of their population in the drylands should also be at risk of dryland degradation, it would be possible to derive therefore indicators of dryland degradation and, desertification risks using data on areas of aridity zones and human populations in the various zones given in Tables 1 and 4 above. Such data and statistics have been calculated by UNSO/UNDP (1997) to inform on countries likely to be vulnerable to desertification. The UNSO/UNDP (1997) data was used to compute and compile sub-regional indicators of degradation and desertification risks (Table 7). This helps to indicate the extent to which national policy makers and international development partners should respond to support dryland management initiatives. Assuming that:

(i) Productive land vulnerable to desertification (PLVD) = Arid, Semi-arid, and dry sub-humid lands,

And that;

(ii) Productive land (PL) = Arid, Semi-arid, dry sub-humid, moist sub-humid and humid lands,

Then;

PLVD/PL = indicator of drought/desertification risk.

Furthermore assuming that:

(iii) PLVD Population (PLVDPOP) = Population level within the drylands,

And that;

(iv) PL Population (PLPOP) = Population level within agriculturally productive lands

Then;

PLVDPOP/PLPOP = indicator of risk to dryland degradation.

Results of ratios of dryland area to productive land, and dryland population to population in the productive land (PL) as percentages are shown in Table 7 by regions to indicate vulnerability to degradation of productive land in the drylands.

Table 7: Productive land (PL) vulnerable to degradation and desertification by region for Africa

Sub-region	Vulnerable dryland/ Productive land %	Dryland population/ Population in PL%	Remarks
Northern Africa	100	100	All countries have their productive land and population in drylands
Western Africa	51	50	16 countries included have values ranging from 0-100 in both indicators of vulnerability determination
Central Africa	5	6	Largest portion of the six countries included are located in Equatorial Tropical Rain and is of high potential productivity
Eastern Africa	63	52	Appears more people live in the more productive land than in the drylands in Eastern African countries
Southern Africa	71	71	Much of Southern Africa region is semi arid and is wholly inhabited by local populations for farming purposes
Average for Africa	58	56	Generally about half of the productive vulnerable drylands in Africa is inhabited by people

Data Source: UNSO/UNDP 1997. PL = Productive land as defined in the text above.

Results in Table 7 indicate that the two indicators of vulnerability to land degradation and desertification gives about same results. It is apparent from the results in the table that with

exception of Central Africa, the other four sub-regions of Africa require serious attention and priority in addressing natural resources degradation and eventual desertification. Attention on Central African region should be to mitigate deforestation of its tropical forests and woodlands to avoid further expansion of desertification through the exposure of soil mantle.

The International Context

All the three major Conventions i.e. Convention to Combat Desertification (CCD), Convention on Biological Diversity (CBD) and Convention on Climate Change (CCC) relate to issues of land degradation and subsequent initiatives of rehabilitation, albeit in different perspectives.

The Convention to Combat Desertification (CCD) is ideally meant to be the key convention for dryland ecosystems (Lean, 1995). It recognizes that degradation is a world wide problem, that the crisis is more acute in the drylands and that within the drylands of Africa 73% of its agricultural lands are moderately or severely degraded. It further acknowledges both the natural and human related causes of degradation and recognizes that development must be human-oriented if such efforts are expected to be sustainable.

The CCD convention is legally binding to those countries that accede to implement it. This convention is said to have the strongest development policy - by focusing on both the protection of soil in the drylands and reduction of poverty (Hoven, 2002). Affected developing countries are obliged by the convention to accord status to combating desertification within the scope of their strategies for sustainable development while developed countries should undertake to support these efforts by means of sustainable financial contributions within the scope of existing bilateral and multi-bilateral development cooperation. It is worthy noting that the convention does not provide for new global financing mechanisms but places its faith in greater efficiency in using available resources of finance. We wish to state that this is one of the "weak links" to supporting programmes under the convention.

A key instrument for the implementation of the convention are the National Action Programmes (NAPs). All signatory governments are required to prepare, publicize and implement NAPs as the central element in their strategies. In addition, donor organizations should be integrated into

the development and implementation of NAPs. The need for regional integration is emphasized to avoid duplication of efforts and ensure efficient utilization of resources. NAPs already formulated show clear positions effects in terms of closer and better coordination of donors. However, most of these NAPs fail to formulate concrete verifiable milestones and time horizons.

During elaboration of NAPs, the convention recognizes the local population of the affected areas as the greatest resource. It stresses onfull participation of local population (especially women and NGO) based on the principal of "a bottom up" approach in the formulation and implementation of the NAPs. An evaluation of the already prepared NAPs confirms involvement of the local populations though qualitative indicators for evaluating their participation need to be clarified.

A major contentious issue in the convention relates to financing of the NAPs. As previously mentioned there is no new financing mechanism. Funding through a dedicated window at Global Environment Facility (GEF) is complicated by the fact that soil degradation was not categorized as a global environmental problem during the negotiation of the convention. However, two options offer scope for limited support;

- integrating measures for combating desertification and the outcomes of NAP processes more strongly into national level development strategies e.g. national poverty reduction strategies and coordinating with other programmes running in parallel e.g. conservation of forests and biodiversity, and
- linking measures for combating land degradation with protection of biodiversity or climate change.

The above funding options, though useful, are not an end in themselves. There is need for better options to be explored to ensure that the vision and good intentions set out in the convention are realized. Meanwhile, the affected countries need to place their NAPs within strong institutions and government ministries as donor governments intensify to underscore the significance of the convention in their political dialogue with partner countries (Hoven, 2002). Additionally, the

contribution of the convention to ensuring food security and poverty reduction by maintaining soil fertility needs to be clarified both in the donor and recipient countries as an incentive to financial support.

The Convention on Biological Diversity is a legally binding agreement which recognizes the importance of conserving biological diversity as well as the sustainable use of natural resources. The convention has three main objectives (WWF, 1996)); the conservation of biological diversity; the sustainable use of its components; and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. To achieve its objectives, the convention; which includes 42 articles, emphasizes national actions and details some techniques to achieve its goals.

The dryland ecosystem is covered under various articles (Secretariat of the Convention on Biological Diversity, 2001). Article 8 on In-situ Conservation addresses three areas: ecosystems, habitats and viable populations; rehabilitation of ecosystems and recovery of threatened species; and traditional knowledge. The convention emphasizes the need for each contracting party to promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings. One of the targeted activities is the sustainable management of dry and sub-humid land production systems. Contracting parties need to undertake to rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, inter-alia, through the development and implementation of plans or other management strategies. Restoration of degraded lands and biodiversity is a major focus of the international initiative for the conservation and sustainable use of pollinators and is one of the targeted actions in response to identified needs in the work programme on dry and sub-humid lands. The respect, preservation and maintenance of knowledge, innovations and practices of indigeneous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promotion of their wider application involving holders of such knowledge and encouragement of equitable sharing of the benefits arising from utilization of such knowledge, innovations and practices are recognized. This aspect is closely linked to a number of other provisions of the convention including thematic work programmes on the biodiversity of dry and sub-humid lands, among others.

Article 10 examines the sustainable use of components of biological diversity and emphasizes the need of integrating biodiversity concerns into national decision making process, supporting local populations, developing and implementing remedial action in degraded areas where biological diversity has been reduced and promoting wider public and private sector involvement within the goal of conservation and sustainable use of natural resources including those from the drylands. Research and training has been given a special focus under article 12 with emphasis on the conservation and sustainable use of biological diversity.

Funding mechanisms are covered in articles 20 [financial resources], 21 [financial mechanisms] and 39 [financial interim arrangements]. Under article 20, each contracting party is requested to provide financial assistance and incentives to support national plans and priorities. However, the convention recognizes that economic and social development, as well as the need to overcome poverty are priorities of many developing countries, some of which may be unable to comply with the convention and calls upon the support of developed countries. The convention has therefore provisions for a financial mechanism (article 21) on a grant or concessional basis. The Global Environment Facility of the World Bank, UNEP and UNDP is the interim funding mechanism. Additionally, developed countries are encouraged to strengthen existing financial institutions to provide financial resources in support of the convention through bilateral, regional and other multilateral channels. This is the only convention with elaborate funding mechanisms even though there exist some controversies.

Dry and sub-humid lands are among the six thematic programmes established under the convention. The dry and sub-humid programme has two parts; assessments and targeted actions in response to identified needs. Six activities under assessments and three under targeted actions have been identified. Overall, the convention is supportive of interventions in the lands relating to conservation of biological diversity and sustainable use of the resources. It is still a challenge for the contracting parties in the drylands of Sub-Saharan Africa to make full use of the enabling provisions of the convention.

The United Nations framework Convention on Climate Change [UNFCCC] was developed following a growing public concern of the possibility of global climate change. The idea was conceived in the 1980s. This was followed by a series of international conferences in the 1990s that led to the establishment of the Intergovernmental Panel on Climate Change [IPCC] through which rapid progress was made. In 1990 the Intergovernmental negotiating Committee for a framework Convention on Climate change [INC/FCCC] was set up with the mandate of drafting a framework convention and related legal instruments. The United Nations Framework Convention on Climate Change [UNFCCC] was adopted in 1992 and ratified at the Earth Summit in Rio Brazil [UNEP/WMO, 1992]. The framework of the UNFCCC has 26 articles.

The objective of the Convention is "to achieve … stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic influence with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adopt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner". To achieve the objective and implement its provisions, the convention has laid down five principles and ten commitments, which the conference of parties should comply with.

This is the least understood and most confusing convention. For example, it is called a framework convention because it is concerned primarily with the creation of an arena for consensus building and many negotiations still lie ahead on a wide range of issues to the present day. Silveira (1994) has outlined six other reasons as to why it is still a framework convention. The convention does not set rigid mechanisms of the commitments though it provides two broad categories of action which however, are not legally binding:

- The first is on "research and observation of climate change phenomena, education, training and advocacy in accordance with national laws and capabilities, and communication of information relating to the implementation of the convention's objective,"
- The second concerns "the Institutional organization that will follow up on the implementation of the convention including conference of parties, which will

monitor action of various countries; the secretariat which will deal with day-to-day matters; a body for scientific and technical advise; a subsidiary body for implementation; and a multi-lateral consultative process.

There is no clear mechanism on financial arrangement with only general statements being made. For example, it is expected that each signatory builds climate change considerations into its national development policies, plans and programs. Further, that resources are to be provided to support developing countries with grants for the implementation of the convention's objective. GEF is expected to operate the funds but the mechanism is not well elaborated. It is also expected that the implementation of measures under the convention will be financed through bilateral or multi-lateral sources, but the resources that have been committed are so far still limited.

Nevertheless, Africa in general, and in the context of this report, the dryland sahel countries have a role to play in the convention. Although Africa's contribution to the increasing concentrations of greenhouse gases is minimal - believed to be no more than 7% (Silveira, 1994), scientific evidence indicates that the effects of global warming will be felt in every region, some more severely than others. For example, it is expected that global mean surface air temperature, under the prevailing circumstances, will rise by 10% by the year 2050. As a result, the warming would be strongest over the drylands of northern and southern Africa. Rainfall levels would decline by 10% in some parts and this reduction, coupled with higher temperatures, will worsen the already extreme conditions in some parts of the drylands, especially in the northwest. These climatic changes will have negative impacts on a wide range of sectors/natural resources – agriculture and therefore food security, water resources, natural vegetation, among others.

Africa will need to be part of the international community in working strategies for mitigating climate change, albeit from an African perspective. For example, Africa like other developing regions, needs to identify research, technological and financial needs that can be met through the opportunities created by joint implementation projects. Secondly, investments to joint implementation projects by the north should be seen

as additional investments in the south. African countries should lead in the formulation of relevant objectives to avoid falling into support not relevant to Africa and local goals.