Desertification in Sudan, Experiences and Lessons Learned

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Abstract: The intention of the present paper is to analyze the declining trends of forest cover in the Sudan and its implications on the environment. Data derived from reviewing and analyzing previously accessible published and unpublished studies and meticulous projects appraisal in the regions affected by desertification and land degradation of the Sudan, constituted valuable foundation for this paper. Approaches for the enhancement of the forests use and management, based on local people participation, are investigated. The impacts of participatory approach on forests development are highlighted. The paper appraises the roles plaid by donor funded projects in the dry lands in Sudan derived from successful experiences.

Key Words: Desertification, Participatory Approach, Selected Donor Projects, Success Stories.

1. Introduction

The Sudan is a large country extending over approximately 2.5 millions square kilometers. It is divided into twenty six states, the majority of them are threatened by the creeping desert. Serious environmental problems caused by poorly planned land use development in the Sudan and are reflected in forest cover changes, land degradation and progression of desertification. Large extensive areas of the dry zones have turned out to be desert like at present. As said by Noordwijk (1984), in a period of 17 years between (1955 and 1972), a zone of about 100 km wide between the desert frontier and the semi-arid land has become desert as a consequence of human activities. Reasons which are held to blame for this desertification are many:

Throughout the 20th century, the climate reported to be changing noticeably. Dry periods interchange with wet periods. In the dry years the desert shifts to the south as a result of vegetation destruction that does not recover and exacerbated by human activities. Over cropping, results in a great deal of land clearance and removal of the natural vegetation for growing crops, in areas where a good crop is promising only in remarkably wet years. For mechanized farming trees are believed to be an obstacle to the machinery and accordingly the fields are becoming bare of cover. Larger areas that were once used for practices of bush-vegetation land use are converted to mono-cropping.

Over grazing leads to deterioration of the carrying capacity by averting regrowth and by trampling which diminish the penetration of rain water into the soil. Overgrazing is the most prevalent cause of desertification in almost all over Sudan. This is especially so around water points and where water table is often lowered after increased or excessive use of water. Noordwijk (1984) described this status as a vicious circle which can simply be broken down by limiting animal numbers and by giving the vegetation a chance to recuperate by fencing off certain parts and establishing rotational grazing.

Abandonment of bush-fallow land use practices and unplanned burning which results in elimination of on-farm trees constitute serious problem in dry land management. The clearance of bushes for wood and the burning of grass and forest for land preparation for crop cultivation, can lead to desertification. This is exercised in several areas in Central Sudan. Fires devastate the soil cover leaving it exposed and consequently susceptible to erosion and desertification.

The Present Status of Desertification in the Affected States

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The rate of deforestation and forest depletion in the Sudan are continuously increasing. Deforestation in the Sudan has been reported to follow similar trends in tropical natural forests in Africa, where the rate of forest conversion is approximately 29 times the rate of reforestation (Lanly 1982; WRI 1985). Presently, enormous areas are completely bare. The only remaining forests are scattered natural forest reserves and relics of natural forests outside the reserves. People living in the rural and urban areas illegally access these forests for collection of wood and non-wood forest products and on crop cultivation to sustain their livelihood.

The large quantities of biomass consumption, particularly at urban societies, in a country with almost 90% of it classified as dry lands characterized by low yield in biomass, implies that the rates of biomass use is more than can be supported by the land capacity. In fact the biomass consumption in many parts of the Sudan exceeds the biomass stock (FNC 1998).

The natural forests of the Sudan were estimated to cover 40% of its total area in 1901 but declined to 34-36% in 1958 (Harrison and Jackson 1958). Based on National Energy Administration (1972) estimates and World Bank (1986) reports, the total forest area in Sudan was estimated at 34.8% of the total area of the country with an annual change rate of approximately 0.7 %. The forest cover decreased to 28.6% in 2005 (Forest Resources Assessment (FRA) 2005, Elsiddig et al 2007). Forests are also harvested by intensive selective felling that resulted in decrease in total volume. Brown and Wolf (1984) stated that the total biomass in Sudan declined from 2.4 billion cubic meters in the 1970s to 1.6 billion cubic meters in 1984. Abdelmagid et al (2008) reported that volume per hectare in the dry lands declined from an average of 15.0 cubic meters to approximately 7.0 cubic meters. Associated with these changes of forest cover, land productivity has also declined. Elsiddig (2006) stated that the productivity of grains per hectare was about 1500 kg during the 1970s but presently it does not exceed 600-800 kg per hectare (Figure 1). Signs of environmental changes in semi-arid areas have been reported by Elhag (2006) indicating that the 100 mm isohyets shifted southwards by almost 63.0 km.

Consistent with Sudan National Action Plan for combating desertification (SNAP) (2007), thirteen-affected states in north Sudan have tropical sub-continental type of climate whose nature is determined by two main air movements. The second is a major airflow of Maritime source that enters the area from the south and takes moist air and brings rain. Consequently there is a dry period from November to April and a wet period from May to October. The rainfall follows a general north-south gradient, increasing from 25 mm per annum in the extreme north to 1000 mm per annum in the southern borders. As a result the states that are situated in the northern part of the dry areas obtain limited annual rainfall than those in the southern Savanna. These states located in the dry semi-arid zone are more susceptible to desertification, including the Northern State which is situated in the desert. Almost 29% of the Sudan is in the dessert zone and 20% in the semi arid zone.
indicating that 49% of Sudan is in serious dryness (Abdelmagid et al. 2008). The rainfall is in the range of ≤ 75 mm/annum in the dessert zone to ≤ 300 mm/annum in the semi-arid zone.

Deforestation, a major aspect of desertification and land degradation is one of causes of social suffering (Daak 2007). Case studies based on remote sensing indicate that forest cover in the Sudan is declining at varying rates. Elsiddig 1999 reported that forests are converted to mechanized farms at approximate 0.5 millions hectares per annum. This estimate is very close to FRA (2005) estimate of annual rate of forest clearance in the Savanna zone of 0.54 million hectares per annum. When these figures are compared with the World Bank (1986) that approximates an average of 0.47 millions hectares of forest clearance, the conclusion could be that forest cover decline in the Sudan follows an increasing trend which is confirmed by Daak (2007).

The background situation of the forestry sector was virtually in a crises by 1980, resulting from a low investment in forest development and high removal of cover indicated by high rates of deforestation (World Bank 1986; Elsiddig et al 2007). Deforestation is a serious activity in connection with its impact on forest resource depletion and creation of an environment that contains risks of conflicts between forest resource users. Deforestation resulted in the retreat of forest cover southward as a result of land uses including agriculture, grazing and wood collection (Daak 2007). While agriculture may benefit from forest removal, pastoral activities face negative influences as a result of decreased carrying capacity and changing nomadic routes.

Deforestation generates appropriate environment for invasive tree species that create monoculture of single tree species crop replacing the biodiversity of indigenous tree species. Mesquite is an example found to dominate the banks of seasonal rivers and vast areas of bare lands in the central clay plains once covered by natural forest areas (Abdel Magid, 2007).

Desertification has negative impact on the climate. The Higher Council for Environment and Natural Resources in the Sudan (HCERN, 2003) reported that vast area clearance in the Sudan resulted in ranking Sudanese Forests as the major source of CO₂ emission. Forests in the Sudan contributed by 75% of the total CO₂ emissions as reported in the first communication report by HCERN (2001).

2. Sudan Experience in Combating Desertification:

Previous Projects:

In relation to a quarter of a century back, the Rural Development Administration implemented a number of agricultural development projects in Sudan over a wide array of a climatic and soil conditions. A few of these projects were planned for fighting desertification which was referred to as Desert Encroachment Control and Rehabilitation Programme (DECARP, 1976). It was recognized at that time that desertification was initiated by human activities as indicated by overgrazing, unsound cultivation, wood cutting for fuel and increased water use (SNAP 2007). Some projects can be cited as examples of the effort of fighting against desertification.

Restocking of Gum Arabic for Desertification Control

Gum is produced by the species Acacia senegal which grow in a belt 300 km wide, characterized by a low rainfall in the range 300 – 450 mm/annum (Elsiddig 2003). The gum belt extends in desert prone areas within the low rainfall woodland savanna. Acacia senegal is described as a suitable species to be grown within this belt because of its ability to restore the soil fertility during a twenty years time of bush-fallow rotation followed by agricultural land use for a period of five years (Elsiddig 2007). The bush-fallow system of gum production is people-oriented, founded on small holdings gum gardens managed in integrated agriculture and gum trees existing sequentially in five and twenty years respectively (Balla 2005). The Acacia Senegal bush is cleared at age twenty years when it ceases production of gum and by then, the soil is restored and becomes ready for cultivation.
The main objectives of the project are to establish ten extension service centers in three desert prone districts of northern Kordofan. El Obied, Um Ruaba and Bara districts were selected for being suitable for gum Arabic cultivation system and they represent desert prone areas in the sand areas of Kordofan State. The project also aimed at promotion of individual and community involvement in the restocking of the gum belt and combating desertification.

The activities of the project aimed at creation of facilities and levels of technical ability within the rural communities to enable them to become self-reliant in combating desertification and in improving their living standards. People involved in the project activities benefit from gum production to support their needs while managing the gum bush to protect the environment. The project activities include establishment of extension centers to trigger community in restocking of the gum belt in addition of establishment of central nurseries and distribution of seedlings to the farmers.

**Integrated Resource Management for Desertification Control (Al-Odaya)**

Elodaya area is characterized by existence of different groups of land users including pastoralists, sedentary farmers and wood users. They enter into conflicts as a result of land degradation and desertification in the area. The aim of the project is to establish institutional structure to promote individual and community involvement for the regeneration, conservation and proper management of the natural resources in their area. The immediate objectives included: Establishment of self-reliant rural communities through creating operational Village Councils, Development Committees (VCDCs) with their subcommittees that focus on the natural resource management, enhancement of land management with stress on range management and development of water harvesting techniques,

The activities constituted major results that lead to activities such as consolidation of eleven operational VCDCs and development of new ones, formation of nomadic development committees, establishment of a Council for Area Resources Management (CARM), organization of specialized sub-committees on range, water, finance and village nurseries and provision of on-job training for villages during participation in project activities (Elsiddig 2007). The project provided successful stories of bringing community groups like farmers and nomads to work together to resolve conflicts and fight against desertification problems.

**Western Savanna Development Project (WSDP):**

This project has created an integrated part of government long-term agricultural and rural development programme in Southern Darfur. The Western Savanna Development Corporation (WSDC) became operative in 1978 and had two projects, namely South Darfur Rural Development Project and The Savanna Development Project. The objectives of these two projects included increasing small farmer incomes through higher production, adoption of improved farming system, arresting the ongoing land degradation, rehabilitation of water supplies facilities, extension of new technologies and conservation of rangelands and pastures.

The project development plans included activities that aim at adoption of operational research and establishment of four controlled settlements with secure tenure, registered wet season enclosures, wet season grazing system implemented with a group of nomads.

The Western Sudan Agricultural Research Project (WSARP) as an integral part of (WSDC) was to generate new farming systems and improved crop production and to protect the environment.

Each of the projects achieved some of its objectives and contributed in desertification control, for example:

- Establishment of nursery techniques and adoption of tree planting including restocking of gum Arabic gardens.
- Technology of rest-rotation grazing system.
- Concept of traditional reserves and water catchments techniques.
- Establishment of an extension system.
- Trials and partial success in the establishment of new farming system and a sustainable environment.
Success in developments achieved by these projects induced awareness about the role of people oriented anti-desertification projects and enhanced the establishment of several projects that indicated concern about desertification and the need for its control. Some of these projects were based on women organizations. Examples of these projects are cited in the next sections.

**Women’s Forestry Project (WFP)**

The WFP implemented a wide range of forestry related activities targeting women as a main stakeholder of the community in the River Nile State in Northern Sudan. WFP pilot phase started in 1994 and terminated in December 2000. This area of project activities represents a wide zone of dry land that suffered severe problems of desertification and land degradation. The WFP achieved major objectives including training of women on extension work among themselves.

In 1999 the activities have been intensified, and the women show interest, enthusiasm and self-confidence, and during their ceremonies and occasions they discussed matters concerning resource management, shared and transferred their experiences to each other. This state is indicated by the following statements of assessment as provided by experts who evaluated the project. It was stated that women:

- Developed capabilities in identifying tree’s names, types of trees and seeds, and different techniques of nurseries.
- Always very cautious in irrigating and protecting their nurseries, woodlots and shelterbelts.
- Carry seeds and seedlings to other neighbouring towns and villages that are not targeted by the project.

The majority of women working as extensionists demonstrated immense keenness for the work. This was verified by the fact that a group of extensionists from phase 1 of the WFP formed a team for puppet show to work in different villages of the project areas and that WFP held refreshment courses for the extensionists. The presence of women was very high and provided evidence of high interest to acquire new skills and knowledge.

The programme of women forestry project achieved several results amongst that included a considerable number of women who participated in establishment of home nurseries in the targeted villages, and also some nurseries have been established in other villages beyond project area. The project staff encouraged the women to produce horticultural and citrus trees, by purchasing from them forestry seedlings from their nurseries and providing them with citrus seedlings.

The project was concerned with tree species that proved to be successful in desert control like *Silvadora persica* and encouraged the participated to protect this species together with some endangered plants.

There are other projects that indicated concern about several aspect of developments that also play significant role in tree planting and desertification control in the northern ststes that are facing desertification.

**School programme:**

Schools located in desert prone areas provide opportunities for development of school programme that participated in tree planting strategy. Introduction of hand pumps in selected schools yards, which radically solved the problem of irrigation and also provided impovinvolving school programmes in desertification control and improvement of environmental conditions of the targeted schools. A considerable number of schools were planted with different types of trees, and in some schools, seeds were collected from woodlots which were used for sustaining tree planting activities in other villages where schools are located. Project designed programmes for involving students' societies for taking care of tree plantings and protection.

**Use of improved wood and charcoal stoves:**

The improved cooking stoves that use charcoal were accepted and adopted by women local organizations. Incentive for encouraging women was provided by the project staff that disseminated and subsidized the prices of stoves. Since the stoves have been economically viable and socially acceptable, women started to provide the local materials of tins and cans for stove manufacture. Consequently they contributed to the improvement of the environment through recycling of these waste materials and simultaneously improve their economic status.

**Environmental awareness**
Many of the projects working in areas facing desertification are convinced about the importance of extension and awareness raising. Environmental awareness about desertification has been realized in different facets. This can be exemplified by citing the responses of local people and their understanding of knowledge diffusion. Cooperation and willingness of villagers in encouraging women to be trained as women extensionists is an example of the encouraging attitude in area where people are conservative about women involvement in activities outside their homes. Other examples of people enthusiasm about participation in desertification control is indicated by cases that in ceremonies and other social occasions, people discuss project benefits and the physical results achieved, so they shared experience and exchange information between them.

There are many occasions where men are encouraging their wives, sisters, and mothers to get involved in project activities. Moreover, they provide help and assistance for their wives in building walls and fences to protect the nurseries and planted trees in their home yards.

3. Lessons learned

Throughout the period since early 1980s, international assistance introduced management practices inside the natural forests based on projects concepts and local people participation with the objective of forest rehabilitation and sustainable management considering environmental protection and people needs (Abdel Magid and Elsiddig 2003). During the period from 1980 towards the end of the 1990s, many experiences and lessons have been gained from developments of projects activities in some government's forest reserves and community-owned forests based on extension and awareness raising campaigns and community involvement. The partnership between the communities and government institutions set objectives of tree planting strategies in addition to natural forests development, management and rational use. Fuel wood scarcity, food security considerations and environmental degradation were among the driving forces for development and management of communal and government partnership to facilitate sustainable management of the forest resources and protect the environment.

The Women’s Forestry Project (WFP) grew out of SOS Sahel’s first project in Sudan and the Village Extension Scheme, in the Shendi area of River Nile State, were entirely managed by Sudanese staff for the desertification control in the Nile State. In the early years from 1985-1993 this project covered a wide range of activities aimed at protection of natural resources and improving the standards of living of population in the destituted areas through establishment of central village nurseries, woodlots and village shelterbelts by the local people. These green belts protect villages and farms from windblown sand, provide fodder for animals and produce fuelwood and building materials for the community members. Furthermore the project successfully achieved its objectives through adoption of several strategies of people awareness and building capacity of project staff to execute efficiently the community forestry programmes and to stimulate the community members to participate in tree planting activities and conservation measures.

The projects achieved their activities in covering 30 villages and more than 5000 women were involved in the activities and illustrated their interest. Village extensionists were energetic in their community even after project termination. The number of trees planted is significant, and the total number of women who planted trees is consciously increasing. Women are willing to plant horticultural trees, but due to the long time needed to produce seedlings of citrus in nurseries, women can only plant fruits by purchasing prepared seedlings.

There is no doubt that planning and managerial capabilities of staff had improved, supported by many evidences. The overall goal of the projects is to promote the livelihood of the local communities in the project area by involvement of women in the sustainable development in desert prone area in arid zone, which is endangered by desertification. In this context the project can be considered as a virtuous example to be replicated in other areas with similar conditions.

The projects also aimed at improving the conservational use of the resources through adoption of improved technology and the use of efficient cooking stoves. Elsiddig (2004) confirmed that educating people for rational use of the forests under participation of communities enhances conservation. Natural forest reserves in the dry land of eastern Sudan is a success story in which people and the forestry administration (FNC) have achieved shared benefits. The experience has by now been replicated in other, larger reserved forests under similar conditions. Glover (2005) and Luukkanen et al. (2006) stated that the example of eastern Sudan in environmental protection represents a criterion of “increase in forest cover based on people involvement.”
success in achieving this criterion is based on the indicator that the number of people involved increased from 30 farmers in 1994 to 800 farmers in 1998. In addition, the annual area rehabilitated and protected by the farmers resulted in a good stocked 77 forest cover which is an indicator of rehabilitation of the degraded part of the forest.

Joint forest management, as observed in desert prone areas, signifies a progressive move towards state appreciation of the interdependence between the safety of forests and the welfare of the local people depending on forests for survival and livelihood needs. The socio-economic studies conducted by FAO project (Forest Resource Conservation Project) showed that rural people appreciate the benefits of trees and forests and are even prepared to become involved in forest management.

4. Conclusions and recommendations

Conclusions

Since 1980, sixty projects were being implemented in the forestry sector and environment protection, for short periods of 10-20 years except twenty projects that continued after the end of the 20th century. Objectives and activities of donor projects concentrated on contributing to development and were well coordinated in order to avoid duplication or overlapping. Most of the projects concentrated on extension with material on desertification control and natural resources conservation.

In presenting the experience of these projects the following conclusions are drawn: -

- Some projects utilized straightforward and rational approach, which could be replicated else where by the rural communities for desertification control.
- Capacity building reflected in institutional development and restructuring of units including introduction of extension facilitation for environmental protection.
- Extension activities all over the Sudan enhancing community mobilization towards involvement into natural resource management and integrated farming system.
- Some projects implemented intermediate technical approaches combined with efficient funding model approach, which proved to be helpful to the local community.
- Dependence on foreign funds may have a negative influence unless co-ordinated with the local component.
- Some donor projects relied solely on external expertise and when terminated left behind unsustainable project activities.

Out of several lessons learned from the previous projects in Sudan, it can be concluded that it is achievable to organize the advantage allocation within the community and stimulate the local people to take part in forest protection and rehabilitation.

Recommendations

The majority of Sudanese communities depend on forests for livelihood support whether directly from products or indirectly as related to environmental protection. Hence sustainable forest management is essential for supporting present generation and considering the needs of future ones. The following recommendations are accordingly suggested.

- Consolidate and encourage efforts by legitimate organizations and community groups regarding protection and conservation of natural resources at the national and local levels and support collaboration between different stakeholders.
- Capacity building and training of local communities and their organization in conservation, rational utilization and sustainable management of natural resources is an important need.
- More specific studies are still needed to educate natural resource user groups about the importance of conservational use on success of desertification control programmes.
- Incentives for people to take effective part in forestry activities should be organized.

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