Role of Forest Policies, Institutions and Governance in Adaptation to Changing Climatic Conditions: The case of Sudan

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Role of Forest Policies, Institutions and Governance in Adaptation to Changing Climatic Conditions: The case of Sudan.

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Sudan's Forests National Corporation

2008

Abstract

Forest conservation and sustainable forest management are important means of mitigating the GHGs and the associated climate change. The paper will provide an in-depth analysis of forest policies in Sudan since the beginning of the 20th century. The positive role of partnerships in forest sector development is recognized in the forest policies. The role of NGOs and their impacts on forest policies and sustainable forest management will be reviewed and examined as one of the important tools of adaptation to changing climatic conditions. Innovative approaches to enhance people's participation in sustainable forest management in Sudan will be highlighted.

The paper will discuss the institutional framework for adaptation of forest ecosystems and the forest sector considering the relationships with other related sectors. Land transformation in dry land regions in central Sudan and their dynamic changes between agriculture, forest, scattered trees and bare lands is a continuous process leading to deforestation and land degradation as a result of conflicting interest.

The knowledge of indigenous peoples and local communities must guide the process of establishing a systemic ecosystem approach to adaptation of forest to changing climatic conditions. The subject of multi-functional uses and sustainable forest management will be stressed upon as approach towards compatibility with changing climatic conditions. Different studies indicate that there is a very strong linkage between land degradation, desertification and conflict in Sudan.

Key words:

Forest policies, sustainable management, deforestation, adaptation, community participation

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Introduction

The Sudan is the largest country in Africa with a total area of 2.5 million square kilometers. It is bounded on the east by the Red Sea and is surrounded on the other sides by nine African nations. Its terrain is characteristically flat, except for few mountains including the Imatong – Didinga mountain series in the south, the Red Sea Hills series in the east and Jebel Marra in West Darfur in addition to few insleburgs crop at different locations. The most salient geographical feature is the River Nile basin that traverses the country from south to north. The River Nile is composed of two main branches; the White Nile that originates in the Equatorial Lakes and the Blue Nile that descends from the Ethiopian Highlands. The two rivers unite in Khartoum to form the River Nile that runs to the Mediterranean Sea. The river Nile and the mountains constitute special sites, characterized by high rains and waters of special importance to Sudan.

It has over 35 million people with diverse ethnic backgrounds living in different conditions in divergent climate and vegetation zones. The precipitation in Sudan increases from north to south, but for the most part the country is covered by arid and semiarid areas. Sudan Forests play a key role in the livelihoods of the people, by providing important services to support their livelihood. Most of the population (approximately 66%) is rural and is considered as forest dependant for fuelwood as the main source of energy and on round wood for building. In their productive role the forests provide products such as round poles, fuelwood, and sawn timber for construction, furniture and railway sleepers. Non wood products include a wide variety of fruits, gums, nuts, tannins, fibre, fodder and bark that are used for food, medicine and raw materials in cottage industries. Forests protect the agricultural environment resulting in higher yields, thus contributing to food security and rural development. Forests are the habitat for a wide variety of wild flora and fauna.

Forests play a crucial role in environmental protection through its influences on soil, rainfall, wind and in relation to climate change; forests play an important ecological role by the provision of carbon sinks.

Rainfall Fluctuation

Climate change is likely to impact seriously on the Sahel where, according to some studies, precipitation has dropped considerably since the mid 1950s and the decrease in precipitation has contributed to large human and economic losses. An increased intensity of droughts and floods and changes in growing seasons in the Sahel may have significant implications for soil productivity, water supply, food security, and human welfare, as well as deleterious and often irreversible impacts on the biological diversity. It is anticipated that a change in climate in the region will result in more adverse socio-economic impacts related to the vulnerability of society and the sensitivity of the environment. Population factors such as high population growth rates, restricted population movement, poor health standards and low material standards make African countries particularly vulnerable (Salih 2000 In: Jörn Laxén, 2007).

Anu Eskonheimo in her Academic dissertation titled "Women, environmental changes and forestry related development: Gender affected roles of rural people in land degradation and environmental rehabilitation in a dry region of Sudan" studied the area of north Kordofan, Western Sudan.

The study area has been affected by a particularly dry episode of the Sahel that began in the late 1960s and lasted until 1991. To obtain information on the precipitation in this episode (and in the 20th century as a whole), records of the mean annual precipitation in El Obeid were studied in conjunction with this study. It is of importance to recognize, however, that the precipitation varies at the local level, and therefore, the rainfall records of El Obeid can only illustrate rough trends of the mean annual rainfall in the area as a whole.

The mean annual precipitation in El Obeid during from 1902 until 1984 is here presented as it was summarized in Lennart Olsson's doctoral dissertation (Olsson, L. 1985, 103105), based on rainfall records from Sudan Meteorological Department's station in El Obeid. The Figure 1 reveals that the trend of annual mean precipitation (linear line) from 1902 until 1984 was only very slightly decreasing, but during this period the mean annual precipitation (dashed line) varied considerably between years: While some years were characterized by rainfall of less than 200mm, in some other years the mean annual rainfall reached over 600mm. However, when a shorter time period from 1950 until 1984 is focused upon, the trend of annual mean precipitation is more clearly decreasing (see Figure2).

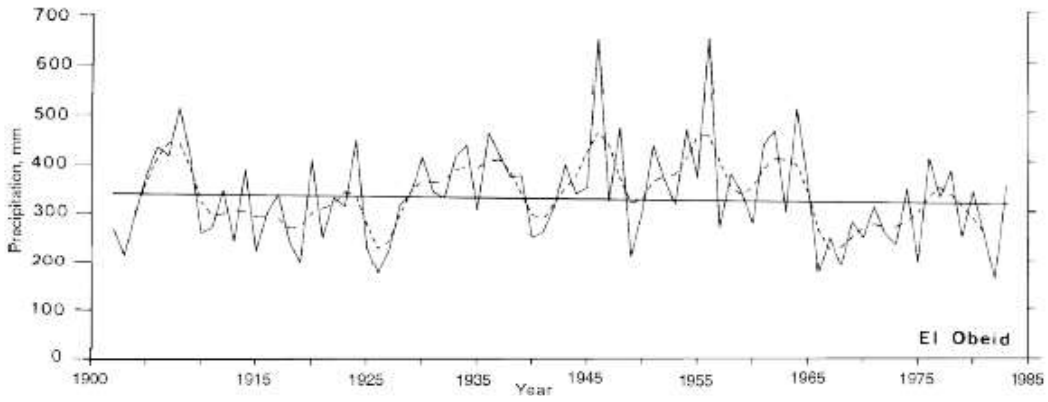


Figure 1: Annual mean precipitation (linear line) from 1902 until 1984

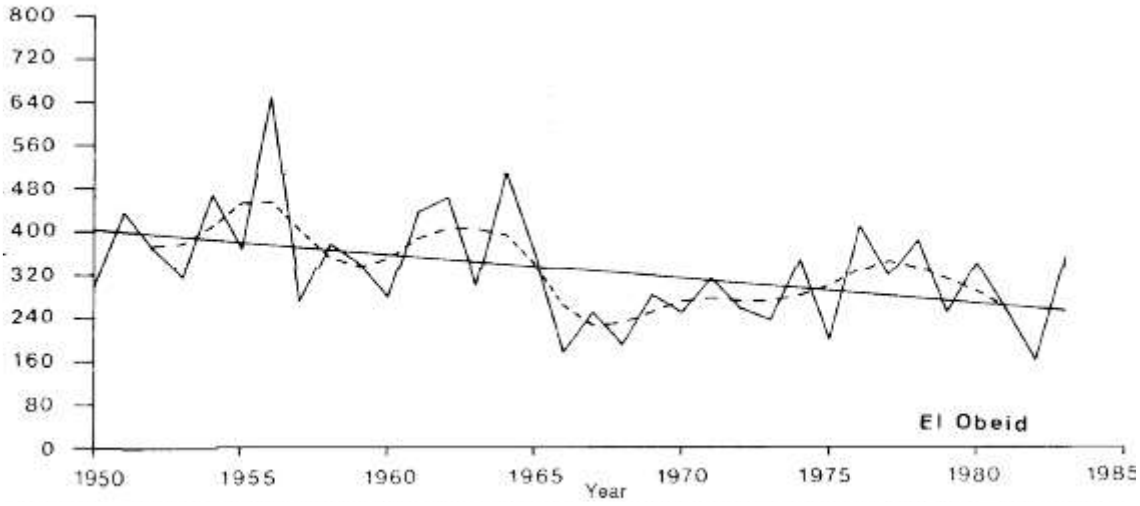


Figure 2: Annual mean precipitation from 1950 - 1984

The declining trend in rainfall from 1950 until 1984 was caused by two long lasting droughts, which affected El Obeid from the mid 1960s until the mid 1970s and in the first half of the 1980s. (Meteorological Department 2002).

In this connection, it is recognized that the two long lasting, extremely dry periods that occurred in the area during 1966-1975 and 1981-1985 included some years with an exceptionally low rainfall, even when the precipitation statistics from the whole century are considered. These severe droughts also took place in an exceptionally short period of approximately 20 years, and there were no years with an exceptionally high annual rainfall between these two droughts. (Eskonheimo 2006)

Furthermore, it needs to be recognized that the rainfall patterns do not only vary in different years, but also within years. If rain occurs as fierce storms, the rainy season benefits the area less; particularly since the common soil type in the area is sandy soil, with poor water holding capacity (ElDukheri 1997, 12 in Eskonheimo 2006). Thus, even though the total rainfall during a year might not be exceptionally limited, the crops and the overall vegetation can suffer from serious shortages of water, if the rain has been received in a few strong storms. Strong storms also contribute to surface erosion and damage vegetation. Available water resources in the area are also highly sensitive to climate variation.

To store rain water, reservoirs, locally known as *hafirs* have been established. Hafirs are important sources of water for people and animals; in fact, it has been estimated that hafirs provide approximately 80 percent of the water that is available for consumption in the North Kordofan State (Office of the UN Resident and Humanitarian Coordinator for Sudan 2003, 11). The problem of limited water resources in the area is not solely the result of rainfall patterns, vegetation or soils. In fact, temperatures play an important role in connection with the water problem as well, since high temperatures contribute to high evaporation rates.

The efforts of rural Sudanese to maintain their livelihood in dry lands are complicated by the insufficient and erratic precipitation that affects the productivity of their

croplands and availability of vegetation for grazing and browsing for their animals. Although the local people often suffer from environmental changes in dry lands, they may harm their environment themselves for example by cutting trees intensively or herding large numbers of animals in a limited area (Olsson and Rapp 1991, 193; Dregne 2002, 110, 122 cited by Eskonheimo. 2006).

According to (UNEP, 2007) the 2nd half of the 19th Century has particularly witnessed a pattern of declining rainfall culminating in the wide-spread 83-84s drought. Climatic variability manifests itself in the form of severe drought and occasional floods, and Sudan faces both problems. For over three decades, recurrent drought, with occasional severe droughts, had become normal phenomenon in most of the country. Drought is threatening the existing cultivation of about 12 million hectares of rain-fed mechanized farming and 6.6 million hectares of traditional rain-fed lands. Pastoral and nomadic groups in the semi-arid areas of Sudan are among the most affected communities.

In Sudan, continuous and regular instrumental measurements of climate have been practiced since the turn of the twentieth century; but it has not been covering wide areas of the country particularly during the first two decades (HCENR, 2003).

Rainfall has inevitably been the climatic resource most intensively measured and documented in Sudan, due to the great dependence on rainfall in many parts of the country. Sensitivity of Sudan rainfall to global warming is not yet known since the regional detail of precipitation changes resulting from the temperature increase are still poorly modelled by GCMs (Schlesinger and Mitchell, 1987 In: Elasha, 2007).

Impacts of Climate Change

Due to Sudan's inherently climate sensitive agricultural systems, climate variability and change have always affected its agricultural production. Under future climate change and consequently increasing variability, further declining of agricultural productivity would be expected. This has been illustrated by the climate change models for Kordofan State in Western Sudan which showed an unfavourable precipitation scenario involving large reductions in precipitation and an increase in temperature (HCENR, 2003). *Achim Steiner*, UNEP Executive Director, mentioned in a press release that a big part of the future, and central to keeping the peace will be the way in which Sudan's environment is rehabilitated and managed,. Furthermore, adverse climate change impacts on natural systems and resources, may lead to reduced economic growth and increase poverty. These negative impacts could jeopardize the attainment of the Millennium Development Goals (MDGs). It could also lead to the loss of essential livelihood assets, displacement and migration thus reducing the access to education and constraints the achievement of MDG 2. MDG7 (environmental sustainability) may be threatened by climate change which may adversely affect the quality and productivity of important ecosystems and related natural resources.

Alam (2006) studied the gas emission from the brick making industry in Sudan. The study focused on the potential roles of the brick making industries in Sudan in

deforestation and greenhouse gas emissions due to the consumption of biofuels. The results were based on the observation of 25 brick making industries from three administrative regions in Sudan namely, Khartoum, Kassala and Gezira. The methodological approach followed the procedures outlined by the Intergovernmental Panel on Climate Change (IPCC). For predicting a serious deforestation scenario, it was also assumed that all of wood use for this particular purpose is from unsustainable sources. The study revealed that the total annual quantity of fuelwood consumed by the surveyed brick making industries (25) was 2,381 t dm. Accordingly, the observed total potential deforested wood was 10,624 m3, in which the total deforested round wood was 3,664 m3 and deforested branches was 6,961 m3. The study observed that a total of 2,990 t biomass fuels (fuelwood and dung cake) consumed annually by the surveyed brick making industries for brick burning. Consequently, estimated total annual emissions of greenhouse gases were 4,832 t CO2, 21 t CH4, 184 t CO, 0.15 t N20, 5 t NOX and 3.5 t NO while the total carbon released in the atmosphere was 1,318 t. Altogether, the total annual greenhouse gases emissions from biomass fuels burning was 5,046 t; of which 4,104 t from fuelwood and 943 t from dung cake burning.

According to the results, due to the consumption of fuelwood in the brick making industries (3,450 units) of Sudan, the amount of wood lost from the total growing stock of wood in forests and trees in Sudan annually would be 1,466,000 m3 encompassing 505,000 m3 round wood and 961,000 m3 branches annually. By considering all categories of biofuels (fuelwood and dung cake), it was estimated that, the total emissions from all the brick making industries of Sudan would be 663,000 t CO2, 2,900 t CH4, 25,300 t CO, 20 t N2O, 720 t NOX and 470 t NO per annum, while the total carbon released in the atmosphere would be 181,000 t annually.

Carbon sequestration

The United Nations Framework Convention on Climate Change (FCCC) is not specifically dealing with forests but is concerned with natural ecosystems. It acknowledges the role and importance of terrestrial ecosystems of sources and sinks as well as the reservoirs of green house gases. Forest ecosystem is perceived as immense carbon sink. Thus, the close relationship between climate and forests is recognized. It also acknowledges that human activities have been substantially increasing the atmospheric concentrations of green house gases. The ultimate objective is to achieve stabilization of green house gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (human) interference with the climate system. This objective is to be achieved within a time frame that allows ecosystems to adapt naturally to climate change, ensures that food production is not threatened, and enables economic development to proceed in a sustainable manner.

Sudan is a party to the UNFCCC since 1993. To meet the requirements of the UNFCCC Sudan embarked on the implementation of a project “Capacity Building for the UNFCCC”. The project aims at building Sudan’s capacity to prepare its First national Communications Report, strengthen institutional networks, assess greenhouse gases in the country, train personnel in planning, evaluation and development of means and ways of climate change mitigation measures, establish policy dialogue, assess vulnerable sectors and adaptation systems and evaluate climate change

mitigation measures, and incorporating the principle of sustainable development in the formulation of developmental schemes. The project carried a number of activities: prepared informatics background of a national communication and the emissions of greenhouse gases, and defined the options for emission reduction net and methods for different sources. Now the project is in the process of formulating a national strategy for climate change.

The project conducted a national green house inventory in 1998 and presently is preparing for the second national communication in which the second inventory on Green House Gas will be conducted. The forestry sector is represented by members from the FNC and forestry education institutes. Staff from the Faculty of Forestry of University of Khartoum contributed in training for capacity building. In the first communication report, Sudan concluded that forest sector contributed by 75 % of the total national Co_2 content in the atmosphere.

Conflicts over the Sudan

Climate variability in the form of erratic rainfall and recurrent drought in Sudan could trigger conflicts due to competition over scarce resources. The tribal conflicts are considered among the main factors leading to both migration and displacements. This situation is expected to worsen under climate change with more migration and tribal movement across the country and between boundaries. Pastoralism is the dominant productive activity in most of the arid and semi arid land of Sudan, where large settlements are few, and mobility is vital to maintain access to water and fodder. Three major groups are identified in Sudan, based on livelihood strategies:

(1) Sedentary crop-rearing societies/tribes; (2) Livestock rearing nomadic (trans-humant societies/tribes; (3) owners of mechanized agricultural schemes. The three groups are known for their dependence on rainfall for their livelihood; with most of the recorded conflicts on a local scale occur within and between the first two groups; pastoralists and traditional farmers fighting over land and water UNEP (2007). Pastoralists are sometimes also in conflict amongst themselves.

Land degradation could force the farmers to expand their cropping areas into the natural migratory routes of livestock herders, eventually leading to conflicts and civil wars (UNEP, 2007). Figure (3) shows the migratory routes of pastoralists in Sudan

Fig. (3) Annual Pastoral Migration Routes in Sudan (2007

To address the on-going conflicts over resources, there is a need to understand the dynamism of common property regimes based on mobility. According to (IIED, 1999 cited by Elasha, 2007), this requires more forums for negotiation, and supporting of Pastoralism by through the enabling of efficient sale and movement of livestock to markets. A study of the causes of local conflicts in Darfur from 1930 – 2000 indicated that around 80% of conflicts were triggered by competition over water, land and grazing compared to 20% due to political and administrative disagreements (UNEP, 2007), (See fig4 below). **Fig (5)** shows a variation in rainfall with a declining trend during the same period which stresses the impact of climate variability in triggering competition and resource-based conflicts.

Figure (4) Causes of local conflicts in Darfur 1930-2000 (UNEP,2007 after Elasha,2007)

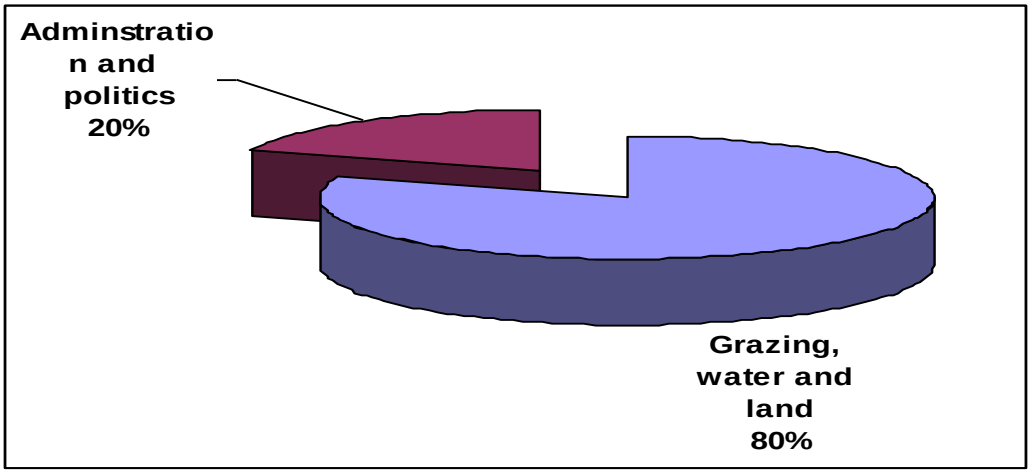
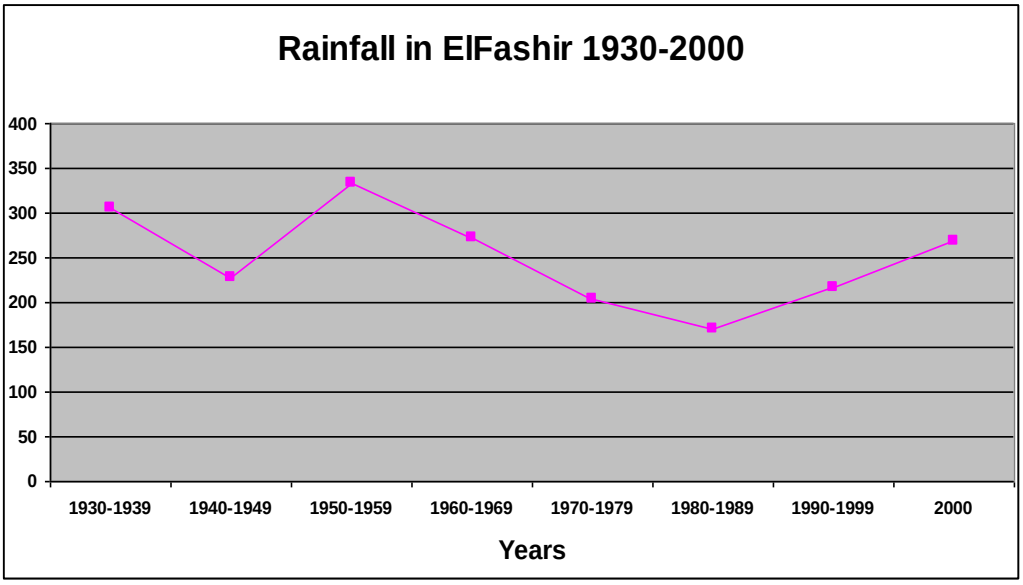


Figure (5) Declining trend of rainfall in ElFashir (UNEP,2007)



Recently some studies have attempted to evaluate the impacts of climate change on runoff in the Nile Basin. Conway, 2005, stated with a high confidence that temperature will rise but according to Hume *et al,* 2001 and 2003, there are disparities between models on rainfall predictions over both the Blue Nile and White Nile. The various mathematical, hydrological and theoretical models and assumptions have produced inconsistent results ranging from a fifty percent reduction in runoff in the Blue Nile Sub-basin due to a twenty percent decrease in precipitation, to an increase in water runoff up to the year 2025. Temperature rise will lead to greater loss through evaporation placing additional stress on water resources regardless of changes in rainfall. Nine climate scenarios showed decreases in Nile flows from zero to approximately 40 percent by 2025. Such scenario of reduction in the water resources,

coupled with economic development and increases in population, may trigger conflict between the different countries sharing the basin **(**Elasha, 2007),

Forest Governance, Law Enforcement and Land Tenure in Sudan

Widespread failure of forest governance and law enforcement directly undermines any nation's attempt to achieve sustainable economic growth, societal equity, and environmental protection. Internationally, governments are beginning to acknowledge the deep costs of illegal logging, associated illegal trade and corruption in the forest sector. Some governments have taken steps to improve governance in log tracking and concession management, for example. The G-8 countries launched the Forest Action Program, a key element of which is addressing illegal logging. International organizations, agencies and NGOs are increasing their support to forest law enforcement and governance programs. Private sector organizations are recognizing their role and responsibility in combating this problem, and are entering into innovative partnerships with other stakeholders to do so (WB, 2002).

Governance is a major issue in the Sudan's Forests National Corporation, the lead institution in forest management. Other institutions involved in forest management include Forest Research Centre, Universities, Higher Council for Environment and Natural Resources, Ministry of Agriculture, None Governmental Organizations (NGOs). Several national and international NGOs are active in forestry development. Their efforts are concentrated on awareness raising, the adoption of participatory management techniques and working with villagers on community forests and environmental programmes. Forestry village communities and the Gum producers Union are also among the active NGOs. Private forestry is not common in Sudan albeit encouraged by FNC and the forest regulations. Local communities have, however, been attached to nearby forests providing local paid labour and getting free goods such as tree leaves, fruits, tubers, roots etc as a bonus. FNC also provides land for villagers to raise their crops in lieu of planting of tree-less areas inside the forest. In gum production areas the whole family engages in the different gum development operations from planting to tending and harvesting of gum. Gum gardens are either privately, communally or state owned. In the 1980s around 26 donor funded projects were operational in the forestry sector. Currently some projects are running, these are: UNHCR funded project on reforestation of areas damaged by refugees. FAO TCP on forest policy revision, institutional reorganization and legislation reform. Assisting Gum producers through credit provision, quality improvement and value addition. Rehabilitation of Oil Fields affected Areas. Strengthening the production and quality control of gums and resins in Africa (TCP/RAF/2914 (T)). Africover for vegetation mapping, and National Forest Programme - Facility

Forest loss has impacted negatively on the economy of the country; socially, environmentally and economically. It has created tension among local communities; contributed to loss of biodiversity; reduced water availability, agricultural productivity and timber production; and lowered the capacity for hydro power generation.

Threats to forests in the Sudan are identified as follows*:*

- Illegal tree felling.

- Encroachment on forest lands by agriculture.
- Unorganized grazing inside forests.
- Forest fires.
- Urban expansion and road construction.
- Insects and diseases.
- Difficulty of natural regeneration particularly in dry areas.
- Shortage of funds needed to support reforestation and other forest development aspects.

Indigenous Knowledge

Traditional knowledge has been used for generations by local communities, farmers and pastoralists, in the Sudan in the management and rational use of natural resources for their livelihood. In rural areas, land use is organized through tribal based management systems implying the right of use for sedentary farmers, transhumant and nomadic people. For instance, change from cattle to sheep and goat husbandry in relation to feed requirements, is a good example of coping with drought events by pastoralists and agro pastoralists as outlined by El Siddig (2001)

Over the years, Sudanese traditional farmers in the gum belt have developed a close relationship with and a complete husbandry protocol for the Hashab tree. In the ideal setting the farmer portions his holding into four parts. One quarter carries mature Hashab trees, another carries young ones which permit intercropping, the third is for pure cropping where the fertility is declining and soon goes under trees while the fourth has just come under crops having been under trees for 15 - 20 years.

The protocol encompasses such aspects as tree regeneration, spacing, tapping and gum collection. Hashab regenerates readily from seeds or by coppicing. Tapping is carried out when the tree sheds its leaves naturally to start its dormancy period. The close relationship and complete protocol are not in vain. Over and above gum production and soil amelioration, the Hashab tree produces pods, leaves and twigs which are very nutritious to livestock, and at the end of the rotation is felled to yield building poles, firewood or charcoal (Abdel Nour, 2000).

Community Forestry

Community–based natural resource management (CBNRM) has been recognized as one of the effective means that contribute in long–term, sustainable use of natural resources (Abdel Magid and Elsiddig 2003; Elsiddig 2004). Since 1984, the concept of Community-based forests reservation and plantation establishment continued to be increasing in areas and species planted in response to donor-funded activities. Examples of successful social forestry programmes, community forestry development, and tree planting strategy and experience of partnership in forestry characterized some of the degraded lands rehabilitation in dry lands of central Sudan (Glover 2005; Luukkanen *et a*l. 2006). Community involvement in tree planting strategy at local and national levels may provide suitable conditions for adoption of sustainable forest management and planning production outputs on sustainable basis. Example of good governance is the Participatory Forests Management Models adopted in different ecological zones of the Sudan: (quoted from Ibrahim, 2000)

Rawashda Model I:

The FAO Fuel Development Project in the Sudan (1983 – 1989) designed a management plan for the Rawashda forest, Eastern Sudan. The general theme of the plan was the participation of local inhabitants in the development of the reserved forest by their responsibilities to the forestry rehabilitation programme (replanting trees in a *taungya* system). The forest committee, which was formulated by the local inhabitants, was also responsible for the protection of the reserved forest against illicit felling, illegal grazing, etc. In return, the community of local inhabitants was illegible to forest products determined by the forestry service in those compartments that were prescribed by the plan.

Rawashda Model II:

The forestry component model of the Agriculture Development Project for the Eastern Sudan (ADES) is very similar to the FAO Model with the exception of the fact that local inhabitants has nothing to do with the final felling of trees; they are not allowed to collect firewood or other forest products other than those prescribed as rights and privileges in the Forest Act 1989. Here, farmers are given pieces of bare land to cultivate their arable crops (Dura, Seasame, etc) and to rehabilitate 25% of the land with tree cover. This is continued annually for four years until the whole piece of land is reforested. Then another piece of bare land within the forest reserve is targeted.

Gedarif Model:

Farmers are allowed to grow their arable crops within the forest reserves according to special contract approved by the forestry service and they pay rental cost, which are used by the forestry service for rehabilitation of forest reserves. This is continued for 4-year then another piece of bare land within the forest reserve is targeted.

Role of Forest Policy and Legislation

Opportunities to address the weak forest governance exist. For example, The Forest Policy Statement responded to the new concepts, perceived since the seventies based on the emphasis on environmental protection, popular participation and the multiple uses of forests. The Statement:

- Recognized new forms of forest tenure including private, community, and institutional forests, targeted 20% of the area of the country as forest reserves;
- stressed the role of forests in environmental protection by creating new obligations on a lessee in mechanized farming or irrigated area to maintain or establish green belts;
- Emphasized the role of public participation and the international community in afforestation and sustainable management of forests;
- Recognized the need for research in forest development and emphasized the role of forest extension.

The Forests Act 1989 has, since its promulgation, been repeatedly praised as the most important piece of legislation of its kind ever enacted in Sudan. It recognized new types of forest ownership: private, community and institutional forest reserves to be

managed by owners, committees and institutions respectively, in addition to the national and regional forest reserves. All these forest reserves would be under the technical supervision of the Forests National Corporation. The control over tree cutting outside the reserves was tightened by the requirement of a permit to be issued from the corporation. Investors in agricultural schemes were obliged to leave a percentage not less than 10% of the total area of a rainfed project and a percentage not less than 5% of the total area of an irrigated project as shelter belts and wind breaks for the purposes of production and protection. Investors were also obliged to convert the cleared trees into forest products.

The Forests Act of 1989 also obliged any driver of a means of transportation, when transporting forest produce to obtain a permit from the competent authority. Furthermore, it imposed a deterrent penalty: the confiscation of any property, including the means of transport, used in the commission of the forest offence for the benefit of the corporation.

The Forests and Renewable Natural Resources Act, 2002, provides the framework for the management and protection of forests and renewable natural resources encompassing pasture and range as well as the framework governing the managerial system of the forestry sector. The Forest and Renewable Natural Resources Act is pivotal for the management of the forestry sector. However, in this context the act contains many points of special importance.

Sudan National Forestry Policy Statement 2006 stated that Sudanese government sought to actualize the forest policy framework and prepare the forestry sector to the challenges ahead; namely reduction of poverty, improvement of people's wellbeing, amelioration of the physical environment and combating desertification. There were other drivers for the review of the forest policy. The development of the oil production was having direct and indirect impact on the sector. The economic reform for stabilization and liberalization demanded in turn reforms in some forestry activities such as public sawmills and gum arabic export. The government agencies sharing responsibilities for forests and other natural resources were feeling the need for better governance and closer intersectoral relationships and also for increased participation in the international dialogue in forestry. Governmental agencies were also reacting to the need for concerted action on the obligations dictated by the international summits on environment and commitments brought about by the international conventions such as UNCCD, CBD and UNFCCC.

The first attempt for setting the criteria for the designation of federal and state forests was made in 1997 by the Council of Ministers issuing the Decree No. 40. The said Decree states that forests protecting inter-state water, watersheds and protecting federal structures and forests arresting the process of desertification are federal forests to be managed by FNC. Other forest reserves are to be managed by the states. The Decree also states that private, community and institutional forests are to be managed by their owners. As to the distribution of royalties originating from outside forest reserves between FNC and the states, the Decree adopts an equitable distribution of (40%) each; the remainder (20%) is to be assigned to a Forest Reservation Support Fund. Notably, the framers of Decree No. 40 bear in mind the criteria of singleness, distinctiveness and indivisibility for the designation and classification of federal and state forest (Kanon, 2003 In: Elsiddig et al, 2007)).

The Environment Protection Act, 2000 harmonizes the different sectoral environmental laws, sets environmental standards, calls for the protection of biodiversity and combating pollution, requires environmental impact assessment to be carried prior to implementing any development project. The 2000 Act also calls for raising environmental awareness and popular participation in decision-making process and setting policies. The 2000 Act empowers the HCENR to draw natural resources policies, including their assessment, development, and management in an integrated way to achieve sustainability; coordinate the activities of state councils; formulate national long term programs; and to review periodically environment-related legislation.

The Comprehensive Peace Agreement (CPA)

Recently, the government of the Sudan and the Sudan People's Liberation Movement/Sudan People's Liberation Army reached an Agreement on Wealth Sharing during the Pre-Interim and Interim Period. The parties agree that the basis for an agreed and definitive framework for the management and development of the petroleum sector shall include interalia, sustainable utilization of oil as a non-renewable natural resource consistent with the national interest and the public good, the interest of the affected states/regions, the interests of the local population in affected areas and national environmental policies, biodiversity conservation guidelines and cultural heritage protection principles. The parties also agree that an independent National Petroleum Commission (NPC) shall be established.

The Comprehensive Peace Agreement (CPA) has some impacts on Forests and Natural Resources. According to Article 24 of the Interim National Constitution, there are three levels of governments; namely:

- The national level of government, which exercises authority with a view to protecting the national sovereignty and territorial integrity of the Sudan and promoting the welfare of the people;
- Southern Sudan level of government, which exercises authority in respect of the people and states in southern Sudan;
- The state level of government, which exercises authority at the state level throughout the Sudan and render public services through the level closest to the people, and local level of government, which exists throughout the Sudan.

Apart from the above, the Interim National Constitution has embodied numerous provisions with direct bearing on environment. For example, Article 11(1) provides that the people of the Sudan shall have the right to a clean and diverse environment. The same Article goes on to state that the State and the citizens shall have the duty to preserve and promote the country's biodiversity. Furthermore, Article 11(2) prevents the State from pursuing any policy or taking any action, which adversely affects the existence of any species of animal or vegetative life or their natural habitat. In order to guarantee the crystallization of these benign principles and directives in binding legal rules, Article 11(3) urges the State to adopt legislation that ensures the sustainable utilization of natural resources.

Participatory Forestry Initiatives and Support to Stakeholders:

Most forest programmes in the country are directed to address environmental problems or at least mitigate their adverse effects. Currently forest activities concentrate on tree protection against biotic and abiotic factors, increasing the forested areas through forest reservation and reforestation and through desertification control programmes. Awareness raising and community involvement are much emphasized upon supplement the formal efforts in environmental protection. The following are participatory forestry initiatives:

- Planting of windbreaks and shelterbelts by farmers on private holdings and establishment of plantations by government institutions, private companies and individuals are all given technical support and provided with subsidized or free of charge seedlings by FNC.
- FNC develops and supervises good management practice codes for non-government forests and offers secondment of staff to assist in the management of those forests.
- Government and non-government initiatives supportive to forestry (roadside planting, arbor days etc) are encouraged and provided with technical support and free of charge seedlings.

Desertification in the Sudan

The United Nations Convention to Combat Desertification (UNCCD) illustrates desertification as "land degradation in arid, semiarid and dry sub humid areas". The Convention describes land degradation as: "the reduction or loss, in arid, semiarid and dry sub humid areas, of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands… " (United Nations 1994, 45). In short, the Convention consequently equals desertification to land degradation, which refers to decrease in land production.

Tackling land degradation through forestry related rehabilitation

Land degradation is a problem that could be perhaps improved in many areas with protection and rehabilitation. In environmental discussions, the term rehabilitation refers to activities that are aimed to bring back elements or functions to an ecological system that has become degraded (McMahon 1997, 480 In: Eskonheimo. 2006). People may rehabilitate degraded ecosystems with various methods. The most effective long term methods to rehabilitate degraded land and to control surface erosion are based on establishing and maintaining vegetative cover. The vegetation cover protects the soil by reducing the impact of raindrops and the flow of water on the soil surface. Surface runoff is further reduced by plants, which reduce the quantity of the water stored in the soil between rainfall events. Soil erosion can be also reduced by the network of plant roots, and the increase in organic material can improve the quality and structure of a soil (Eskonheimo. 2006).

The Sudanese Higher Council for Environment and Natural Resources (HCENR), established in 1992, coordinated the preparation of the first national communication as a climate change strategy response to the United Nations Framework Convention on Climate Change (UNFCCC). The authors used various locally adapted

international climate change modeling tools to be able to forecast the climate change impacts on Sudan. The anticipated impacts for the Sudanese dry lands can be summarized as follows (MEPH/HCENR 2003; Orindi and Murray 2005):

- Decreased rainfall, increased temperatures and evaporation;
- Frequent drought spells leading to severe water shortage;
- Changes in planting dates of annual crops;
- Increased insect infestations due to changes in temperature and humidity;
- Deceases in forest and cultivation areas due to land degradation;
- Decline in crop and gum arabic yields;
- Increased risk of food shortage and famine;
- Reduction in ecosystem integrity and decline in biodiversity;
- Increased potential of malaria transmission and the subsequent burden on the country's health care system.

The long-term meteorological trends have been studied in Sudan by, for instance, Davies and Alredaisy (1995), Mohamed (1998) and Elagib and Mansell (2000) cited by Laxén (2007). The studies concluded that there has been a clear decrease in rainfall over the long-term by up to 30 – 40% in some areas, but there are annual precipitation variations which are larger than any decreasing trends. Elagib and Mansell (2000) found that, particularly for the weather data sets analyzed from Dongola, Shambat and El Fasher, respectively, it appeared that the highest temperature is reached during the autumn season (October), while the lowest temperatures of the growth period are in the summer months. This has implications for the agricultural sector, as the autumn season is important for crop growing. The drop in crop productivity of sorghum and millet cultivated on rainfed lands of North Kordofan is forecasted to be 13 – 82 % and 20 – 76% respectively, while the drop in the same area for gum arabic production is forecasted to be in the range 25 – 35% by the projected scenario years of 2030 and 2060 (MEPH/HCENR 2003; Orindi and Murray 2005). Planning of mitigating strategies would therefore be needed, but so far the Sudanese development plans have mostly stressed the importance of increased agricultural production rather than tackling the balance between natural resource management and agricultural development. As a result, Sudan's natural resources have been neglected and are seriously degraded by destructive agricultural activities and indigenous tree cutting for firewood and charcoal making (Salih 2000).

The importance of forests in watershed management is also emphasized, since the loss of tree cover has led to increased sedimentation and thus to a loss of storage capacity in irrigation dams (Salih 2000; MEPH/HCENR 2003; Orindi and Murray 2005).

With the start of investment in mechanized farming in the dry lands of central Sudan, in the middle of the 20th century, the savanna natural forests are faced with major problems. Forests are cleared for cultivation for 5 – 10 years and abandoned when the productivity declines (Elsiddig et al. 2007). As a result, vast areas are left behind as bare lands.

Forests and trees in the Sudan are removed for various reasons including supply of the demand for wood energy and use of the land for agriculture. Table (1) shows forest cover in the Sudan during the period 1980 – 2005 as reviewed by FRA (2005). Since

1980 forests are annually cleared at a rate of 0.4 – 0.589 million hectares (Table 1). The total forest cover (≥ 10% crown cover) changed from approximately 34.956 million hectares in 1980 to 22.0 million hectares in 2005. The total loss of forest cover was approximating 10.706 million hectares in twenty five years.

Table 1. Forest covers changes and annual rate of forest clearance during the period 1980 – 2005, (Source FRA 2005)

Year	Forest Area (hectare 1000)	Removal (hectare 1000)	Annual rate (hectare 1000)
1980	34956.2		
1990	30949.2	4007	400.7
2000	26500.0	4449	440.0
2005	23555.0	2945	589.0

Conclusions

Land degradation is a problem that could be perhaps improved in many areas with protection and rehabilitation. The most effective long term methods to rehabilitate degraded land and to control surface erosion are based on establishing and maintaining vegetative cover. Awareness raising and community involvement in forest management and protection are important tools for environmental protection. Traditional knowledge has been used for generations by local communities, farmers and pastoralists, in the Sudan in the management and rational use of natural resources for their livelihood. Pastoralism is the dominant productive activity in most of the arid and semi arid land of Sudan, Climate variability in the form of erratic rainfall and recurrent drought in Sudan could trigger conflicts due to competition over scarce resources. The tribal conflicts are considered among the main factors leading to both migration and displacements. Though the forest policies and legislations in Sudan reacted to the most recent political, socioeconomic and environmental changes, but still there is a need for more enforcement.

Way Forward

- Awareness raising on the negative impacts of climate change on the natural resource base.
- Building partnerships with private sector, civil society and NGOs.
- Enhancing policies, laws and procedures.
- Strengthening capacity for climate change adaptation in the forest sector and for forest carbon monitoring, assessment and reporting.
- More research to compute and better monetize the environmental and socioeconomic benefits of forest ecosystem.
- Investment in environmental management.
- Formulate projects to make use of the carbon market and be prepared for the CDM projects ,

- Tackling land degradation through forestry related rehabilitation
- Encouraging Participatory Forestry Initiatives and Support to Stakeholders
- Encourage and support CBFM programmes
- To address the on-going conflicts over resources, there is a need to understand the dynamism of common property regimes based on mobility.
- Use of Indigenous Knowledge as a tool for coping with climatic variations

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