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)

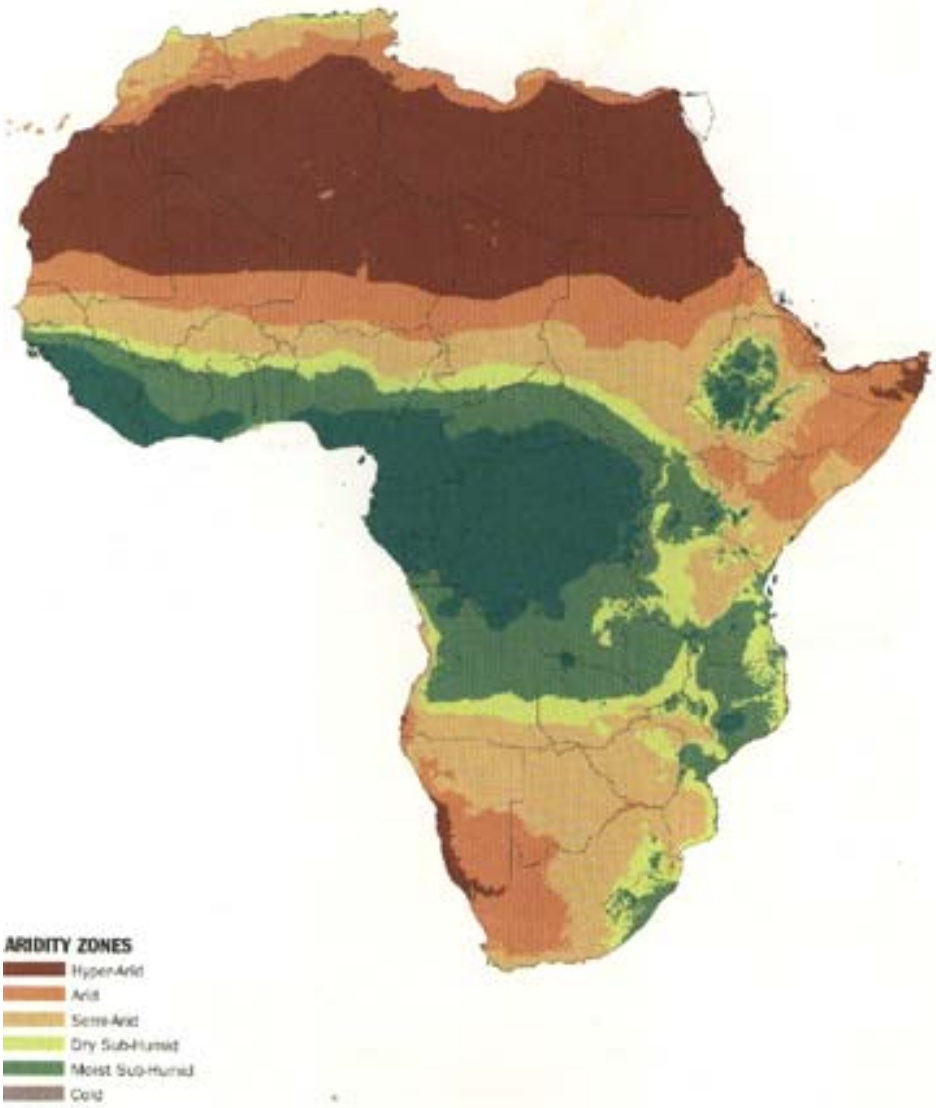
	Hyper-arid		**Arid**		**Semi-arid**		**Dry Sub-humid**		**Total**
Sub-region		%		%		%		%	
Northern Africa	4,736	81	640	11	410	7	43	0	**5,829**
Western Africa	2,363	33	1,465	20	1,278	18	514	7	**5,620**
Central Africa	0	0	6	0	66	2	144	4	**216**
Eastern Africa	878	14	1,670	27	1,768	28	767	12	**5,083**
Southern 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.

Section II: Lessons from Case Studies; Factors for Success or Failure

At the time of preparing this background paper, not many case studies had been received and those available were already published in authoritative sources. The search for representative case studies from the dry sahel is now on. Meanwhile, three cases from Kenya have been compiled to share some of the on-going experiences and draw lessons on rehabilitation of degraded lands in the drylands of sub-saharan Africa.

Case Study 1: Community Resources Management by the Elangata Wuas Ecosystem Management Programme, Kajiado District, Kenya.

Background

This is a case of the Kenyan Maasai people whose pastoral lifestyle has been curtailed since the coming of the colonial government to the present day. First, their movement was restricted South of the Uganda railway line in 1912 leading to heavy loss of prime pasture land including dry season grazing areas, salt licks and watering points. Nomadic pastoralism was perceived then as a retrogressive land use system and major cause of land degradation. In the early 1960s, the government of Kenya introduced a group ranch strategy as an alternative mode of land use in dryland areas, further restricting movement of the communities. In the programme area three group ranches comprising 160,000 ha were created: Elangata Wuas, Kilonito and Torosei. Today, the area is home to about 10,000 persons and 27,500 heads of cattle representing an overstocking rate of about 90%.

The main economic activity of the maasai communities remain cattle raising but in a semi-nomadic and semi-sedentary system. However, with further sub-division of group ranches and allocation of parcels to individual holdings, the traditional livestock grazing patterns have been constrained and more so, in the absence of proven alternative land use technologies. This has led to heavy degradation of the natural resources base, particularly the pastures, soil and water.

Besides these bio-physical forms of land degradation, lack of experience and know how among the communities to engage in benign management practices and technologies, including coping mechanisms under the new land use systems has led to growing poverty, loss of livestock, rising unemployment and declining health. The women, old people and the youth are shouldering the bulk of the burden.

The Elangata Wuas Ecosystem Management Programme [EWEMP] was formulated to address some of these problems. EWEMP is a partnership between the community in the Central Division of Kajiado District, the Centre for Biodiversity of the National Museums of Kenya (NMK) and the Kenya Wildlife Services (KWS). EWEMP was initiated in 1992 through discussions between the NMK and the KWS with the Elangata Wuas, Kilonito and Torosei communities in Kajiado District. Following a protracted planning and design process, EWEMP initiated pioneering field activities in 1998, and has subsequently strengthened promising ones from 2000. The programme is funded by the Ford Foundation with co-funding from the International Development Research Centre of Canada (IDRC).

Mission, Objective and Approach

EWEMP's mission is to empower communities to mobilize their own capacities, be social actors rather than positive subjects, manage their resources, make decisions and control activities that affect their lives and environment. Its broad objective is to develop methodologies for sustainable management of natural resources, rehabilitation of degraded sites, diversification of income generation, and an acceleration of transition into the cash economy for improved community livelihood.

The programme's approach is based on building a participatory partnership that places people and their needs at the centre of natural resource management (NRM) for sustainable development.

Results and Lessons for Success or Failure

During the last four years the programme has achieved the following:

i. Building Community Based Organization and Governance Structures

The programme has developed a Community-Based Organization (CBO) with a strong local foundation. It provides sensitisation, mobilization, recruitment, empowerment and capacity building to the CBO to enable it undertake all local development programmes and sustainable management of resources to generate income for members.

Experiences gained so far show that the grounding of a credible CBO is contingent on establishment of a grass-root structure with legitimacy and recognition from stakeholders, and respect of the community. The members are concerned about transparency, accountability and equitable distribution of benefits. It is only through assuring resource ownership by the community and equitable access to benefits that the participation of the community can be assured.

ii. Woodland Management

This is one of the promising and key micro-enterprises in the programme area. The programme has developed relevant databases on the woody resource that allows low impact off-take practice under a prescribed system of criteria and indicators for sustainable management.

The members of the woodland micro-enterprise have developed a mini co-operative whose members practice a 15-years rotation felling cycle for charcoal production. Each member produces 10 bags of charcoal monthly that she/he delivers to a sale yard from where it is marketed to charcoal dealers at negotiated unit prices. The micro-enterprise is managed by rules and guidelines developed and enforced by its members. Currently members earn about Kshs. 3000/= per month from charcoal production.

iii. Consumptive and Non-consumptive Utilization of Wildlife

- Wildlife utilization

The community is adamant that wildlife which shares their land with livestock should justify its existence by providing some benefits to them. Further, the programme recognizes that wildlife management and conservation depends on information on their numbers, distribution dynamics and the state of the range and the co-operation of the land-owners. In this regard, factors influencing species abundance such as increases in human and livestock population and the people's attitude have been discussed and noted. The programme has explored opportunities for generating of income from wildlife and eco-tourism such as wildlife cropping, ostrich husbandry, beekeeping, filming, bird-shooting, home stays and cultural exchange. To date the community has established a wildlife utilization committee with representation

from all stakeholders in the group ranch, and has been trained on animal scouting, population assessment and tour guiding. The committee is, however, still waiting for the government's guidelines on cropping and inauguration of the micro-enterprise.

- Eco-tourism

The programme has established a base camp with satellite camping sites and a network of recreational activities as a nucleus for its eco-tourism micro-enterprise. Since the launching of the eco-tourism micro-enterprise over one year ago, over 500 visitors have visited the area as individuals and organized groups from institutions, as nature lovers, researchers, or on learning/training missions, using the programme's facilities. The community earned over KShs.1 million from its eco-tourism micro-enterprise during 2000.

- Pastoralist Ostrich Husbandry

Experiences from ostrich husbandry show that the community is able to produce birds cheaply for meat and breeding at a cost of KShs. 4,000 per bird, over a period of 25 to 30 months. The birds are herded with sheep and goats at no extra cost and fetch between KShs. 10000 and 20000 each. By contrast, a mature bird fetches KShs.75000 in the export market. Prevailing poor market structure and unfavourable government policy on ostrich production remain serious constraints to the development of this micro-enterprise. In the year 2000, the 12 participating community members earned KShs.200000 from the sale of 23 months old ostriches.

- Beekeeping

This activity has attracted 20 farmers all of whom have acquired Kenya top bar hives. The programme runs a nucleus production unit at the base camp and provides participating families with backup training and hive management, harvesting and honey processing. Each farmer harvests 10-15kg of honey, two to three times a year, with 1kg of honey fetching KShs. 250.00.

iv. Sustainable Use of the Sand Resources

Sand harvesting along river Toroka has become an important source of income. The area is readily accessible to lorries particularly during the wet season when roads to other sand producing areas

are impassable. This has led to heavy and non-sustainable off-take of building sand. On realizing that heavy sand harvesting affects ground water levels and hence negatively impacting on the wells downstream, the community decided to carry out a study to:

- Determine the volume of sand resources in a specified area along the river,
- Determine the characteristics of the sand beds, the seasonal variation in the water table and the effect of sand harvesting on the water levels on the wells along the river bed,
- Evaluate the general condition of groundwater along Toroka river so as to identify sites for drilling boreholes to supplement existing water supplies.
- Carry out a monitoring of sand harvesting intensity and natural sand recharge rates, and fluctuations in the levels of aquifers in the area, and hence generate basic data for building a Geographical Information System (GIS) for further rigorous analysis, modelling and generating land-use information.

Available information shows that about 400,000 tons of sand can be harvested per year from the river segment under the study sustainably. This is valued at KShs. 20 million of which KShs.19 million should go to the community.

v. Pasture Rehabilitation

The results of assessment of the state of pasture had revealed that overgrazing pressure in the area over the last two decades or so has contributed to marked degradation of the vegetation and the ecosystem in general. Successive trampling and selective grazing has subsequently led to dominance of unpalatable species of forbs and grasses, and invasion of weeds and woody plants. This has concomitantly led to a reduction in the population of palatable woody plants, perennial forbs and grasses and an expansion of annual species.

To reverse this trend the programme;

- Embarked on assessing the effectiveness of promising low cost technologies for mitigating the state of land degradation. The results of investigations carried out so far show that exclusion of grazing pressure, supported by erection of physical structures through construction of cascades of pits, a matrix of pegs drilled on the ground on the eroded surfaces across the contours, a series of

stones and brush wood arranged across run-off channels, and broadcasting seeds of prime browse grasses such as *Digitera macroblaphara, Pennisetum strameineum, Sprobolus pellicidus, Dactyloctenium aegyptium* seeds before the rain, have given promising intervention points. The physical structures trap excessive water run off thereby enhancing infiltration and promoting healing of degraded sites. But it is critical to exclude the affected areas from grazing during treatment.

- Began exploring cost-effective techniques for rehabilitation and sustaining the pasture potentials in wooded areas. The opening up of the wood-encroached sites was taken together with low impact harvesting for biomass production. Managed removal of materials for fuel-wood production enables a gradual opening up of the wooded areas and in time allows regeneration of prime browse perennial grasses.

vi. Women in Development

A total of 10 women groups, registered with the ministry of culture and social services are operating in the area. The women groups have excelled in managing income-generating activities. The programme supports and empowers them through training on product development and quality control in making artifacts and handicrafts. The women are currently earning an average of Kshs.800 monthly on an investment of about one hour per day working on a four to five days per week. Lately they have also been involved in vegetable production using drip irrigation.

Conclusion

The programme has accumulated useful working information in promising components of biophysical, socio-economic and cultural aspects of resources management. The team of researchers and their visiting partners have worked supportively, cross-sectorally among themselves, and with members of the community. The programme has established a cohesive local level resource governance structure that has taken ownership of the programme.

It is noticeable that the community has started to appreciate EWEMP's innovative approach that focuses on community empowerment and capacity building for self development. By contrast, other community-based projects give direct support to individuals or institutions, such as school fees for needy families, granting roofing and water storage materials, but finally leave them unchanged.

Although the micro-enterprises are not fully functional, the initial level of flow of benefits, particularly from the biomass energy, eco-tourism and sand harvesting activities, has caught the attention and interest of members. Consequently, the list of members has doubled up and the community has become actively involved in fighting game poaching, active participation in the micro-enterprises, and other activities of the programme. The enhanced level of interest in the programme was accurately portrayed by the recent experiences in the elections of the PPC and PMC that were vibrant with serious lobbying, canvasing and campaigns. Unlike the previous elections, this time round, people turned up in large numbers under various groupings: clans, age sets etc. as a strategy for out smarting one another in electing candidates into the programme's committees.

It is evident that the processes of empowerment and capacity building initiated in the programme area will nurture the CBO into a dependable vehicle for managing change and development in the area. Results of the research effort in dryland resources management are also encouraging, although many of these have not covered both the good and bad rain years. Generally, members are convinced that with effective marketing of their products they would build new income sources, establish sustainable locally-based economic activities and finally shift from traditional reliance on pastoralism. It is at this stage, that the message on destocking (over-stocking currently stands at 90% and remains a major course of land degradation) and adoption of non-degrading land use systems, will be meaningful.

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Case Study 2: Restoring the Vegetation and Improving the Livelihood of the Kamba and Maasai People in Kenya

Background

The Akamba people are found in south eastern Kenya while the Maasai are found mostly in southern Kenya. The region is characterized by low, unreliable and erratic rainfall. It has two rainfall seasons of march – May (with a mean of 200-300 mm) and October – December (with a mean of 250–460 mm). Evapo-transpiration is high ranging from 1550 – 2500 mm per year.

Most of the land is between 500 – 1000 m in altitude with a number of hills some reaching 1600 m above sea level. The mean temperatures range from 16 – 30^{O}C. The soils are medium-textured ferrasols with the dominant type being moderately deep chromic luvisols. The vegetation is mainly dry woodlands and bushlands. The area has medium to low potential for plant growth.

Over the last 100 years or so the region has continued to attract more people and especially during the last 50 years despite the fact that the region ranges from dry sub-humid to largely semi-arid in ecological conditions. This pressure has led to continued degradation of vegetation and soils.

Due to the evident degradation of the natural resources in the region, the Government of Kenya entered into a partnership with the governments of Japan and Belgium to undertake a natural resource rehabilitation programme for the region. Rehabilitation of forest and tree resources was identified as a priority. Two Ukambani Districts (Kitui and Makueni) and one division of neighbouring Kajiado District; the later largely occupied by the Maasai people, were identified as the focal areas of attention. Two formulation missions carried out in 1985 and 1995 found that the region experienced low farm income and inadequate food supply at household level because of various constraints. But, before a framework of development interventions was formulated, it was realized that the available technical tools and capacity for rehabilitation were inadequate. It was agreed that these shortcomings be addressed before a comprehensive rehabilitation action plan was adopted. The three governments, therefore, came up with a programme to perfect the tools of rehabilitation with the following objectives in focus:

- to improve capacity of extension service and farmers in dryland forest rehabilitation;
- to establish methods of seedling management and tree establishment;
- to establish restoration possibilities for degraded woodlands, soils and soil moisture regimes;
- to select, develop and promote high value timber and food trees to fit into alternative livelihood commodity development options; and
- to develop a social forestry extension model for arid and semi-arid areas.

A Social Forestry Training and Rehabilitation project for Semi Arid Areas [SOFEM] was thus initiated in 1985, in Kitui District and an Agroforestry project for Integrated Research and Development in Semi Arid Areas of Kenya [ARIDSAK] in Makueni and Kajiado Districts in 1997. Both projects have adopted integrated and multi-disciplinary approaches involving all the stakeholders in the planning and implementation process. SOFEM has Kenya Forestry Research Institute [KEFRI], Forest Department [FD] staff and Japanese International Co-operation Agency [JICA] experts as subject matters specialists working closely with selected core farmers, local groups and schools representing beneficiaries. ARIDSAK has KEFRI, KARI and staff from line Ministries of Environment and Natural Resources [Forest and Water Departments] and Agriculture and Rural Development providing subject matter specialists and selected farmers, local groups or schools representing beneficiaries. The project uses research and development approach at on-station where technologies are developed and tested by subject matter specialists. Promising technologies are verified further under farmers' conditions. Proven technologies are packaged in the form of extension materials for use by extension staff and farmers within the project area. Through this approach, neighbouring farmers benefit through learning experiences of the core contact farmers.

Other avenues for demonstration include greening and conservation of selected earth dams to reduce siltation. Meanwhile, capacity building through training has been a major activity of the two projects. A wide range of outputs have been realised.

Results and Lessons Learned

Capacity Building in Dryland Forestry

Courses on social forestry for dry areas, especially focussing on farmers and extension frontline service have been conducted. Some 1400 national participants were trained on tree nursery techniques and management, tree establishment, protection and use by 1997.

In addition to the national courses, regional courses on social forestry were conducted covering dryland tree technologies, extension methodologies, policy formulation to promote social forestry in drylands and the role of forestry in enhancing conservation and mitigating desertification in the Eastern and Southern Africa region. Angola, Botswana, Burundi, Eritrea, Ethiopia, Lesotho, Malawi, Mozambique, Namibia, Rwanda, South Africa, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe and the host Kenya are the regular participants of the Regional Social Forestry for drylands training course. 20 participants from the region are trained annually and to date some 160 participants have trained in the social forestry course. Of the 5 weeks duration for the course, the regional participants spend 2 weeks in the project districts to be exposed on the lessons and experiences in tree and environmental rehabilitation of drylands.

On-Farm Tree Planting and Extension Methodologies

Seedling propagation and management

22 commercial and 32 domestic small-scale nurseries have been promoted in the three districts of Ukambani and Maasai (Kitui, Makueni and neighbouring Kajiado) respectively. 70% of these nurseries are managed by women groups while the remaining 30% by groups comprising both women and men. The focus of promotion of tree nurseries were propagation and raising of seedlings, tree planting in farms, and income generating opportunities.

Nursery activities were promoted for ten years (1985-1995). Five years (2000) since the ceasing of formal intervention, an evaluation was carried out, which revealed that although 25% of the contact groups stopped nursery activities, some 18% new groups had taken up nursery activities and there were more individuals, some who were part of the fall out groups, that had taken up to tree small-scale nursery activities. But what was more interesting is the fact that the estimated total annual seedling production by small-scale nurseries had changed from 550,000 (1993) to a total of 1,245,000 (2000). In addition, among the seven income generating activities of the women and combined groups, tree nursery activities moved from a general sixth position to third or fourth positions in importance. Groups and individual nursery owners within the R & D farms in Kitui and especially Makueni Districts have made income from sale of seedlings ranging between US$ 900-2500 per year. The higher earners, especially individual nursery owners, got more income through sale of seedlings of grafted mangoes and in few cases citrus, which fetches two to three times the price of ungrafted seedlings.

Tree Establishment and Management

Several methods were proposed for use by farmers to enhance establishment of tree seedlings under dryland conditions. The main constraint in dryland forestry practice is inadequacy of moisture to ensure establishment of seedlings. Four water conservation/ harvesting methods have been widely tested and an evaluation of this effort indicated that the use of soil structures to concentrate water to the seedlings has been commonly adopted by over 40% of tree growing farmers. Use of terracottem, which has also been promoted proved to be expensive for the small-scale farmers. Where water is available, the recommended watering regimes and schedules are used almost by all the tree growing farmers.

Promotion of High Value Timber and Fruit Trees

In addition to use of trees in rehabilitating degraded vegetation and lands, a deliberate effort was made to select high value trees as incentive to tree planting. Such trees included *Melia volkensii* (indigenous, fast growing tree, which is resistant to termite), *Dalbergia melanoxylon* (an indigenous slow growing but highly valued for wood carving), *Terminalia brownii* (indigenous and favoured for its good form and resistance to termite), *Senna siamea* (exotic and prioritized for its fast growth and therefore quick provision of fuelwood), *Mangifera indica* (a fruit tree that has become successful), and *Citrus sinensis* (for its adaptability and fruits). It has not been possible to get the proper total area cover of these species. It is however estimated roughly that during the last 5 or so years, *M. volkensii* has gained a collective area cover of about 50 ha, 5 ha for *D. melanoxylon*, 5 ha for *S. siamea*, 3 ha for *T. brownii* and over 60 ha for *M. indica*. The cover of the target timber and fruit tree species is likely to increase since the mood of tree planting is high due to the promotional lobbying done by the projects.

Natural Restoration of Degraded Woodlands

Due to over exploitation of woodlands and especially overgrazing, charcoal production and firewood collection, recovery of vegetation becomes difficult and slow. Monitoring of recovery of woodlands was possible after an area is excluded from grazing for a period of as short as one to two years. Seedlings of *Commiphora, Terminalia* and *Acacia* species regenerate immediately an area is excluded from animal grazing and since these are not browsed, the open areas are fast covered. The success of vegetation recovery after grazing exclusion is an initially quick re-establishment by a dense shrubby layer. The dominant species in the shrub layer are *Hermannia oliveri, Aspilia mossambicensis, Solanum incanum, Chloris roxburghiana* and *Sporobolus fimbriatus*. This layer creates a favourable condition for the quick establishment of drought woodland species dominated by *Commiphora africana, Acacia senegal, A. tortilis, A. mellifera, A. brevispica* and *Terminalia brownii.* Within two to four years some of the species grow to heights beyond the browsing level by goats. This is a successful approach that has been promoted in the Ukambani districts and is largely now being used by the animal range management farmers in the restoration of degraded woodlands and thus providing more foliage and tree raw materials for various and more sustainable uses by the owners.

Social Forestry Extension Model

As a result of an experience on social forestry and tree planting in dry areas of Kitui, Makueni and Kajiado Districts, a Social forestry extension model has been developed by the Kenya-Japan supported dryland initiative. It is expected that extension service and farmers would benefit from the model. The project proposes to develop appropriate guidelines for practical use of the various aspects of the extension model. The Belgium intervention has taken to the use of the project experience to develop district management plans for sustainable use by the extension service and farmers in the Ukambani districts.

Conclusion

The intervention accounted briefly above for the case of Ukambani region and Kajiado in Kenya provide important experiences and lessons which are being put in practice in the area. The experiences are potentially viable for use in other dryland areas of Africa. Capacity of farmers and extension service in rehabilitation of degraded drylands has been improved not only in the project areas but also the Eastern and Southern African region where participants from the regional countries have gained experiences of the projects for the last 8 years. Several intervention technologies have been developed and their use recorded verifiable impacts in reversing degraded lands into more sustainable use of the vegetation resources.

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Case Study 3: Participatory Extension Strategies for Promoting Agroforestry in the Drylands of West Pokot District, Kenya

Background.

The Pokot people are a community inhabiting the West Pokot District in North Western Kenya and northern parts of Baringo District. West Pokot District is largely a dryland area experiencing erratic climatic conditions and difficult terrain.

Traditionally, the Pokots are nomadic pastoralists whose lifestyle is rapidly changing to sedentary mixed farmers, especially in areas where conditions permit. Like many other semi arid areas in the country, the area has been experiencing population increase both human and livestock. The harsh climatic conditions over most of the area and difficult terrain makes the area inaccessible. Traditional pastoral lifestyle is still practiced by most of the community members. The climatic conditions, terrain and traditional lifestyle practiced makes the area impossible to cope with increasing population in terms of sustainable resource management and use. The area is prone to periodic droughts accompanied by famine and poverty. Land degradation is evident over most places further threatening the livelihoods of the local people.

Realising the magnitude of the problem Vi-Agroforestry Programme became concerned and showed interest in participating in the fight against desertification which was spreading fast, threatening the lives of people, animals and vegetation. Vi-Agroforestry programme, which has its headquarters in Kitale town, is funded by the Vi-planaterar Träd Foundation, an International NGO with headquarters in Stockholm, Sweden. Its overall goal is to contribute towards better living standards of the small-scale farmers in the project areas, i.e. farmers who own at least 1 to 5 acres of land and are fully dependent on their farms on a daily basis. Three immediate objectives were identified as the key towards achieving the project goal: increased food and nutritional security, fuelwood availability and income generation. The programme began by carrying out a survey of the Kainuk area, along the Wei-Wei River and in Chepareria Division, which revealed the loss of both soil and vegetation. The seasonal rivers indicated unreliable water source, surface sealing, soil erosion, and loss of useful trees and shrubs, annual grasses and less productive species in the area as well as deep gullies. The situation constituted a threat to both human and livestock movement.

Conservation and rehabilitation by planting trees on the large bare patches was the immediate way of solving or arresting the problem. Conservation involves management of natural resources to prevent destruction and neglect. Well-conserved grazing lands are seen as properly utilized and managed resources that provide for present and future generations without depleting the resource base. On the other hand rehabilitation is a process whereby a misused and over utilised area is reinstated or replenished through soil conservation and tree planting. The study also involved socio-economic measures on how land can be utilized to its usefulness.

Programme Approach and Strategy

During the initial stages of implementation, the Project had some difficulties of gaining acceptance from the community, especially with regard to some of the technologies like enclosure system given past experience where the government used such approaches to acquire land. To overcome this challenge, the project identified representative public institutions; schools and churches which had suffered degradation and established enclosures. The project did all the work, paying for all the costs. After sometime these sites recovered and were used as demonstration sites for the local community. On observing the regeneration and rehabilitation of the land within the enclosures, some pastoralists volunteered a portion of their land for rehabilitation activities. On realising the benefits, their fears were removed and more came to request the project for assistance while others spontaneously established their own pasture enclosures.

Today, the project has applied the principal of participatory extension that involves the following stages;

- Participatory Rural Appraisal (PRA)

  Vi-Agroforestry Project applies PRA which helps the community to identify or diagnose their own problems and seek possible solutions to address them. PRAs are based on the real needs and within the capacity and skills of the community and their local institutions, which could assist the community in the implementation of the plan with either technical advise or other forms of support. **T**he programme works with the District development office, other government ministries and NGOs thus, the PRA process has been institutionalised. Areas requiring PRA exercise have been identified by the project extension officer in-charge, other collaborators or the community themselves who on many occasions had observed the benefits of this activity from their neighbours.

  PRA has been used in a broader scope as the Project's entry point to make community members decide and analyse their own problems and identify their own resources for solving them. This promotes farmer participation in the development of Agroforestry. The awareness created enables the community to develop their own community action plan addressing different sectors of development.

- Community Action Plan (CAP).

The community's needs and priorities are prepared in the form of CAP for implementation. The implementation is at two levels; through groups or individuals. Group approach is more common i.e. a group of farmers are identified on the basis of established groups. The extension workers enter into discussion with the groups over the agroforestry activities to be undertaken, get targets per agreed activities, discuss inputs and agree on the role the group will play in the provision of required input. They also monitor implementation. The same procedure is applied to individual farmers who for one reason or another cannot join a group.

To ensure that a given area is properly covered, the project has adopted an Area of Concentration approach (AoCA). In this approach the project extension agent is stationed in an area of concentration where he/she progressively and intensively works with 200-350 farmers for a period of 3-5years depending on the community response. At this point the community shall have been gradually empowered to sustain various agroforestry activities on their own. The extension officer then moves to a new area, and constant follow-ups are frequently made in the old areas to establish their progress.

Apart from establishment of enclosures and construction of water catchment structures for land rehabilitation, the project has identified and tested other technologies for good land use management practices. These include;

- Soil fertility improvement based on the principle of organic farming (trees/crop residues, farm yard manure or promotion of short term fallows).
- Local seed collection and tree management.
- Woodland management,
- Apiculture (bee keeping) promoted alongside tree planting and woodland management.

Field demonstrations, short courses and related activities are offered to improve the farmers' capacities in sustainable management. Training activities include field days, farmers study tours, especially to the projects Agroforestry Centre, as a model and to other successful farmers and relevant institutions. Basic nursery and agriculture courses as well as advanced Agroforestry training activities are also offered. The aim of several training activities offered is to enhance human resource development and ensuring the project's efficiency. It is worth noting that farmers have

been trained on agroforestry practices, direct sowing techniques, organic farming, farm planning and home tree nursery establishment and seed collection. About 95% of the projects seed supply is from trained women groups.

Results and lessons learned

The project is presently working in both Trans Nzoia and West Pokot Districts with over 25,000 farmers. From evaluation and survey report of the project activities during the year 2001, more than 6,500 households were reached who have acquired knowledge and skills in agroforestry. Out of these, 452 were new farmers. 168 home nurseries produced 7,643 seedlings in W. Pokot while 5 group nurseries in Kongelai produced about 6,300 seedlings. 127 farmers in Chepareria were involved in the collection and use of seeds. Regarding soil and water conservation, there were 45 demo plots and 4,025 ditches in Kongelai and 1,000metres of retention ditches in Chepareria

Rehabilitated areas have trees of both exotic and indigenours species. Among the exotic species doing well in the areas include *senna siamea, Azadirachta indica (neem), Leucaena leucocephala, Faidherbia albida and Parkinsonia aculeata*. Indigenous species predominate rehabilited areas. Major ones are *Acacia nilotica, A. tortilis, Balanites aegyptiaca, Terminalia browinii and Zizyphus macronata*.

The enclosure system has had great impact on:

- Land tenure and value. Land tenure is slowly changing from communal to individual ownership hence, raising the value of the land. Some farmers are now selling grass to their neighbours for thatching which has led to be better housing or rental as pasture (improved animal health) to earn income.
- Reduced migration in search of off-farm grazing hence, families are now staying together for longer time, improved enrolment in schools, improved pasture and animal health.

- Increased food production as more land is now under crops. Maize, beans sorghum, millet and other new crops like cassava, pigeon peas, green grams, kales and assortment of fruits e.g. paw paws, bananas, guavas and mangoes are cultivated.

Changes in roles within families e.g. women assist in herding due to availability of fodder near homes, presence of men in the homes provide extra labour hence, diversification and expansion of the cropped area. Due to increased milk production and commercialisation, men are now involved in milking which was exclusively a woman's job. House construction, previously a woman's responsibility is now almost entirely taken over by men. Tree planting and management has greatly improved since the seedlings are now more protected in the enclosures, especially during the cropping period

Conclusion and Recommendations

Vi-Agroforestry upholds the policy of co-operation with local development partners in its realization of meaningful success in community development. A lot of tangible benefits have already accrued from the project's efforts in the areas of intervention including abundant availability of fodder in West Pokot as the main output of land rehabilitation. This has gone along way to change the lifestyle of the traditionally nomadic community to sedentary life. Many new farmers are getting interested in agroforestry within and outside the Project's area of jurisdiction. This calls for an elaborate Project resource base and a combined effort with other stakeholders to satisfy the increasing desirable viable socio-cultural and economic needs of the communities.

Vi-Agroforestry Project has made every step to work together with the community, transforming from an initial extension approach of demonstration and paid activities over time to one that responds to spontaneous demands from the local community. The changing requirements of farmers should be taken into consideration in extension programmes.

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Section III: Gaps in Knowledge and Recommendations for Policy, Management and Research

Gaps in Knowledge

Although natural causes of land degradation and hence desertification are generally well known e.g. low rainfall and associated drought phenomenon, high temperatures and resultant global warming as well as physical factors like wind, accurate and reliable data on some of these factors are grossly inadequate. One reason for this inadequacy in data relates to the dynamism of dryland climatic regimes which, for example, are quite variable in both time and space (Willliams and Balling, 1996). The effects of natural causes of land degradation are complicated further by human induced activities that often occur in a vicious cycle. It has been observed that because of the dynamism of climatic regimes, dryland boundaries vary considerably over time and yet delineation is based on average conditions (Hulme, et al 1992). Reliable data on the extent and severity of ground surface land degradation are still scarce and some of the available data are often controversial and open to cristism. This brings into perspective the issue of relevant capacity in terms of human, financial and physical resources to carry out assessments on the one hand and mechanism for monitoring on the other hand. Because of this, most governments in the dry sahel are ill equipped to mitigate effects of some of the natural causes of desertification e.g. drought and only attempt to respond to an already worsened situation.

Information on global warming from Africa in general, and the drylands in particular, is even scarcer despite general acknowledgement of the place of the region in the debate. Very few published studies exist that examine causative factors and their levels of contribution to emissions of green house gases. Some information exists based on predictive models which however, are based on scanty information. There is general understanding about the role of drylands vegetation as stores of carbon sink and hence in carbon sequestration but very little experimentation to generate supportive data is being done and published. These limitations will continue to deny Africa her place in

meaningful contribution to the debate on global warming and hence proper participation in the UNFCCC.

Wind is a well known agent of land degradation. Major problems of wind erosion and gaps in understanding them have now been identified for some dryland areas in sub-saharan Africa (Sivakumar et al, 1998). However, there is still little information on their seriousness or location of problem areas. As a consequence, there are no long term strategic plans to counter the erosion and reduce the resulting damage. Fire is another important land degrading agent whose contribution is not properly documented. This has been attributed to inadequate data on incidences and intensities of fire to allow comprehensive analysis on its contribution (FAO, 2001)

The role of human activities in land degradation is well recongnised. Human activities are considered to be the main causes of accelerated degradation. Man continues to fight for ownership of every part of land and resources thereof and to claim responsibility of the way such lands are managed and used. The issue of land ownership and the rapid land use changes taking place in the drylands is of concern. Such changes arise, in part, from the ever-increasing population. There is inadequate information on how these land tenure and land use transformations should be managed to allow for sustainable resource use. The issue of land tenure and property rights, in particular, in the face of changing land use systems remains a teething problem. There are more examples on the effects of increasing population on land degradation in the drylands. Case studies on the positive contribution of increasing population and development are, however few.

Forestry is considered as part of the holistic approach to desertification control in complimentarity with actions developed in other sectors (SOCEM 1996). Yet in sub-saharan Africa, including the drylands, countries continue to suffer deforestation, especially for purposes of agriculture and settlements. There is a huge gap between de-forestation rate and afforestation which stands at 32:1 (Odera, 1996). Many recommendations to reverse the trend are in place but the situation on the ground continues unabated. There is need to address this gap by clearly isolating factors

hindering afforestation/reafforestation programmes if initiatives in the rehabilitation and sustainable natural resource management are to be realised.

The three conventions (CCD, CBD and CCC) provide opportunities for national, regional and international actions and collaborations despite various constraints and limitations identified under each of them. However, full realization of the benefits from these conventions will depend on how contracting or conference of parties provide enabling environment on key actions identified under each convention. It is necessary also that actions should be from regional perspectives (e.g. African perspectives). The Intergovernmental Panel on Forests (which has now been replaced by the United Nations Forum on Forests) has a crucial role in monitoring "actions to support afforestation, reforestation and restoration of forest ecosystems particularly in countries with fragile ecosystems and affected by desertification and/or drought particularly in Africa" (SOCEM, 1996). The contribution of the Intergovernmental Panel on Forests in the past towards this cause has not been realized. Meanwhile, there is now the presence of a wide range of regional and international networks in the areas of forestry and allied natural resources whose role in sustainable management and use of dryland resources including rehabilitation has not been fully understood and/or made use of. Key amongst these networks are the Forestry Research Network for Sub Saharan Africa (FORNESSA), African Forestry Research Network (AFORNET), Sub Saharan Africa Forestry Genetic Resources Network (SAFORGEN), Network for Natural Gums and Resins in Africa (NGARA) and the European Tropical Forestry Research Network (ETFRN).

Recommendations on Policy, Management and Research Issues

Various regional and international fora as well as reviews and reports by various organizations and individual experts have addressed aspects of the degradation of drylands and their sustainable development. Most of recommendations are still valid today though some of them require modifying to take cognizance of new information

available and changes that have taken place. The recommendations given below are based partly on facts generated in this paper and recommendations from various fora and reports.

Recommendations on Policy Issues:

- **That** National Governments express strong political commitment in addressing dryland issues including forest resource conservation, management and sustainable development and formulate national policies that encompass peoples involvement, sound management of ecosystems, and economic and social relevance;
- **That** institutional reforms involving civil society and NGO's are formulated and implemented and that these should focus on empowering local communities, facilitating the set up of partnerships in the natural resources and providing them access to financial resources at national and local levels;
- **That** appropriate policy statements are formulated and practical actions developed that allow and encourage tree and land security, thus having the long term aim of developing participatory, shared and joint forest protection and management regimes.
- **That** national governments strengthen the legal and institutional framework that includes monitoring and preparedness to facilitate implementing mechanisms for mitigating disasters.

Recommendations on Management Issues

- **That** governments develop national strategies and capacities to monitor the state of natural resources (including trees and forests) in order to plan for effective conservation and rehabilitation of the resources following defined targets and timeframes;
- **Recognizing** the importance of forests and allied natural resources in environmental protection, poverty alleviation and support to rural livelihood in the drylands, integrated and sustainable management of the resources is strongly recommended;

- **That** governments and development actors identify and disseminate appropriate knowledge regarding natural resource management and conservation, and validate and promote local innovations and experiences;
- **Recognizing** that the relevant UN conventions have not achieved their targets in combating desertification, it is recommended that the strengthening of the conventions is done focusing on, among others;

    - Proper consultation and involvement of relevant stakeholders in the formulation, design and implementation of desired actions.
    - Development of clear rules and procedures that are understandable by the people who have to implement the action plans at all levels,
    - Political support both nationally and internationally, and
    - Improved coordination of CCD linking it with the other conventions and sectoral programmes to ensure synergies and enhance resolving of conflicts

Recommendations on Research and Training Issues

- **Recognizing** the importance of adequate and precise information on natural resources for sound decision making and, especially lack of such data on a wide range of aspects covered in this report, it is recommended that proper mechanisms be put in place for data acquisition;
    - recommends further that governments and donors carry out ex-post evaluation studies on completed projects on dryland Africa and make findings widely available in order to guide future actions,
- **Recognizing** the continuing and increasing needs for skills to combat desertification and the challenging needs at national and international levels, it is recommended that national governments and partners should support formal and in-service training and, curriculum development including gender issues;
- **Recognizing** the significance of dissemination of information and adoption of technologies to beneficiaries or target groups, it is recommended that

governments and partners should support and strengthen extension and training facilities at research and educational institutions.

- **Recognizing** that research in Africa is far from complete but that relevant data exists in other regions within the tropics, it is recommended that mechanisms be put in place to share such results and lesions to avoid duplication of efforts and ensure formulation and implementaion of more effective programmes,
    - recommends further that advantage be taken of the existing networks to promote and acquire relevant information.

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