# The Elodaya Desertification Control Project

## Western Kordofan (Sudan)

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# 1. Basic Information

## Location, Area and Population

- The town of Elodaya lies in Western Kordofan State. It is located about 83 km south of En Nahud and 30 km north of Rigel El Fula, the capital of western Kordofan State. It is enclosed between latitudes 11° 58° and 12° 20° N, and longitudes 28° 28° and 28° 02°E. (see location map, Figure No (1)).
- Elodaya is the capital of Elodaya Rural Council (RC). The RC extends over a total area of about 3000 km$^2$ with a total population of approximately 40000 people, 20000 of which in the town, the remaining 20000 lives in the surrounding villages.
- Elodaya being a permanent water supply center provides drinking water for humans and livestock of the surrounding villages. The livestock population is approximately 2000 cattle, 5000 sheep and 7000 goats. These numbers were further augmented by livestock from the surrounding villages which depend upon Elodaya water facilities during the summer.

## Ecological Set-up

- Elodaya town and its surroundings are part of the low rainfall Savannah Ecological Zone. It is located in the transitional zone of the sub-division *Combretum cordofanum, Dalbergia and Albizzia amAra* savannah woodland (450-600 mm rainfall). The soil consists of undulating sand dunes and the vegetation around the town and the RC are classified into six vegetation communities. These communities are as follows:

| | | | |
|---|---|---|---|
| Community Type (1a) | **Eragrosis Tremula Guera senegalensis** | Community Type (1b) | **Cenchrus biflorus Acacia senegal** |
| Community Type (1c) | **Eragrostis Tremula Conchurs biflorus** | Community Type (1d) | **Sclerocarye birrea Eragrostis Tremula** |
| Community Type (2a) | **Sida cordifolia Zornia glochidiata** | Community Type (2b) | **Guira senegalensis Albizzia amara** |
| Community Type (2c) | **Zornia glochidiata Albizzia amara** | Community Type (3) | **Cassia Tora Acacia senegal** |
| Community Type (4) | **Acaica Albida Balanites aegytiaca** | Community Type (5) | **Pannicetum ped., Cassia tora** |
| Community Type (6) | **Taristrehpe bicalyclata Albizzia amara** | | |

## Environmental Degradation at the Town Surroundings

- The town surroundings are severely affected by general land degradation, drought and desertification. Human activities are mainly based on rainfed farming; fuel wood cutting, livestock grazing and cyclic drought are among the major factors of natural resource degradation. Previous vegetation communities, as indicated above in para (1-2) have undergone severe compositional changes or completely disappeared from the surroundings of the town. The sand dunes started to move and to cover the fertile clay pockets inside the town, with detrimental effects on horticultural activities.

### Administrative Structure

- Administratively, as from 24th march, 1994 the whole Sudan has been organized as a federal system, dividing the country into 26 states, sixteen in the north and ten in the south, each led by a Governor (Wali) and five or six ministers, one of who deputy of the Wali.
- Kordofan region lies west of the White Nile and Khartoum. The region extends over 381000 km² (15%) and has at present a population of 3.25 millions of which 63% are sedentary cultivators, 24% nomadic and 13 urban dwellers. The region is divided into a Northern, Southern and Western state. The project area (Elodaya town) is situated in Western Kordofan State and represents the center of Elodaya Rural Council (RC). The RC cover a total area of approximately 3000 km² with a total population of about 38162 people living in 27 village councils approximately 95 villages.

### Land Use

The major activities of the resident population is horticulture within the clay pockets stretching into the town, livestock grazing, and rainfed farming of millet, sorghum, groundnut and water melon.

## 2. Problem of Desertification

### Definition

- One of the most important issue facing Sudan and North Africa in general to day is the threat of continued drought and desertification, of resulting destruction of natural resources, agricultural lands and their political and social disturbances. Desertification has been defined as the phenomenon of environmental degradation which converts land into desert-like conditions unfit for man and animals.

### Major Causes of Desertification

- The hypothesis that desert encroachment is a manifestation of major geological climatical changes is still subject to considerable scientific debate. Most scientists seem to agree that weather fluctuation or cyclic drought of one or more years and land misuses are the actual causes of desertification particularly in arid regions such as the case in Sudan.
- This fact most probably led Sudan's soil conservation committee (1994) to conclude that there is very strong evidence that the climate of today with its normal variation (periodic drought) has undergone no basic changes for better or worse since the close of the final major rain phase. They conclude that soil degradation and desertification that has occurred since 1944 and cintinues to occur up to the present are mainly attributable to general land misuses rather than to major climatic changes.
- In Sudan the most destructive effects of human activities which are leading to natural resources degradation and causing desertification result from droughts, coupled mainly with the extensive rainfed farming on marginal land, overgrazing, wood cutting, deforestation, uprooting of shrubs and burning of grasslands and forests shrubs.
- Several writers believe that the real danger to all arid regions south of the Sahara is not a physical advancement of the desert from the north, but is the process of desertification *in – situ,* especially around towns and cities due to the extensive farming activities that rapidly exhaust soil fertility and soil-binding substances.
- It may ultimately be concluded that a combination of factors, involving fragile ecosystems developed under harsh climatic conditions and human activities which are increasing in irreversible magnitude, are the actual causes of the desertification problem in Sudan (DACARP / 1978).

# 3. Desertification Impacts

## Desertification Impact on the Surrounding Areas of Towns

- The problem of desertification is very severe in the savannah belt of western Sudan. Land degradation and desertification are particularly severe in the areas surrounding towns, big cities and villages where permanent water supplies are available. This phenomenon is due to the intensive pressure on natural resources for crop production, forage for livestock grazing, fuel and wood for other purposes. The degradation of these parameters grows in diameter as human and animal populations increase. Not uncommonly, the area effected grows by 20 to 40 miles around these sites.
- The problem of degradation of town parameters, particularly those with permanent water supply facilities, has long been recognized by the Sudanese Government. As early as 1944, a programme for the establishment and management of the parameter of El Obied town was implemented to conserve and manage the natural resources so as to prevent their degradation.

## Decline in Food Production and Migration to Big Towns and Cities

- The decline in food crops production per unit area encouraged the horizontal expansion of rainfed farming to compensate for low yield at the same time encouraged migration to big towns and cities.
- Table No. (1) below indicates changes in land use categories within the project area in 1994 compared to 1959.

Table No. (1) **Size of Land Use Type in 1959 Compared to 1994**

| Land use type | Size of land use types in km² | | Percentage of changes |
|---|---|---|---|
| | **1959** | **1994** | |
| Cultivated area | 334.97 | 615.1 | +167 |
| Horticulture | 2 | 4 | +100 |
| Range land | 1104.22 | 733.36 | - 33 |
| Settlement (in number) | 18000 | 116000 | +511 |
| *Source: vegetation, soil and land use survey report (1994)* | | | |

- As the table above indicates, the rangeland which formerly dominated 40% of the project area, declined to almost 27% due to the horizontal expansion of rainfed farming activities. Settlement inside Elodaya town increase to almost +511 % due to the migration of farmers to towns and big cities.

## Refugees

- Including the project area (Elodaya), the area affected by drought and desertification forms a link between two seriously drought affected countries (Chad in the west and Ethiopia in the east). In spite of the drought situation the Sudan including Elodaya is currently hosting over one million refugees from Chad, Niger and Ethiopia. There can be no doubt that the migration of refugees is complicating the overall situation.

# 4. Elodaya Desertification Control Project and the Role of the International Cooperation

## General Overview

- As previously mentioned desertification in Sudan is particularly severe around towns, big cities and villages where a permanent water supply are available.
- Elodaya was selected for this project because it is one of the most densely populated town in western Kordofan State and has been severely affected by land degradation and desertification. Owing to its location, Elodaya will serve also as an important demonstration model for the surrounding areas, and raise public interest in favour of implementing similar projects elsewhere. Figure No. (2) indicates the project area within the Rural Council (RC).

## The Role of International Cooperation

- The Elodaya project (UNSO/SUD/81/x03) or the management of rangeland around permanent water supply center for desertification control was initiated by UNSO during the period 1982-1997.
- The project was funded through special contribution by the Swedish Government to the United Nations Trust Funds for Sudano-Sahelian activities. This project was started in 1983 and lasted for five years (up to 1988) with a total funding of US$ 655,599. The project was executed jointly by the Sudan Government and the FAO as Cooperating Agency.

Figure No. (2): **Project Area within the Rural Council (RC)**

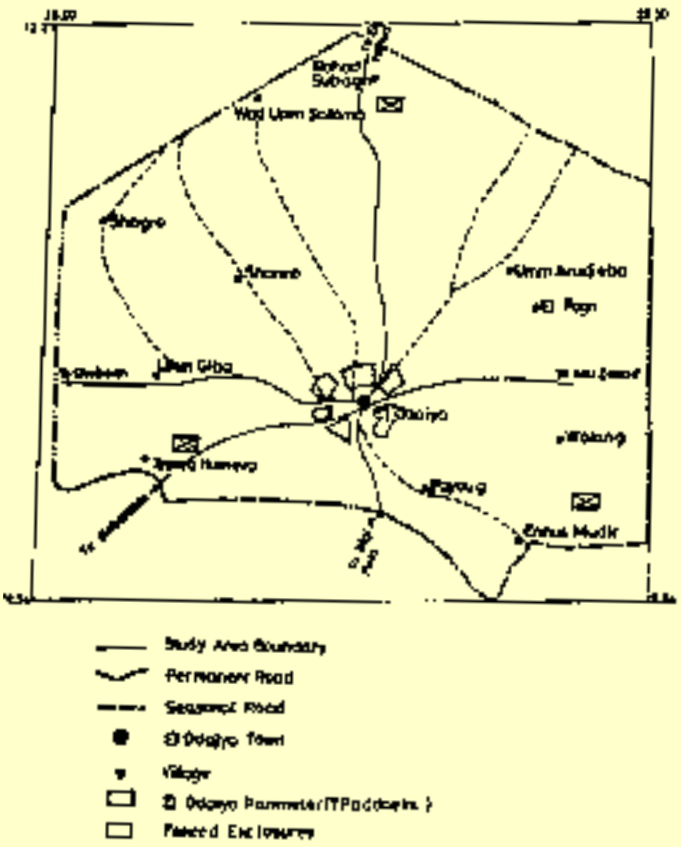
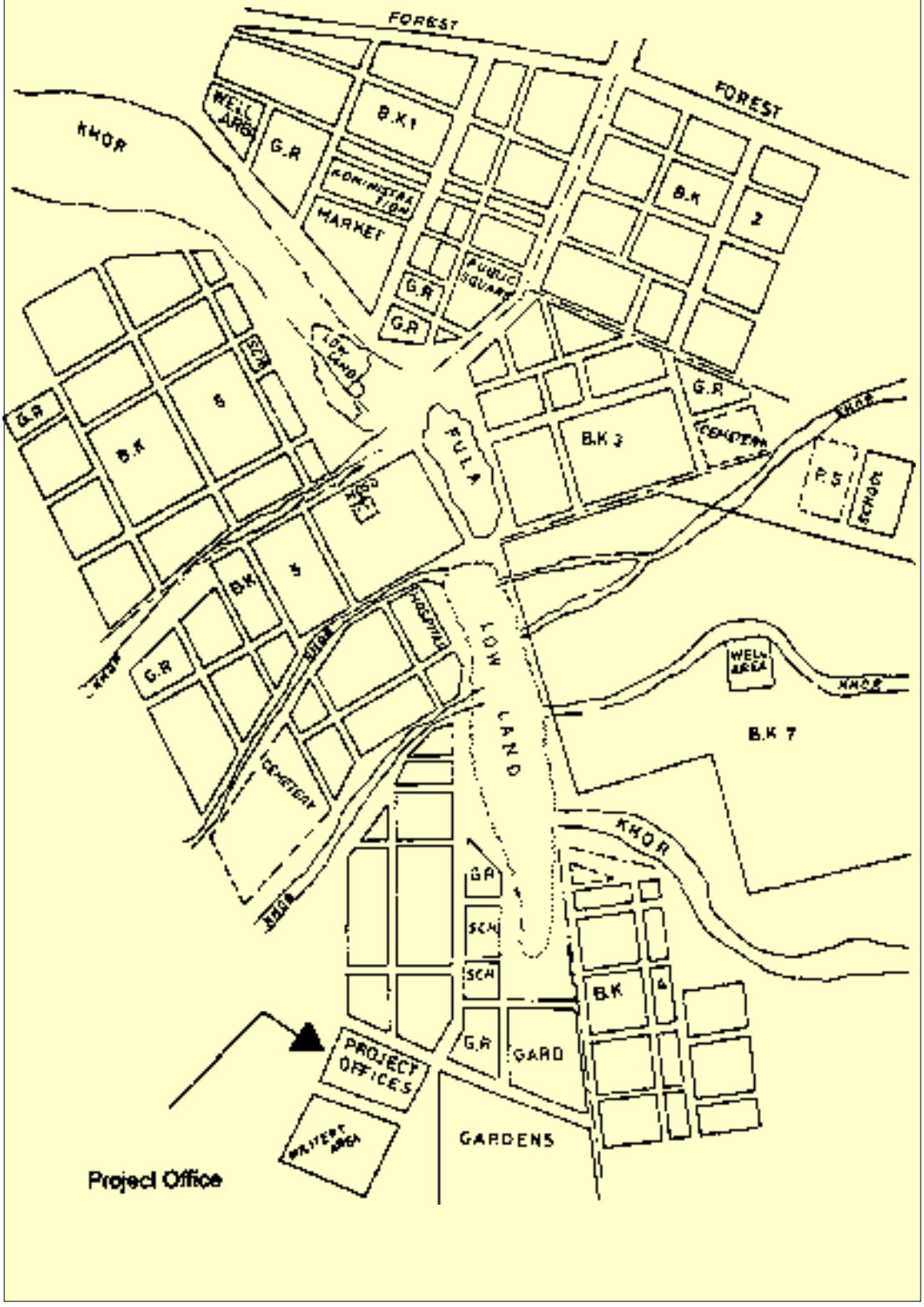


Figure No (2) **Scale 1/10000**

**EL ODAYA TOWN**



## The Project Philosophy

- The philosophy of the proejct was mainly based upon the following prinicples:
  - General Land degradation and desertification is confined to envelops immediately surrounding towns and big cities and villages where permanent water supplies are available.
  - The project alone was not expected to reverse the trend of desertification. Therefore the philosophy of the project was based on self-help, i.e. local inhabitants were involved in planning, implementation and management of project activities.

## Project Objectives

- The ultimate goal of the project is the establishment of a self-sustaining continuous programme of locally organized environmental rehabilitation and management measures. The objectives are the following;

### Long Term Objectives

- To restore land productivity through rehabilitation, improvement and systematic management of rangelands in the surroundings of Elodaya Town.
- To alleviate grazing pressure around the Town.
- To contribute to the diversity and quality of cropping and livestock production thus promoting the area's overall economic and social developments.

### Short Term Objectives

- The establishment of a fenced-in area around the town for range rehabilitation and proper grazing management.
- To develop well-balanced plans for proper resources management to ensure their continued productivity.
- To provide practical models for demonstration purposes. Such model could be replicated elsewhere.
- To involve the local people in the planning and implementation of project activities to ensure continued participation.

## Project Layout

### Demarcation and Fencing of the Surroundings

- Figure No (3) illustrates the layout of Elodaya Parameter, which was fenced around the town. This layout was designed by the Range, The Forest Administration, The Local Government Authorities and later approved by the Survey Department.
- As Figure No. (3) indicates the area was divided into six individual blocks (grazing paddocks) in order to allow free passages to and from the town, and also to facilitate the utilization of the area as part of the rest-rotation grazing system. The rotation system was based upon the actual carrying capacity of the individual paddock and the stocking rate to correspond with the actual grazing capacity. This is mainly to prevent over gazing and rangeland degradation.
  The actual sizes of the individual paddocks and the total size of the parameters are illustrated in table No. (2)

Figure No. (3): **Design of El Odaiya Town**

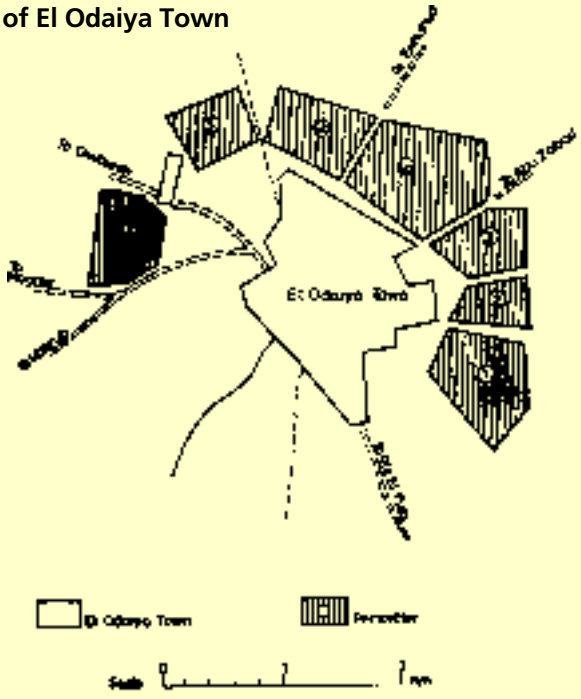


Table No. (2): **Size of Parameters and Individual Paddocks Around Elodaya**

| | Size | |
|---|---|---|
| Paddock No | $km^2$ | Fedd. |
| 1 | 0.73 | 173.74 |
| 2 | 0.26 | 61.9 |
| 3 | 0.34 | 80.92 |
| 4 | 0.34 | 80.92 |
| 5 | 0.52 | 123.8 |
| 6 | 2.85 | 678 |
| Total | 5.04 | 1199.58 |

**Management Practices**

- To achieve its goals the project applied several management practices. These management practices include the following.

1. *The establishment of Village Councils*

- In addition to Elodaya nine village council development committees were formed for the implementation of project activities. These activities include: fencing of parameter, nursery establishment, Transplantation of seedlings for agroforestry, water provision and soil conservation activities. Before the implementation of project activities, village development committees were given extensive training in all these areas. Specialized sub-committees were selected from these village councils to mobilize the local community in favour of the implementation of project activities.

2. *Parameter Fencing*

- In addition to the parameter, three other fenced exclosures were established in three villages within the project area (refer to figure 2) . These fenced exclosures were mainly intended to demonstrate rangeland rehabilitation for desertification control. After rehabilitation was achieved the grazing management inside the exclosures was carried out by the specialized sub-committees under the supervision of the project staff.

3. *Range rehabilitation using seeding of adaptable forage seeds*

➪ Fencing was used to encourage range rehabilitation through the process of natural succession. Seeding of adaptable forage seeds was used to accelerate the process of range rehabilitation and improvement.

➪ In the process, different exotic and indigenous forage seeds were introduced. Example of these seeds are listed in table No. (3)

Table No.(3): **Forage Seeds Used in Seeding**

| Species Name | Local Name | Life Form |
|---|---|---|
| **Blepharis linarifolia** | Abu Rakhis | G |
| **Cenchrus ciliaris** | Haskaniet | G |
| **Chloris gayana** | – | G |
| **Clitoria teranta** | Clitoria | F |
| **Stylosanthus guianensis** | – | F |
| **Stylosanthus fruticosa** | Natash | F |
| **Dactylctenium aegptium** | Abu Asabie | G |
| G= Grass F = Forb | | |

4. *Afforestation*

➪ Inside the parameter and the fenced exclosures two rows of four meter width were planted with adapted tree seedlings of *Acacia senegal* (Hashab) and *Balanites aegyptiaca* (Higlig). These rows were placed in parallel to the wire fence in order to act as shelter-belt. In addition to these two species other different types of tree seedlings were planted within the parameter and the fenced exclosures.

5. *Nursery:*

➪ A central nursery with a capacity of 150,000 seedlings per year was established at Elodaya town. The nursery was mainly intended to generate all seedlings required for range and agroforestry work.

6. *Fire Line Construction*

➪ Fire Lines were usually constructed following the rainy season to protect grazing resources within the parameter and the fenced exclosures against fire outbreaks. Fire lines were also introduced to conserve the open grazing land. The total length of the fire lines introduced in 1985/86 reached about 450 km.

7. *Seed Collection*

➪ Seed collection was carried out annually to provide seeds for range seeding and afforestation activities. The seed collection campaigns were usually organized before seed dispersal. The mobilizing sub-committee usually organize the seed collection campaigns.

8. *Gully Erosion Control*

➪ Check dams were constructed across gullies for soil conservation within the red compacted non cracking clay soil (Hamaraya soils). Cheap materials such as rocks, dead wood and sacks full of soil were used in gully erosion control. (See fig. 4).

9. *Water spreading for range improvement*

➪ Dams or diversion dikes (fig. 5) were built across water ways (Wadies) to spread water over depleted rangeland for improvement using direct seeding of forage seeds. This technique usually improve soil moisture condition for better distribution of seeds.

*10. Water Development*

- New watering points were established in the surrounding villages to alleviate the heavy pressure exerted on Elodaya town water resources. The efforts made in this context were concentrated on areas which by their very nature lack permanent water sources and are at the same time characterized by having good natural resources potential.

## 5. Environmental Impact Assessment

- The botanical studies conducted within the fenced parameters and exclosures compared to the open range, indicated major botanical changes due to range rehabilitation and improvement. These botanical changes include: plant cover, frequency, density and total forage biomass production per unit area. These positive results indicated greatly improved ecological conditions due to project intervention. These ecological indicators include the following:

Figure No. (4)

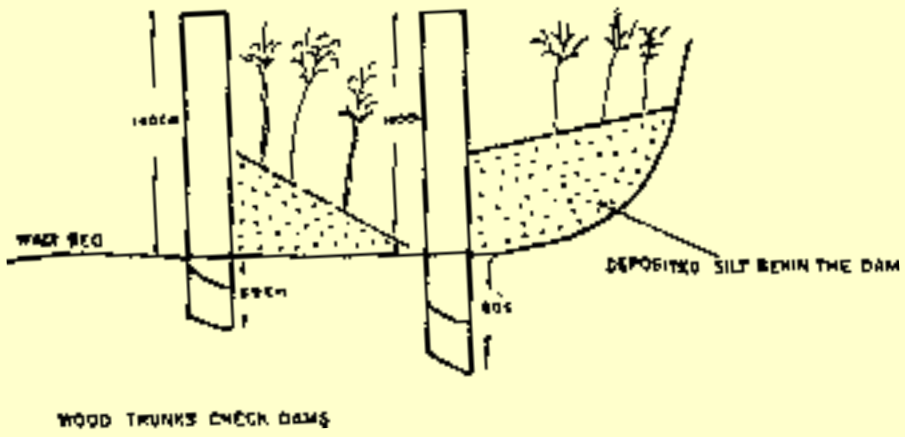
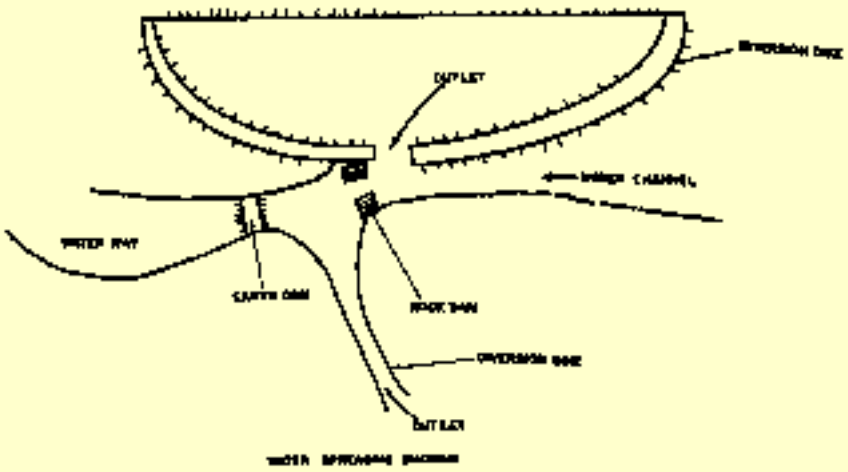



Figure No. (5)



## Plant Percentage cover

- As a result of range rehabilitation and improvement plant cover increased inside the parameter and exclosures while bare soil ratio decreased. Table (4) indicates average plant cover and bare soil before and after the establishment of parameter.

Table No. (4): **Average Percentage Plant Cover And Bare Soil Before and after the establishment of Elodaya Parameters**

| Period | Average % of plant cover | Average % of bare soil |
|---|---|---|
| Before project (1982/19983) | 46.09 | 53.91 |
| After Project (1988/1989) | 83.28 | 16.72 |

*Source : Institute of Environmental Studies , U. of K , Publication NO. (8) Range Rehabilitation at Elodaya.*

## Plant frequency

- All life forms (Perennial and annual ) inside the parameter had exhibited changes in their relatives frequency. The frequency values of perennial plants increased substantially after project implementation. According to botanical measurements taken, the relative frequency in percentage in 1982/83 amounted to 0.04%, while in 1988/89 the relative frequency increased to almost 4.02%.

## Plant Species Composition

- The forage plant composition inside the parameter witnessed some changes by the appearance of some valuable perennial forage species such as *Andropogon gayanus* which was not recorded before the project implementation. These perennial plants are of considerable importance in grazing and for soil protection.
- Annual plants such as *Blepharis linarifolia* (Beghil) was the most palatable annual forb that exhibited remarkably dynamic trends after project implementation. In 1982/83 it was absolutely not recorded while in 1988/98 it scored 2.2% of the total plant frequency.

## Forage Biomass Production and Carrying Capacity Assessment

- The quadrate or the one meter square frame was used in the assessment of forage yield per unit area inside the fenced parametet compared to forage yield in the open rang at the surroundings of the parameter.
- Table No. (5) indicates forage yield inside the parameter compared to the open range.

Table No. (5): **Estimated Forage Yield Inside the Parameter and on Open Range**

| Site | Average Forage Yield (kg/ha) |
|---|---|
| 1. Elodaya Parameter | 755.80 |
| 2. The Open Range | 193.23 |

*Source : Elodaya Project Files*

- As the table above indicates , the forage yield per hectare increased within the parameter compared to the open range as a result of range improvement.
- The carrying capacity was determined on the basis that 80% of the produced forage in utilized by stock leaving 20% as allowance for a proper use factor. Table No. (6) shows carrying capacity value inside the parameter compared to the open range.

Table No. (6): **The Estimated Carrying Capacity Inside the Parameter and Open Range**

| Site | Carrying capacity (Ha / LSU / year) |
|---|---|
| Elodaya twon parameter | 7.55 |
| The open rangeland | 29.43 |
| *Source: Project Files* | |

- The above findings are fully in line with the total forage biomass production value.

## 6. Social Impacts of the Elodaya Parameter

- During the third year and after range rehabilitation was completed, the parameter was opened for town dairy cattle and sheep grazing during the summertime. Livestock grazing was organized according to the rest – rotation grazing management system. This grazing system gives a rest period to each of the grazing paddock for a complete year for natural recovery. This is mainly to ensure continuity of milk supply, both for local consumption and for marketing. As the parameter was also used by beef cattle, quantity and quality of meat production was also improved. This increase in milk and meat production stimulated both economic and social development of Elodaya town.

## 7. Conclusion and Recommendations

- In conclusion, it can be stated that a combination of factors involving both fragile ecosystems developed under a harsh and fluctuating climate and human activities arround big residential centres which are increasing in irreversible magnitude are the actual causes of urban desertification problems in many countries. This process cannot be reversed unless actual causal factors are removed.
- It is well acknowledged that the restoration of degraded ecosystem is always not an easy task particularly in developing countries where economic constraints and lack of immediate alternatives are prevailing. However these constraints can easily be overcome by genuine public support and active involvement of the target population and resources users in the implementation of desert encroachment control programmes.
- This project (first phase) was evaluated by a mission comprising representatives from UNSO, FAO, and GOS. Following the identification of the strength and weaknesses of the project's first phase, the evaluation mission recommended to continue the project with a more integrated approach to cover the entire area of Elodaya Rural Council, which extends over 3000 km$^2$, including 133 villages and 22 villages councils.

- The evaluation mission recommended that the new second project phase after evaluation in 1997 be extended for another two years in order to consolidate its activities before the project gradually handed over to the institutional structure at community level created at this stage