ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

SCHOOL OF INFORMATION STUDIES FOR AFRICA

# RESEARCH ON DROUGHT AND DESERTIFICATION IN SUDAN : A COMPUTER-BASED INFORMATION SUPPORT SYSTEM

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE IN INFORMATION SCIENCE

BY

MOHAMMED OSMAN ELHAG IBRAHIM

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# ADDIS ABABA UNIVERSITY

## School of Graduate Studies

**Research on Drought and Desertification in Sudan:**

**A Computer-Based Information Support System.**

by

Mohammed Osman Elhag Ibrahim

School of Information Studies for Africa (SISA)

**Approved by Board of Examiners**

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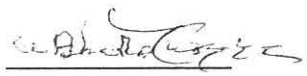
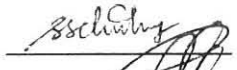
| Prof. G. Bhattacharyya, Advisor |  |
| Dr. G.G. Chowdhury, Advisor |  |
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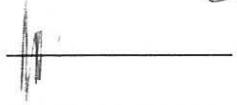
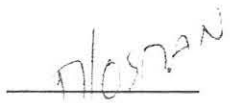
| Dr. Taye Tadesse, Internal Examiner |  |

## DECLARATION

The thesis is my orginal work and has not been presented for a degree in any other university.



**(Signed)**

**Mohammed Osman Elhag**

**May 24, 1995**

The thesis has been submitted for examination with our approval as university advisors.

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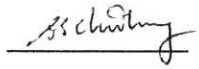

**(Signed)**

**Dr. G. G. Chowdhury**

**May 24, 1995**

## DEDICATION

**To my Father Elhag, Mother Hawa, All Brothers and Sisters, and to my Wife Randa, Son Waleed.**

## ACKNOWLEDGEMENT

I wish to express my gratitude to my advisors Prof. G. Bhattacharyya and Dr. G. G Chowdhury for their valuable, supportive assistance, guidance, suggestions and constructive criticism, and for their constant encouragement while conducting this research. I would like to admit that I have benefited enormously from their academic experience and supervision, I have learnt a lot, their help and support is much appreciated.

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## ABSTRACT

Information is a crucial resource for conducting research.The present study examines the ways of providing environmental information for researchers in drought and desertification in Sudan.

Drought and desertification is one of the serious environmental problems facing Sudan, and it has resulted in remarkable degradation of natural resources. The performance of the economy has been affected accordingly, and a number of serious social problems have cropped up. The government has realized the extent of danger, and has initiated plans to combat desertification through the unification of efforts. The dispersed efforts have to be consolidated through the use of information, and communication technologies, that can facilitate the exchange and dissemination of information.

The results of a survey shows that the existing information facilities are inadequate for the provision of reliable information service to researchers, planners and decision makers.

This study proposes the introduction of a new computer-based information support system that can replace the old inefficient manual system at IES, and proposes the linkage of the various institutions concerned with environmental issues through networking. Prototype databases have been designed using Micro-CDS/ISIS which can be used for retrieving information using a search interface available at SISA. Measures to be taken for implementation and for further improvements of the prototype system have been suggested.

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## LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| AACR 2 | - | Anglo-American Cataloguing Rules |
| AAR | - | Agricultural Research Corporation |
| CCF | - | Common Communication Format |
| DECARP | - | Desert Encroachment Control and Rehabilitation Programme |
| ENRRI | - | Environment and Natural Resources Research Institute |
| IDRC | - | International Development Research Center |
| IES | - | Institute of Environmental Studies |
| INFOTERRA | - | International Information Centre for the Environment |
| ISIS | - | Integrated Set of Information System |
| ISO | - | International Standards Organization |
| LAN | - | Local Area Network |
| MANRAW | - | Ministry of Agriculture, Natural Resources and Animal Wealth |
| NDDU | - | National Drought and Desertification Desertification Unit |
| NFC | - | National Forestry Corporation |
| NGO | - | Non-Governmental Organization |

| | | |
|---|---|---|
| TCDC | - | Technical Cooperation among Developing Countries |
| UNCOD | - | United Nations Conference on Desertification |
| UNEP | - | United Nations Environment Programme |
| UNSO | - | United Nations Sudano-Sahelian Office |
| WAN | - | Wide Area Network |

# CHAPTER 1

# INTRODUCTION

## 1.1 INTRODUCTION

Environment is a broad term which refers to the surroundings, conditions, influences or forces that influence or modify, as the complex of climatic, edaphic and biotic factors that act upon an organism or an ecological community and ultimately determine its form and survival (Webester 1981).

The conservation of nature is essential for our survival, because natural resources are scarce. The human factor, among others, plays a major role in the degradation of natural resources.

Man can alter nature, and exhaust natural resources, by his action; and therefore, must fully realize the urgency of maintaining the stability and quality of nature, and of conserving natural resources.

Sudan is a rich country in terms of the natural resources available within its boundaries. The environment is threatened and exposed to damage due to the misuse and maladministration of natural resources caused by the over cutting of trees, overgrazing of pastures, and over cultivation of fertile lands. The situation is worsened by the climatic variation and low rainfall in some areas. All these factors together, have contributed to the phenomenon of drought and desertification which is a serious threat to our survival.

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rts in environment and natural resource management.
problem of desertification, for its grave effects on the
nd (c) social life of the population.

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**D JUSTIFICATION**

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ped and developing nations, and is a particular
and Pakistan, China, Australia, the former USSR,
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le No.1 below

on of Dry Lands by Regions

| sq Km. | % Total |
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n Conference on Desertification (UNCOD) was
ugust to 9 September 1977, and was attended by
ost all the United Nation organs and specialized
non-governmental organizations.

destruction of people's livelihood and land resources. Mass migration for food and shelter accentuated the degradation process.

Research in drought and desertification in Sudan is largely hampered due to lack of adequate information. Therefore, there is an urgent need to develop an information system, by making use of the appropriate information technology, to support the studies and research in this area. This research has taken up this problem, and aims to develop a prototype information support system for the purpose.

### 1.2.2 Justification

There is a common agreement among countries about drought and desertification of being a global problem which needs the joint efforts of all countries together, to come up with measures of urgent and wise treatment. National governments should build their national information infrastructure and their technical capabilities in order to combat desertification. They should possess the knowledge base necessary to alleviate the imminent adverse effects of drought and desertification.

Man must acquire knowledge to maintain and enhance his ability to use natural resources in a manner which ensures the preservation of the species and eco-system for the benefit of present and future generations.

Research on drought and desertification seems to be imperative. In order to extend appropriate information support to this research, there is a need for the establishment of

appropriate information systems and centres. They should be equipped with machines and equipment which are products of advances in information technologies.They should be staffed with qualified manpower that can cope with these technological advances. They should have the capability of managing and running these information systems and centres efficiently to support research on drought and desertification.

The provision of the relevant information at the right time to the appropriate persons in all sectors, will help much in overcoming all the difficulties that man might encounter in his life.

Environmental problems occur at the level of relations between people and their environment, that is, their nonliving (soil, water, air) and living (plants, animals) surroundings. The environment is increasingly becoming a global issue of political and socio-economic significance. Hence the availability of environmental information is becoming increasingly important as a prerequisite to finding any scientific solutions for environmental problems in this era of information explosion. In the so-called information explosion era, proper use of environmental information, combined with the appropriate technology, will increase the sustainability of the third world development (Eisa 1990, 3).

The Institute of Environmental Studies (IES), in the University of Khartoum, is one among other institutions and governmental bodies that deals with the environmental problems. IES is devoted to the solution of problems of drought and desertification. Research has been conducted by experts in the field, to minimize the grave effects of the problem on both the economy, and the social life of the whole affected population throughout the country. The

Institute's information infrastructure, its information handling including processing, and its provision of information services, are absolutely traditional. Besides, the provision of information services is largely inefficient and ineffective. This is what the users of the existing system feel about it. The situation calls for the application of computer technology in order to enhance its productivity in terms of efficiency and effectiveness. The current users of the existing system, express it categorically that they would highly appreciate it, if a computer-based information support system replaces the existing one.The institute's initiative in this direction is already visible. The institute is planning to be more effective in capturing the most relevant information, by introducing the computer technology in its daily activities. It seeks to strengthen the communication channels for the information flow among users, and similar institutions. The improvements in the communication channels through the application of the communication technologies, as well as through the introduction of the computer, will result in a remarkable support to the research in IES. Therefore, the prototype information support system, that the present research envisages to develop, will be of great help to the researchers in (IES), and also to other people who are interested in this area, by providing adequate information products and services. This in turn, will contribute to the socio-economic development of the country.

## 1.3 OBJECTIVES

### 1.3.1 General Objectives

The general objective of this study is to develop a prototype computer-based information support system that would be capable of rendering reliable information services to meet the

information needs of the researchers, working on drought and desertification in IES, to their satisfaction.

### 1.3.2 Specific Objectives

The specific objectives of the study are:

(1) To identify the potential users of information in the field of drought and desertification in Sudan and to ascertain their information needs;

(2) To identify the existing information support facilities, and check their contributions and their limitations in providing the timely, relevant information to the end users;

(3) To identify those activities and components which need the application of computer technology;

(4) To design prototype databases with the capability of linking users need and sources of elevant information, more specifically to design a specialized database of the profiles of the areas affected by drought and desertification in Sudan.

The whole set of specific objectives seek to develop an operational computer-based information support system capable of rendering satisfactory services to meet the users requirements and satisfy their information needs. This, in turn, would help the users accelerate their research pace to combat the problem.

## 1.4 SCOPE AND LIMITATIONS OF THE STUDY

### 1.4.1 The Scope of The Study

"Environment" is a broad term that comprises a variety of environmental problems. Environment is officially designated as a global problem." Drought and desertification" is an environment-related problem; and it constitutes a serious problem among other environmental problems. The scope of this research is narrowed and restricted deliberately to focus solely on the studies on drought and desertification in Sudan.The purpose is to serve the researchers, in IES, by maintaining an information base to generate reliable information services to support their conduct of research, and dissemination of research findings to other concerned governmental bodies and institutions to combat desertification.

### 1.4.2 Limitations of The Study

The scope of "Environmental Study" is quite extensive. Various categories of researchers are engaged in the study of environment as a whole. They are all users of information on this broad field of study. In Sudan, within this group of researchers, there is a comparatively smaller group of researchers, which is engage in research on drought and desertification. The purpose of this study is to develop a computer-based information support system which would meet the information needs of the latter group of researchers This itself, is a limitation of this study.

The other limitations that entered into this study were due to lack of time and money. For this reason, it can not be claimed that the data collection corresponding to each of the specific objective, is totally exhaustive. But, for the purpose of this study, the collected data are quite adequate.

## 1.5 ORGANIZATION OF THE THESIS

The thesis is divided into three sets of broad components: The first set of components includes the preliminaries which comprise the title page, acknowledgement, table of contents, list of tables, list of figures, list of abbreviations, and the abstract. The second component is the text which includes the introduction and the main body of the thesis which is divided into chapters and sections; and at the end of the thesis, comes the conclusion and the recommendations. The third component is the reference material, as a major component of the thesis, which comprises the bibliography, and the appendixes.

Chapter 1 is devoted to the discussions on the basics of this study, like introduction to the problem and its justification, general and specific objectives, and the scope and limitations of this study.

Chapter 2 deals with the methodology used to collect the relevant information for this study. "Methodology" includes various techniques and procedures, such as, the questionnaire method, the interview method, the observation method and the method of literature survey.

Chapter 3 gives the background information about Sudan, its geographic location, climate, soils and vegetation, health, population, education, government, its economy, and its information infrastructure.

Chapter 4 is devoted to a general discussion on drought and desertification in Sudan. This chapter covers the ecological and environmental disasters, and the affected resources, such as vegetation, livestock, soil, water and human resources. It also deals with the causes and magnitude of desertification, and discusses measures for its control. Finally, the conservation of environment is dealt with.

Chapter 5 deals with the existing information facilities on drought and desertification in Sudan. The Institute of Environmental Studies (IES). Environmental information services, the existing information service facilities, technical processing, provision of services, human resources, and its publications are covered. This chapter also covers some selected institutes dealing with drought and desertification; and studies the limitations of the existing information systems.

Chapter 6 presents discussion on the proposed information system, its objectives, functions, structure, the system requirements, system demonstration, and system implementation.

Chapter 7 is the final part of the thesis. It includes the conclusion of the study, and also certain recommendations.

# CHAPTER 2

# METHODOLOGY

## 2.1 INTRODUCTION

The aim of the study is to develop a computer-based information support system for research on drought and desertification in Sudan. Different methods for data collection have been used in order to facilitate fast collection of data in the limited time available. This chapter is devoted to deal with the different methods used for data collection and for acquiring thorough knowledge needed to carry out the whole study.

## 2.2 DATA COLLECTION

In order to achieve the objectives of the study, both primary and secondary data have been used. The primary data were obtained by using the methods of questionnaire, interview, and observation; where as, the secondary data were largely collected from literature.

### 2.2.1 Questionnaire Method

There was the need for collecting data for the following purposes:

(1) To ascertain the information needs of the researchers, teachers, and students of IES, and of others in other institutions, engaged in activities related to drought and desertification in Sudan.

(2) To collect data about the organizations, and institutions concerned with drought and desertification in Sudan, either fully or partially.

(3) To collect data about the persons who are recognized as experts in the matter of advising on matters relating to drought and desertification in Sudan.

(4) To collect data about the information centres /systems dealing with information in the field of drought and desertification.

(5) To collect data about the projects involved in finding solutions to problems created by the incidence of drought and desertification.

For all these purposes, five separate sets of questionnaires were designed and made available to their respective identified respondents. The responses received were adequate for the purpose of this study.

### 2.2.2 Interview Method

Interviews with the librarians, head of environmental service units and with end users such as researchers, teachers, students in environment were arranged with a view to identifying their information needs, sources, products, and services offered.

The respondents furnished data in the filled-in questionnaires. There arose a need to cross-check the data received by using the questionnaire method. In relation to ascertaining the information needs of the users, and also in ascertaining the validity of facts about the information centres, it was necessary to fix up appointments for carrying out interviews with the respondents. Besides, there was the need for collecting some important items of

additional information relevant for carrying out the study, specially for the justification of the proposed computer-based information support system. For all these purposes interview method was used for collecting relevant data. Before collecting the filled-in questionnaires, appointments were fixed with the respondents, seeking their permission for a personal meeting to be used to conduct the interview. In addition, for the purpose of conducting the interviews, an appropriate interview-schedule was designed and used. The group of persons interviewed was selected from the following organizations and institutions.

(1) National Drought and Desertification Unit;

(2) Soil conservation, Land Use and Water Programming;

(3) National Forestry Corporation;

(4) Environment and Natural Resources Research Institute; and

(5) Range and Pasture Administration.

### 2.2.3 Observation Method

The observation method was used primarily for the purpose of being familiar with the professional activities of the identified information centres which were in some way concerned with information on environment. After being familiar with their respective objectives, functions, and structure, special attention was paid in carrying out an observational study of their respective professional information collection and processing activities along with their associated techniques and tools; and of the information products and services generated and rendered by those centres, respectively. The knowledge acquired by carrying out the observational study proved to be extremely helpful in designing the proposed computer support system.

The observation method was used to supplement the data collected through questionnaires.

## 2.3 LITERATURE SURVEY

For the purpose of carrying out this study, it was essential to acquire thorough knowledge about drought and desertification. In addition, it was necessary to acquire thorough knowledge about information system analysis and design. For both these purposes, the method that has been extensively used is the method of literature survey. Besides, for supplementing collected data, pertinent literature survey was quite helpful. All the documentary sources of information that have been used for this purpose are listed in the " Bibliography".

The method of literature survey was used to collect relevant pieces of information from different documentary sources. But, for the purpose using those pieces of information in relevant chapters, the technique of "Information Analysis and Consolidation" (IA+C) was used.

## 2.4 FACILITIES AND TOOLS FOR SYSTEM DEVELOPMENT

It may be noted here that, for the purpose of developing the prototype information support system the following facilities and tools have been used:

(1) The network facility available at the School of Information Studies for Africa (SISA);

(2) The Micro CDS/ISIS software for the creation of the databases;

(3) The ABNCD (Abebe et al 1992) integrated database approach; and

(4) The SISA interface (Molla 1993).

# CHAPTER 3

# BACKGROUND INFORMATION ABOUT THE SUDAN

## 3.1 INTRODUCTION

In 1956, the year of political independence, the Sudan became the largest country in Africa, with an area of just slightly under one million square miles. The country has abundant natural resources and great agricultural potentials. These resources are not fully exploited due to the lack of finance, expertise, and the spread of illiteracy among the majority of the population.

The economic performance is low, and the country is considered to be one of the underdeveloped countries.

Drought and desertification is a serious problem; it threatens the country's natural resources. The collection of background information about the Sudan is crucial for understanding the problem and its magnitude.

## 3.2 GEOGRAPHIC LOCATION

Sudan, with an area of 2.6 million square Kilometres, is the largest country in Africa and extends from about latitude 4° N in the south to latitude 22° N in the north. It is bordered by eight countries: to the north by Egypt and Libya, to the west by Chad and the Central African Republic, and Zaire, and to the south by Uganda and Kenya, while Ethiopia and

the Red Sea make up the eastern boundary. The country is mainly composed of extensive plains of ironstone soils in the south, clay in the central parts, and sand in the north and west. There are only a few mountainous areas of which the principal ones are the Imatong in the south, Jebel Marra in the west and the Red Sea Hills in the east (Danida 1989, 8).

Sudan has a coast line of about 700 Km along the Red Sea. The country is a gently sloping plain with the exception of jebel Marrah Massif, Red Sea Hills, Ingessana hills, Nuba Mountains and the Imatong Hills. Sudan is traversed by 9000 Km of the Nile and its tributaries.

The Nile River extends towards north from the Ugandan border to the seasonal swamps of the Sudd. The land to the north of the Sudd is drained by the White Nile; at Khartoum it is joined by the Blue Nile which originates in the Ethiopian highlands. Between Khartoum and the Egyptian border, there is a very fertile strip of agricultural land irrigated by waters from the Nile and the Lake Nasser (New African Yearbook 1993-94, 352).

### 3.3 CLIMATE

Sudan has a wide range of tropical continental climates. The dry season ranges from three months in the humid south to nine months in Khartoum. In the north, high temperatures are common throughout the year. The mean daily maximum temperature reaches about 4o°C (104°F) in Khartoum in May and June, the highest being 47.8°C (118° F). In the South, mean maximums are only slightly lower in the hot months of February and March. January, the coolest month has a mean maximum temperature of 32.2°C (90°F) in the north. In the

south, the rainy season produces over 127 Cm (50 in.) of rainfall. This is reduced to between 38 and 76 cm (15 and 30 in.) in the central area and between 13 and 25 cm (5- 10 in.) in the Khartoum region. Much of the northern desert area receives only a few scattered showers each year and northern border areas may not receive any rain at all during some years( Kurian 1982, 1650).

Sudan is dominated by tropical continental climates, with conditions reflecting the transition from desert areas to the humid tropics. Annual rainfall varies from less than 100 mm in the North, in (July -September) to over 1000 mm in the South (April-November). Temperatures are generally high throughout the year, reaching more than 38° C in Khartoum in May and June. February and March are the hottest months in the South, where average daily temperature throughout the year is 30° C (New African Yearbook 1994, 353).

Average temperature and rainfall change steadily from month to month, except where the effect of the Ethiopian highlands disturbs the east-west trend in the climatic belts in the south-east. The North of Sudan is desert, with negligible rainfall and high average daily temperatures summer 35°C, winter 20°C; low temperatures are recorded only in winter. Rainfall is convectional in origin and increases steadily south of Khartoum (200 mm per year) reaching over 1000 mm per year at the southern border.

Rainfall varies from year to year, especially in the north, and it is seasonal. In the south, it falls in the period of April to October. The rainy season is progressively shorter towards the north, where it lasts only from July until August. Potential evaporation approaches 3000

mm per year in the north, and is always over 1,400 m per year, even in the humid south. (Africa South of Sahara 1993, 837).

### 3.4 SOILS AND VEGETATION

The soil resources of Sudan are rich in agricultural potential. The exploitation of these resources depends on the availability of the limiting factor, viz, water; and only a small proportion of the clay plains of central and east Sudan are currently farmed intensively. The clay plains are the results of millennia of alluvial sorting and deposition of eroded basic volcanic material from the Ethiopian highlands. Clay also occur in the south, being deposits of the White Nile and Sobat stream.

Recent alluvium provides a basis for productive agriculture in the narrow Nile valley in north of Khartoum. Elsewhere, in the west and in the north the soils are sandy, with little agricultural potential, except in the dry valleys, which generally contain some soil moisture.

Vegetation is closely related to the climatic zones. From the desert in the north, vegetation gradually improves through the semi-arid shrub to low woodland savannah characterized by acacia and short grasses. Progressively higher rainfall towards the south promotes trees and shrubs as well as herbs, while the more reliable watered rangelands of the Bahr al-Arab provides an important seasonal resource for the graziers from the poor pastures of Darfur and Kordufan. The flooded areas of the Sudd and Machar and environs support swamp vegetation and grass land. On the uplands of the southern border, rainfall is sufficient to support tropical rain forest (Africa South of the Sahara 1993, 838).

Mountains; and higher densities than average in better-farmed parts of the Southern and the Darfur Regions.

The ethnic origin of the people of sudan is mixed, and the country is still subject to significant immigration by groups from Nigeria and Chad, such as the Fulani. In the South, the Nuer, the Dinka and the Shilluk are the most important of the Nilotics peoples.

The Arab culture and language predominate in the North, which includes the most populous provinces and the capital Khartoum. The South is predominately Christian and this cultural differences, added to the ethnic separateness and its extreme remoteness, have been expressed in economic backwardness and attendance to political distinctness which have been the main cause of frequent disturbances in Southern Sudan. (Africa south of the Sahara 1994, 838).

Arab and Nubian people populate the northern and central two-thirds of the Sudan; where as, one-third of Sudan is occupied by the Nilotic and Negro people. Arabic is the official language; and Islam is the state religion, although the Nilotics of Bahr el Ghazal and Upper Nile valleys are generally Animist or Christians.

### 3.6 HEALTH

The Ministry of Health organizes the public health services. In 1981, there were 158 hospitals with 17,205 beds, 220 heath centres, 887 dispensaries, 1,619 dressing stations and 1,095 primary health care units.

In 1984, there were 2,095 physicians working in Sudan, while nursing and midwifery personnel totalled 12,986.

In 1986, medical personnel included 2,405 physicians, and the total number of beds in medical establishments was 18,571 (The Europa World Yearbook 1994, 2766).

Most public health and hospital services are free. Diseases such as malaria, schistosomiasis, sleeping sickness, tuberculosis and dysentery are prevalent. Health conditions, which are poor in normal times, have declined in 1980s because of famine and the inability of relief agencies to reach stricken areas. (Kurian 1982, 1811).

### 3.7 EDUCATION

The government provides free primary education from the ages of seven to 12 years. Secondary education begins at 13 years of age and lasts up to six years, divided into two cycles of three years each.

The education system of Sudan is divided into three levels consisting of 6 years of the first level, 6 years of senior secondary levels, and 2-6 years of third level. Secondary education is separated mainly at the end of post-intermediate cycle into general education on one hand, and technical education and teacher training on the other hand.

There are two categories of technical education. The first comprises training programmes of 4 years undertaken by the Ministry of Education in commercial, industrial and agricultural fields as well as in home economics and in teacher training. The second consists

of vocational training organized by the Ministry of Labour and Social Security at post-intermediate level for a three year period in the areas of metal trade, electrical and building trade. Tertiary education includes both degree and diploma training programmes. Basic degree courses are given in academic and technical education of 4-6 years, while diploma courses of 2-3 years are also given in teacher training, agriculture, health and other occupational fields of study.

School education is free for most children, but not compulsory, beginning with six years of primary education, followed by three years of secondary education at general secondary schools.

The medium of instruction is Arabic. English is taught as the second language in all schools. Khartoum University has 10 faculties. Besides, there is a branch of Cairo University at Khartoum; an Islamic University at Omdurman; and other universities at Wad Medani and Juba. In addition to the universities, there are various technical post-secondary institutes, as well as professional and vocational training establishments.

The average rate of adult illiteracy was estimated by the UNESCO at 72.9% (males 57.3% ; females 88.3%) in 1990, compared with 85.3% in 1966. In 1990, the total enrolment at primary and secondary schools was equivalent to 37% of children in the appropriate age-groups (42% boys; 33% of girls).

About 15% of current government expenditure in 1985 was for primary and secondary education. Pupils from secondary schools are accepted at the University of Khartoum,

subject to their reaching the necessary standards. The Khartoum branch of Cairo University was appropriated and renamed as Neelain University by the Sudanese Government in April 1993.

There are three universities at Omdurman: Omdurman Islamic University; Omdurman Ahlia University; and Ahfad University for Women. New universities were opened at Juba and Wad Medani (University of Gezira) in 1977. There is also a University of Science and Technology in Khartoum. (The Europa World Yearbook 1994, 2766).

### 3.8 GOVERNMENT

Under the terms of 1985 interim constitution, legislative power was vested in the 301-seat National Assembly. There was a Supreme Council, comprising a president and five other members, which collectively exercised the functions of the head of state. Executive power was exercised by the Council of Ministers (headed by the Prime Minister), which was responsible to the National Assembly.

In February 1992, a 300 member transitional National Assembly was appointed by Lt. Gen. al Bashir. The Assembly was vested with legislative authority and was charged with preparing the country for parliamentary elections. In October 1993, the Revolutionary Command Council for National Salvation, which had assumed power after the military coup of June 1989, was dissolved after appointing Lt. Gen. al Bashir as The President and head of the new civilian Government.

In February 1994, Sudan was redivided into 26 states rather than the nine that had formed the basis of adminstration since 1991. A governor was to be responsible for each state, assisted by five-, in the case of the southern states, six-state ministers.

In April 1985, the army command assumed power after popular demonstrations, and deposed Nimeri, and appointed a transitional government. In May 1986, power was transferred to a civilian regime following multi-party elections. The third military coup, since Sudan's independence, took place on 30 June 1989, when the government of Saddig al Mahdi was overthrown by Brig. General Omer Hassan al Bashir. The constitution was suspended, and the parliament was replaced by a 15-member ruling junta, the members of which have defacto control over the cabinet of 21 ministers.

## 3.9 ECONOMY

Sudan is one of the 49 low income countries of the world, one of the 29 least developed countries, and one of the 45 countries seriously affected by recent adverse economic conditions. It has free market economy dominated by private sector (Kurian 1982, 1651). The major sectors of the sudanese economy are briefly discussed in the following subsections.

### 3.9.1 Agricultural Sector

Sudan is primarily and potentially a great agricultural and pastoral country, and the availability of water and irrigation facilities are the main factors for this. The country has

Sudan's Agriculture is based on large- and medium sized public sector irrigation projects, with small scale private irrigation schemes providing mostly fruit and vegetables. Mechanized and traditional agriculture is practised in areas of sufficient rainfall.

Sudan is primarily an agricultural and pastoral country, with about 61% of the economically active population engaged in the agricultural sector; and the majority in essentially subsistence production.

Sudan's agriculture production, provided employment for over 60% of the labour force and contributed to 37% of GDP in 1986/ 87.

In 1991, Agriculture, including forestry and fishing, contributed 40.2 % of GDP. About 57.8 % of the labour force were employed in the sector in 1992.

A major expansion of rain-fed production, which provided most of the staple foods and some export crops, in 1970s, helped to generate vigorous economic growth. By early 1980s, however, the progressively deteriorating rainfall in the west and east of Sudan began to reduce production, and the contribution of Agriculture to GDP declined sharply. Nevertheless, agriculture has remained the largest single contributor to GDP accounting until recently for about its one-third. Agriculture is also the source of virtually all of Sudan's earnings of foreign exchange. In 1990, according to estimates by the World Bank, Sudan's gross national product (GNP), measured at average 1988-90 prices was US $ 10,107 million, equivalent to $ 400 per head. During 1980-90, it was estimated, GNP increased in real terms, at an average annual rate of 0.3 %, but real GNP per head declined

by 2.4 % per year. During 1985-92 the population increased by an annual average of 2.8%

According to FAO estimates, during 1980-88, agricultural production increased by an annual average of 2.1%. It declined by an estimated 20.3% in 1989 and by a further 7.6% in 1990. In 1990, however, it rose by 30.8%, and in 1992 by 14.9%. In 1992, Sudan recorded a visible trade deficit of US $ 596.8 million, and there was a deficit of 506.2 million on the current account of the balance of payments.

In 1987 the principal source of imports (10.5 %) was the United Kingdom, which also provided the principal market for Sudanese exports (8.2 %). Other major trading partners in that year were the USA, Japan, and the Federal Republic of Germany.

The principal exports in 1987 were cotton, sesame seed, millet and sorghum, and gum arabic; and the principal imports were petroleum and petroleum products, wheat and meslin and machinery.

Sudan is a member of the African Development Bank, the Arab Bank for Economic Development in Africa, the Arab Fund for Economic and Social Development, the Arab Monetary Fund, the Council of Arab Economic Unity, and the Islamic Development Bank. Sudan's economic problems are largely due to mismanagement in 1970s, when the development of the country's agricultural potential was neglected, and the government began to borrow heavily resulting in the country's present unmanageably large foreign debt. Sudan's foreign debt is the biggest obstacle to its economic recovery.

#### 3.9.1.1 Crops

The principal grain crops are dura (great millet) and wheat, the staple food of the population. Sesame and groundnuts are other important food crops, which also yields an exportable surplus and a promising start has been made with castor seed. The principal export crop is cotton. Traditionally a major producer of long stable cotton, Sudan has, in recent years, grown more short and medium -staple cotton; these grades now account for more than half total production. Production in 1987-91 was estimated to be around 837,000 bales. Cotton, accounted for about 50% of export earnings in 1991. The other principal subsistence crops are sorghum and wheat. Sudan also produces the bulk of the world's supply of gum arabic. Sugar cane also is an important crop, although Sudan still has to achieve self sufficiency in its production.

### 3.9.2 Livestock Sector

The livestock sub sector embraces a wide range of traditional animal raising activities spread out all over Sudan. This sub sector contributes slightly more than 25 % of the aggregate agricultural production. Livestock is the mainstay of the nomadic arab tribes of the desert and the Negro tribes of the swamp and wooded grassland country in the south. Production has, however, been affected by drought, famine and flooding.

In the late 1970s, there was also a significant rise in livestock exports, encouraged by large demand from the Middle East; and their value rose from 2% of total earnings in 1975-76 to about 13% in 1982/83, and to 17% in 1984/85, when the drought ceased sales to

increase. The depletion of the national herd has, however, caused dramatic decline in livestock exports, no cattle or goats were exported in 1988.

### 3.9.3 Manufacturing Sector

The industrial activities in Sudan is spread over a long range of industrial products, the following are the products of different industries in Sudan:

(1) Refined petroleum and several other petroleum products;

(2) Fertilizers;

(3) Cotton fabrics of many varieties;

(4) Consumer goods, such as, soap, shoes, soft drinks; cigarettes etc.;

(5) Sugar, and many other processed and canned fishes; and

(6) Paper and cement.

Significant among these products are the products of food processing industry. The products of textile, cement, and petroleum industries are also considered to be significant in Sudan.

Many of the industrial products are dependent on agricultural output in Sudan, for example, sugar, canned and package food stuff, edible oils and products of confectionery are some of those.

Industries based on animal products include tanneries, leather and shoe industries and that of woollen carpets. Products of milk processing and that of ivory and bone works are also significant.

Several of the industries are dependent on forest products, such as, those of sawmilling, carpentry, fibres and rope making and partition-board making. Other important industries are those for producing cosmetics, bricks, lime, and paints etc.

The ginning of cotton encouraged the beginning of industry in Sudan in the early 20th century. With the expansion of cotton production, the number of ginning factories has increased. The Gezira Board alone is operating the world's largest single ginning complex, on which rehabilitation work was started in 1985, as part of the 10- year improvement programme for the scheme. There are 25 spinning and weaving mills, the majority of which were built in 1970's. The country is not yet self-sufficient in basic cotton cloth. However, nowadays seed oil and oil cakes are being produced in substantial quantity. Groundnuts are also processed for producing edible oil and cakes. These are all export items of Sudan now.

Minerals, such as, copper, mica, iron, chromite, and more recently, gold, which constitute less than 1% of exports, are exported in the crude forms.

With the exception of enterprises producing cement, soap, soft drinks, and vegetable oils, large scale manufacturing of import substitutes started in Sudan only after 1960.

By 1986, the public sector included the four sugar factories, three tanneries, a number of food-processing plants, the two cement works, and the spinning and weaving mills. The Port Sudan tyre factory is a joint-venture company from Republic of Korea. The fertilizer plant located in the south Khartoum is a joint-venture with a company from USA. All state

controlled enterprises in the manufacturing sector, operate with varying degrees of inefficiency.

Sudan has reserves of petroleum, marble, mica, chromite, gypsum, and gold. The contribution of mining in Sudan is insignificant. A considerable amount of Arab support has come for the development of industries in Sudan.The Khartoum-based Arab Authority for Agricultural investment and Development supports a dairy project, several vegetable processing plants, and many other agro-industrial schemes.

Only 6% of the working population of Sudan work in one or another form of industry, even though the sector is quite extensive, so far as the range of products is concerned includes companies producing flour, cement, cigarettes, soap, batteries, shoes, household goods, plastics, tyres and more.

The Industrial sector like Agricultural sector, has been facing alot of problems. Most factories were working at just 25% of their capacity from the mid-1980s. Lack of raw materials, shortage of trained workers and spare parts, poor energy supplies, and weak transport and communication systems, have been responsible for the poor performance of the industrial sector. In 1980's its contribution to GDP was only 6%.

In 1960's the industrial products in Sudan accounted only for 2% of its gross domestic products (GDP). In 1988, it accounted for 15% of its GDP. During 1980-90, industrial production increased by an annual average of 2.9%.

## 3.10 INFORMATION INFRASTRUCTURE

Information is part of all human experience. Acquiring and processing information are fundamental aspects of life itself.

Current interest in a science of information has developed as a result of the complexity of life's problem. The rapid development of technology, the growth of knowledge, and the fast pace of the modern world created an increasing awareness of the importance of information (Antony 1988, 1).

Information is considered as a resource in the development process. It has economic, social and political values. The characteristic of today's socially, economically and technologically complex society is an ever growing information output coupled with a constantly increasing reliance on information. Information is considered a resource; and there is a recognition of the political and economic value of information.

The national capabilities for making knowledge and information accessible, for the transfer of knowledge and information and therefore for putting knowledge to work, are often referred to as a country's information infrastructure (Atherton 1977, 1). It consists of information resources, services and systems supported or not supported by informatics and telecommunication facilities, necessary for the processing and delivery of information. The traffic within this infrastructure is information itself (Montviloff 1990, 6).

Sudan with its poor information infrastructure and weak economy has failed to make full

and better utilization of the knowledge produced internally, as well as information produced externally by international information systems.

Nobody, nowadays, can ignore the vital role that the information can play in the attainment of a high level of economic growth and development within a particular society. Sudan, as one of the African countries, is underdeveloped. One major characteristic of its underdevelopment is that "under utilization of information".

The results of neglecting the task of building information infrastructure are explained by Radia Mohammed (1989) as follows:

(1) The internal and external efforts have failed to achieve objectives of development;

(2) The absence of organized system, guided by an overall policy;

(3) Lack of the standardization and consequent compatibility among systems; and

(4) There is no proper utilization of scarce resources.

Information infrastructure is specifically concerned with data collection, classification, cataloguing, storing, and retrieval of information either manually or online, and dissemination of information in different ways. Since 1960's, the government had recognized the need for the development of library system. Sewell (1961) (a UNESCO expert) surveyed the libraries in Sudan and presented 13 major recommendations which reflected the level of library development in Sudan. It was found to be a case of slow progress. Parker (1971) made a thorough study of the state of libraries; and formulated a plan for overall library development. For this purpose, he surveyed the component elements of a national information system comprising generators of information, information

processing agencies, the users and the mechanism which allows the interrelationship and interaction among the component of the system. He suggested some guidelines for planning. He proposed the formation of a scientific and technical information advisory committee, representing the component elements of the information system. In 1990, The British Council and the National Documentation Mission of Sudan, jointly conducted a survey of libraries in Sudan, to come up with some recommendations for the development of libraries. Among the recommendations, the following were some of the important ones:

(1) To enrich the library collections with appropriate documentary sources of information;

(2) To appoint more qualified library professionals;

(3) To arrange for the training of the existing members of the staff;

(4) To take the initiative for introducing computers to carry out the technical and housekeeping operations of libraries, along with the use of improved professional techniques; and

(5) To enhance the budget for the libraries to ensure an optimum level of their development.

### 3.10.1 Problems Affecting the Development of Sudan's Information Infrastructure.

The most important obstacle to the development of information infrastructure is the inadequacy of financial and material resources available for information activities. The cause of these inadequacies is the low priority attached to the information service by the government which works against development aspirations. Information systems have been neglected for a long time. Of course, there is a policy on scientific and technological

information. However, Sudan has no overall national policy or legislation governing, regulating, and guiding the information activities in sectors. (Bassit, 1988).

In addition, There is no mechanism for the coordination of information activities at the national level. There is no authority as yet formed having the necessary powers of decision making, implementation, and monitoring specific programmes and projects relating to information service activities. Even in the sectors where some sort of information infrastructure exists, their responsibilities and tasks are not properly defined; and they lack the authority, or the capacity to formulate and implement realistic policies at national levels.

A legislative framework does not exist to guide the creation and development of an information infrastructure. In addition there is the scarcity of space, equipment and

qualified personnel, and the inadequacy of legal deposit legislation. Inadequate legal deposit law has also caused impediments to the organization of national bibliographic control.

There is no central point within the government to which requests for publications could be addressed. There are often no set of standards for printing, numbering and circulation of the government publications. There is also lack of application of library and documentation techniques to governmental documents to ensure their effective utilization (Yousif 1989).

Recently, a scientific conference for establishing priorities and programmes of scientific research in the country, organized by the National Council for Research (NCR) has given attention to the enhancement of (a) national information capabilities; (b) information

resources and facilities including their planning and design; and (c) the need fo comprehensive surveys of the existing information management capabilities. Anothe important cause of the under utilization of information is the poor reading habits, and th lack of motivation for usingn information on the part of the people at large.

# CHAPTER 4

# DROUGHT AND DESERTIFICATION IN SUDAN

## 4.1 INTRODUCTION

Since independence, the problems of drought causing severe shortages of food supply and famine, coupled with political instability, have greatly worsened the poor economic condition of Sudan.

One factor behind the food crisis is the apparent failure of the agricultural strategy to expand food production, and to stop the decline in agricultural productivity. It is argued that the decline in productivity is due to the lack of credit for small farmers engaged in both modern and traditional agriculture. Credit is needed to finance inputs, agricultural operations, and the marketing of production. In fact, the agricultural sector as a whole suffers from a lack of development capital; and it has found difficulty in raising sufficient operating funds.

Another factor underlying the food crisis is the deforestation and desertification, which have made the effects of the drought much more severe than they otherwise would have been. The process of deforestation has been accentuated by the fast expansion of the extensive mechanized rainfed farming in the central lands of Sudan. The severe exhaustion and undermining of natural resources, resulted from the extensive use of land and the instability of the mechanized farming system forced private investors to shift to new locations every five years. This shifting mechanized cultivation contributed to soil erosion and restricted the

process of capital accumulation in the agricultural sector. Moreover, observers have cited the cutting down of trees for firewood or in preparation for farming and overgrazing by livestock as principal causes of desertification in Sudan. (Medani 1994, 5).

Desertification is confused with drought which is assumed to be the main cause of desertification. Desertification is the aggregate result of drought in the form of water shortage, plant desiccation and plant recession, soil erosion etc. It is generally defined as, a process of turning productive land resources to zero production or non-productive resources. Alternatively, it is defined as a process of changing productive land into desert production conditions or marginality of production conditions whose recovery is either very expensive or impossible to attain. (Abu Sin 1991, 39).

Drought is defined as a case of rain failure and variability within the lowest 10% of recorded rainfall. It could also be defined as the deficiency of annual rainfall below the requirements of the dominant plant species. In its broad definition, the level of severity needs to be considered as a water shortage relative to water demands of human beings, animals and plants. It is a sustained period of water deficit in a particular area, perhaps lasting a few months or even many years.

The term drought can be classified according to a number of criteria involving several variables as: meteorological drought, in which annual rainfall is below the average for a year or more; agricultural drought, in which the rains fail during the crop-growing season; and hydrological drought, in which the flow of rivers is too low to supply the needs of crops grown on adjacent irrigated lands, or people's drinking water needs. (Alan 1990, 40).

Sudan has been struck by a prolonged period of drought which continued for a succession of years starting in 1968. Desert-like conditions occurred in most parts of the country. Misuse or over-exploitation of the natural resources were the main causes of the problem. These drought problems are closely related to the reduction in forest cover. Besides the drought, the situation was further aggravated by desertification causing loss of rural productivity and large movements of the population out of the worst affected areas.

Sudan's vulnerability to the desertification process is very high due to the climatic marginality, and the extent of semi-desert areas and savannah that constitute two-fifth of the land area of the country.

The severe desertification areas in Sudan have been estimated to be 650,000 sq Km. There are four levels of the process of desertification in Sudan which have been persistent for several years in the past:

(1) Slight desertification process, causing less deterioration in the physical environment in the less marginal areas on the southern fringes of the savannah belt.

(2) Moderate desertification process, in which the resource base is affected, but not beyond recovery. The affected areas are the ecological zone of the savannah and pockets of rich micro- ecological capabilities. In these areas dunes, gullies, and speed of run-off and wind erosion are influential, particularly in the Qoz (sandy land) of the western Sudan. Soil salinity increases in these areas reducing crop and natural biomass yields.

(3) Severe desertification process, in which all the processes are active, i.e. the

processes of water shortage, plant desiccation, run-off, soil erosion, dune movements, salinity, etc. This results in substantial reduction of the productivity, and also causes delay of resource recovery except with a very expensive input. This type constitutes the real disaster in the country; and it is spreading fast (Abu sin 1991, 39).

(4) Very severe desertification process, where all agents of desertification are very intensive resulting in a near or desert zero productivity. This is the case in the main areas of semi-desert in the country where severe desertification causes the major disasters.

The important known natural disasters in the world are: desertification, drought, famine, and floods. Sudan has experienced all these types of calamities. The process of desertification which is still in action despite control measures, is the results of many man made factors, viz., overgrazing, overstocking, over cultivation, felling of trees, etc. Between the mid-seventies and eighties, Sudan was struck by drought due to the severe lack of rainfall; and this was the onset of its desertification.

The problem of desertification has become quite grave and has covered wide regions of Sudan. The areas affected by desertification rest between latitudes 12° and 18° N; and the areas have crossed the west, involving a strip along the Nile to the Egyptian border between latitudes 30° and 32° East. The total area struck by desertification has been estimated to be 650,000 sq. Km. Moreover, desertification has started to affect the southern savannah areas and the buttana area on the East of the Nile, extending to the Red Sea Hills.

The desertification threatened (a) irrigated agricultural schemes on the banks of the Nile (2.5 million acres), (b) mechanized agricultural schemes (7 million acres), and (c) 75% of the pasture and forestry areas. The desert creep was estimated to proceed at a rate of 5.6 Kilometres per year. The Nile between Dongula and Karima, is endangered by desertification; and the east, and the western bank of the Nile is also endangered by desertification.

According to the available definitions of arid lands, almost the entire territory of Sudan can be included within the boundaries of aridity. The ecological balance here is fragile and vulnerable to disruption. There is a great deal of uncertainty about, and instability in, ecological factors. For example, the climatic components, soil and vegetation, and moreover population pressure and misuse of the available natural resources, have imposed extra burden on the productivity.

Desertification in Sudan is considered as the most serious and prominent form of environmental degradation. This degradation appears to have affected an area of more than 650,000 sq Km where two-thirds of the Sudan's best grazing lands lie, and where most of its traditional and modern agriculture is practised. The belt affected by desertification yields 90% of the country's total agricultural production, 95% of its cereals and oil seeds, and 85% of its fuel wood requirements. (Abu Sin 1991, 23)

## 4.2 ECOLOGICAL AND ENVIRONMENTAL DISASTERS

Sudan as one of the Sahel Zone countries, faces with various types of disaster; and these include drought, desertification, pest infestations, floods, range exhaustion, and conflicts.

Disasters and hazards in physical, biological and man-made forms are frequent all along the course of human history. They vary widely in types, forms and magnitude of damage in space and time; and they constitute the negative disturbances of human life, resource capabilities, and potentials.

Disasters are divided into three main groups which take place separately or together. These are:

(1) Natural or environmental and ecological, and quasi-natural disasters: These are caused by natural processes and disturbances, independent of human action or will and ability;

(2) Biological disasters which are partially independent of human actions, will and ability; and

(3) Man-made or induced disasters which are caused by intentional or unintentional human actions, behaviour, practices and ability.

The ecological and environmental disasters include drought, desertification, and floods.

Environmental problems can be classified according to the type of human intervention which causes them. These are:

(1) Pollution, caused by adding something harmful to the environment;

(2) Exhaustion by removing something essential;

(3) Degradation by adversely changing the quality of something (for example soil structure); and

(4) Safety problems by interventions that endanger health.

Environmental problems in Sudan are various. There are problems:

(i) Arising from the use of resources like forests, wildlife, water, and energy which occur in more or less natural ecosystems;

(ii) Arising in the rural environment caused by traditional farming and livestock raising (desertification), and by modernization of farming, using improved plant varieties, chemical fertilizers, pesticides, irrigation and mechanization;

(iii) Arising because of the urban environmental factors, e.g. insufficient services, such as, that of housing, watersupply, waste disposal, and vector control, which affect human health; and

(iv) Arising because of the pollution caused by industries, and mechanized vehicles of all sorts.

A major issue that confronts developing countries is the over exploitation or misuse of resources, leading to their exhaustion or degradation; and this is also the case in Sudan. Among the problems studied, the desertification of rural areas is by far the most serious. It also contributes considerably to the problems of the urban environment which is unable

to cope with large influx of people from rural areas. (De Jong-Boon 1990, 1).

Sudan is located in an ecologically transitional and marginal zone which is exposed to specific forms and types of disasters and hazards. The old stable geological formation of the Basement Complex exposes the country to none or very limited risks of the instant and sudden disasters of earthquakes, volcanoes, and landslides. Jebel Rajaf area in the south is the only active area of earthquakes. Accordingly, most of the disasters in Sudan are of the type of "ecological nature", that is, of drought, desertification, pests, locust, etc. As a result of its weak health position and status, Sudan is also exposed to biological disasters of disease outbreaks and other environmental hazards.

The nature of torrential rainfall period associated with tropical and semi-arid environment, has also exposed the country to floods associated with rains or overflow of rivers and streams. The second main forms and types of disaster in Sudan are man inflicted ones. These are primarily associated with man's traditional resource use systems, such as traditional farming, livestock raising, forest use etc. In such practices man is accelerating the process of ecological disasters; and by so doing he is participating in the complexity of disasters in the country.

## 4.3 AFFECTED RESOURCES

### 4.3.1 Biodiversity

Sudan's vastness and its varied climatological regions attributed to biological diversity

unsurpassed in many African countries. The river Nile and its tributaries enter the country at a relatively most mesic habitat type, it then emerges from one of the largest wet lands areas (Sudd) following tortuous route across semi-arid and arid terrain and leaves Sudan at an extremely xeric habitat.

Some 226 mammalian species exist in Sudan. Bird species amount to 938 different species; reptiles, fish and multitudes of taxa invertebrates and microorganisms are well represented and so do floral species. This great wealth of biodiversity needs more research and updating, for example, many biomes are yet to be explored. However, wild plants and animals have played an important role in the economy, they provide food and fodder as well as medicine (Tegani 1993, 12).

Sudan's vast and rich natural resources and biodiversity have been acutely affected by drought and desertification.

#### 4.3.1.1 Degradation of Vegetative cover

Three major processes are involved in the land deterioration, that we call desertification. First is the degradation of the vegetative cover, second is the soil erosion, and third is the waterlogging and salinization. Soil compaction is a fourth process that undoubtedly is important wherever livestock and machinery pack the soil. But little is known about the magnitude and a real extent of the problem (Dregne 1984, 28).

The vegetation cover is characterized by many divergent environments resulting from the

interaction of climate, soils, and topography. Apart from the existing cultivated area (26 million acres) and areas which currently are not available for agriculture and grazing, the range land comprises almost 279.4 million acres.

According to the major ecological zones, the components of the range lands include the desert, semi-desert, savannah with low rainfall, savannah with high rain fall, flood region, and mountain vegetation region. Range lands provide 82.6% of total livestock feed.

Kassas (1970) described a shift of vegetational belts on the southern edge of the Sahara in Sudan as "desert creep". The shift in vegetational belts, following overgrazing, wood cutting, erosion, and soil compaction, led to more xerophytic vegetation supplanting more mesophytic types.

In Sudan, the desert vegetation type replaces the steppe type, the steppe type replaces the savannah vegetation, and the savannah replaces the forest, each change bringing into dominance more xerophytic vegetation communities (Dregne 1983, 30).

#### 4.3.1.2 Livestock Degradation

One of the prominent symptom of desertification is the changing of the livestock levels. It has been suggested that the combined effects of drought and unreliable pastures have serious implications for livestock numbers. Thirst and undernourishment lead to a reduction in animal numbers and tend to affect sheep and cattle more than the hardier camels and goats. The reduction in numbers occurs both through death and low fertility of offspring.

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As droughts frequently occur in the Sahel, many pastoralists build up stocks in years of good rainfall as a form of insurance against losses in the dry years. Hence livestock levels tend to fluctuate between good years and bad ones.

Prior to the prolonged drought of 1980s' livestock numbers were reported as constantly increasing due to extended veterinary care, water provision, low off-take and some management practises.

However, due to the increased environmental degradation, losses in some areas like N. Kordofan, and N. Darfur, were reported as high as 99.5% and 99% of cattle and sheep respectively. Big losses of livestock were also experienced in other parts of the country, these losses range between 40-99 %, 20-99 % , 15-94 % and 10-96% for cattle, sheep, goat, camels, respectively.

### 4.3.2 Soil Degradation

Soil degradation occurs in many ways: water erosion; wind erosion; water erosion and compaction; and water logging, salinization and alkalinization. Normally, vegetation protects soil from being washed away by rains and also from "splash erosion" caused by the direct impact of rain drops, the effect of which can be quite considerable in dry lands receiving infrequent rainfall. The rain drops first disturb soil particles and then pack them together on the surface, sealing pores, decreasing infiltration (sometimes causing plants to die for lack of water) and increasing run off. A more serious form of water erosion is "sheet erosion" in which fine layers of top soil are washed away, removing soil nutrients and

leading to declining yields unless the nutrients are replenished artificially. Rapid run off also depletes soil moisture and further increases its vulnerability to erosion. Wind erosion blows away the finer components of soil, as silt, clay and organic matter (which contains most of the soil nutrients) leaving behind the less fertile sand, gravel and other coarser particles. In the less serious form of soil compaction, called surface crusting, high-speed mechanical cultivation or cultivation in the dry season turns crumbs of soil particles into a thin powder which under the pressure of raindrops, is packed into a smooth hard surface crust. Complete compaction down to a great depth occurs when soil with poor structure is compacted either by the wheels of heavy machinery or by hooves of large herds of animals. Crusting and compaction make soil hard and less permeable, run off increases, leading to erosion and less water entering the soil for use by plants, and a packed soil in which it is difficult for the plants to germinate and establish roots.

The salinization, alkalinization, and waterlogging of soil result from poor management of irrigated cropping and of water supplies in general. Irrigating lands, without paying proper attention to drainage, or applying too much water to crops, makes the soil waterlogged, and as excess water evaporates from the surface of the soil, the salts dissolved in water are left behind, either near to or actually on the surface. (Alan 1990, 32).

Crops and natural vegetation grow poorly, forcing people to crop and graze land more intensively, to compensate for falling yields so as to produce enough food for their subsistence. This in turn, depletes soil fertility and organic matter, and reduces the land's protective vegetative cover, which has already been depleted by the effects of drought on the soil moisture; and the end result is the increased degradation of soil and vegetation.

Sudan is primarily an agricultural country, where agriculture accounts for 98% of its hard currency earnings and provides the raw materials for 90% of its local industry. From this background, emerges the importance of its soils, the backbone for agriculture. The soils generally extend over low lying or flat plains with elevations rarely exceeding the range 300-1200 metres above the sea level.

### 4.3.3 Water Resource

Sudan's water resources are the Nile, its tributaries and the basin aquifers. The most important of these basins is the Nubian sandstone formations of cretaceous age. It occurs in the northern Sudan, Upper Nile and Bahr Elgazal regions, as well as in the isolated outcrops in Kordofan. This basin falls within the territorial borders of Sudan, Egypt, Libya, and Chad. The number of aquifers identified in the basin are Sahara Nile basin (tima), Atbara basin, Gedarif basin and Blue Nile basin. The Nile System has a permanent annual recharge approximately 175 million cubic m; Atbara recharges 40 million cubic m; Wadi Howar 10 million cubic m; Wadi Almalik 2 million cubic m; and Wadi Elku 20 million cubic m.

Water resources and water supply problems are associated with desertification. It has been pointed out that the ground water levels have fallen, and that this can be partly linked to less infiltration caused by the destruction of vegetation. Additionally, drought makes it necessary to extract more water from than in wet years, and hence water supply problems increase. Increasing sand cover effectively lowers the level of the water table below the surface.

In areas of water sources, degradation is serious because water attracts people and animals; and such concentration leads to overgrazing around water points.

Environment degradation has harmful effects on scarce national water resources, particularly in the River Nile. Excessive rates of siltation have led to serious eutrophication in some parts of the River. The problems of desertification and environmental degradation have affected many aspects of the Sudanese community. (IGAAD 1990, 327).

### 4.3.4 Human Resources

Desertification and serious environmental degradation, have resulted in a wide range of mobilities of human population and in drastic changes in the social fabric of the rural communities, particularly in aspects related to their cultural and economic activities. Areas affected by desertification, specially in Kordofan, Darfur, Northern and some parts of the Eastern and Central regions, have experienced some sort of population movement both within or outside their administrative boundaries. Most affected groups are the nomadic pastoralists, and small holder traditional farmers. These groups have experienced large scale deterioration in their income base, with little job opportunities in their neighbourhood, and subsequently became destitute and moved out from their areas in large spurts. Migration takes place from threatened areas, where the threat of drought and desertification is such that livelihoods are threatened, specially those of cultivators and pastoralists. Affected population migrate to urban areas where living standards are perceived to be better, and where there is considered to be a better chance of a more regular income. Although some

migration is temporary, it tends to be more permanent where the environmental problems of the source areas are most acute.

Data on the magnitude of affected population is scattered. Available discrete information indicates that more than 80% of the rural population have been affected by desertification. For example, in 1984, in Kordofan and Darfur regions the affected populations were estimated as 2.8 and 1.4 million respectively.

#### 4.3.4.1 Social Impact of Desertification

Following are some of the major social impacts of desertification:

(1) Disruption of the nomadic pastoralists' mode of living;

(2) Decrease in the rural population and increase in urban population;

(3) Change in migration patterns; and

(4) Change in farming income patterns (IGADD 1990, 345).

In 1984, Sudan experienced one of the worst droughts since independence. The famine that resulted from crop failure in the West, and in many other parts of the country, resulted in a large number of deaths, and led to a large number of people moving to areas where food was relatively available. The losses were not only restricted to human population, but a large number of animals also died during the period of drought. The prominent effects of desertification on the social life are the:

(1) Increase of social problems as a result of desertification;

(2) Imbalance between the sexes (more females tending to remain in the source region

(rural villages) with an excess of males in the urban areas.

(3) Increase in immoral activities notably, drunkness and prostitution induced by low incomes and the sexual imbalance; and

(4) Rapid growth of settlement, causing more pressure on social amenities, such, as the medical institutions and sanitary provisions.

Developing countries have been facing degradation not only in their physical environment, but also in their social environment. Degradation of the physical environment results into misuse of natural resources, while reduction in social environmental quality results into hunger, poverty, high mortality and morbidity, bad sanitation and migration. Moreover, environmental problems and poverty are mostly inseparable in most of the developing countries. Such miserable conditions are prevalent specially in rural areas.

Most developing countries have many similarities in social and political structure: lack of institutional capacity, instability, inarticulateness of demands, and absence of public involvement.

In 1987, many developing countries, particularly in Africa, were facing devastating droughts and prolonged famine and declining staple food production. These conditions created the phenomenon of environmental refugees and provoked rural urban migration. (Eisa 1990, 4).

## 4.4 CAUSES OF DESERTIFICATION

UNCOD (United Nations Conference On Desertification) identified four major types of poor land use, as direct causes of desertification, viz., over cultivation, overgrazing, deforestation, and mismanagement of irrigated cropland and water resources. Each of these degrades soil and vegetation in different ways. The most important factor causing desertification is the climatic variations like irregularity and fluctuations in rainfall, and enforced natural activities of human and animals in marginal lands and their slow restoration.

Desertification is also caused by such land misuse as overgrazing, irrational cultivation and irrigation, over cultivation, wood cutting and irrigation, uprooting shrubs for fuel, lowering of water tables due to increased water use, and burning of grass lands, forests, and shrubs lands. (Tegani 1993, 24).

Over cultivation occurs when farmers (a) try to crop land more intensively than permitted by its natural fertility, and (b) fail to compensate for the export of nutrients in the crop by using artificial fertilizers. Over cultivation therefore, reduces the fertility of the soil, damages its structure, and exposes it to erosion.

Overgrazing results when livestock density becomes excessive and too many animals are grazed on the same area of range lands leading to the degradation of vegetation and the compaction and erosion of the soil. (Allan 1990, 77). Nomadic grazers were initially blamed for causing the Sahel disaster by keeping too many animals. It was said, they spread

desertification in fragile lands, although one reason why they were singled out for blame was simply that, the impact of their actions was more apparent than that of rainfed cultivators, because it occurred on some of the driest lands close to the desert. Overgrazing is, indeed, a major cause of desertification.

Poor irrigation management. An increase in irrigated cropping might seem to be the logical way to solve the food problems of dry land areas. By introducing proper irrigation management, threat of crop failure during drought can be removed. Proper mechanisms for watering crops can indeed increase the yield of the cereals sixfold and the yield of root crops five fold. ( Alan 1990, 77). However, in Sudan, the reality is very different, and the poor management of many irrigation projects usually causes productivity to fall after a few years of operation. If an irrigation system is allowed to continue for a long time, it can lead to soil salinization, alkalinization and waterlogging which will eventually make the land unproductive. Therefore, a poor irrigation management system can be a cause of future desertification, while a better management system can be a potential cure to desertification.

Deforestation exposes soils to erosion by wind and water.

Deforestation is the first step along the road to desertification. In dry areas, where vegetation is relatively sparse, trees and open wood lands play a vital role in stabilizing soil and water, and in giving shade to people and animals. When the trees are removed, crop lands, and rangelands become more exposed to the desertification elements. Unprotected soil is baked by the sun and eroded by the wind and rain. Thus the whole area becomes more arid, and towns and villages are exposed to frequent dust storms. It is for these

reasons that Jack Mabbut has called deforestation as the most dynamic indicator of desertification. (Alan 1990, 104).

## 4.5 MAGNITUDE OF DESERTIFICATION

Sudan is one of the Sudano-Sahelian countries, which has been seriously affected by drought and desertification since the late sixties. Desertification or drought, and particularly desertification is, indeed, one of the most important phenomena of our time. As a matter of fact, more than any other phenomenon, drought and desertification have left their long-lasting imprints on the natural habitat, the means of livelihood, and socio-economic fabric in different societies in many parts in Sudan.

Drought and desertification in Sudan have affected an area which lies between the latitudes 12° to 18° N, and traverse the country from its east to west covering the area beginning from the Nile on the east, and ending at Chad border in the west. It includes a northward strip along the Nile stretching to the Egyptian border between longitudes 30° E to 32° E. According to Desert Encroachment Control And Rehabilitation Programme (DECARP), the total area affected consists approximately of 650,000 sq.km. The area affected by drought and desertification includes the semi-desert, and arid and semi-arid (ASALs) ecological regions (468,400 sq. Km) which covers most of the Northern States, Northern Kordofan, and Darfur States and some parts of the Central and Eastern States.

The total area of cultivable land in Sudan is 58.5 million acres, 71% of which (i.e 42 million acres) is being threatened by the phenomenon of desert encroachment (sand

creeping). Desert encroachment is also threatening almost 24.8 million acres of forest land, which is 75% of the

wood's gum Arabic producing area and pasturage of 15 million cattle, 16 million goat and two million camels. (Tegani 1993, 21).

## 4.5 HOW TO COMBAT DESERTIFICATION

Combatting drought and desertification is a long term activity which is quite expensive. To succeed in the control of desertification both the government, whether central or regional, and the people of Sudan, have to cooperate with each other.

Desertification has been occurring for millennia, but became a matter of worldwide concern in the early 1970's, when a major drought in the Sahel region of West Africa which in the opinion of most experts continues to this day, killed between 50,000 and 250, 000 people, about 3.5 million cattle, and countless number of sheep, goats and camel. (Caldwell 1984; Kates et al 1977). This prompted the United Nation to convene a conference on Desertification (UNCOD) in Nairobi in 1977, to agree on a Plan of Action to Combat Desertification and to bring it under control by the year 2,000.

The direct cause of desertification is the poor land use. If desertification is to be controlled, it is, therefore, imperative to improve the productivity and sustainability of each major type of land use, in the areas best suited to it. This should be accompanied by efforts to prevent

soil erosion on croplands and rangelands by planting trees or introducing soil conservation techniques, and to reclaim land that has already been significantly desertified.

### 4.6.1 UNCOD Plan of Action

The four main types of technique which the UNCOD Plan of Action recommended for improving land use, and controlling desertification are mentioned below.

(1) Increasing the productivity of rainfed cropping on good land so that the soil erosion and expansion of cropping on to marginal land are halted, by improving the management of irrigated cropping and rehabilitating failed irrigation scheme to reduce salinization and water logging.

(2) Improving range management, and developing new livestock breeds, to increase the productivity, and reduce pressures on land, by intensifying rainfed cropping on better lands, and restoring traditional fallows, the latter effort would make more pastures available for the grazing of livestock in the dry season.

(3) Restoring tree and wood land cover, to stabilize cropping and pastoralism by reducing soil erosion, and providing more supplementary fodder, to halt widespread deforestation for fuel wood, and to reclaim desertified land, so that it can be more productive again.

(4) Introducing soil conservation practices, and stabilizing sand dunes.

### 4.6.2 UNCOD Plan of Action : Checklist of Priority Measures to Combat Desertification.

**A: Land use and rehabilitation**

(1) Introduce methods of planning land use in ecologically sound ways;

(2) Improve livestock raising by means of new breeds of livestock, and better range management;

(3) Improve rainfed cropping by introducing more sustainable techniques;

(4) Rehabilitate irrigated cropping schemes that have failed, owing to waterlogging, salinization and alkalinization;

(5) Manage water resources in environmentally sound ways;

(6) Protect existing trees, woodlands and other vegetative cover, to restore tree cover and vegetation to denuded lands;

(7) Establish woodlots as sustainable source of fuel wood, and encourage the development of alternative energy sources;

(8) Conserve flora and fauna; and

(9) Ensure the fullest possible public participation in measures to combat desertification.

**B. Socio-economic and Institutional Measures**

(1) Investigate the social, economic and political factors connected with desertification;

(2) Introduce measures to control population growth;

(3) Improve health services;

(4) Improve scientific capabilities;

(5) Expand local awareness of desertification and skills with which to combat it by training and education, both, by means of mass media, and courses at various educational institutions; and

(6) Assess the impact of settlements and industries on desertification, and keep desertification in mind when planning, or expanding new settlements and industries.

Climatic fluctuations, underdevelopment and related social and economic factors, and misguided government policies play important role in causing desertification. These factors need to be taken into account when formulating a strategy to bring it under control.

Combatting desertification calls for several kinds of action some of which are technological, some political, and some social. Anti-desertification programmes must be a part of a broader development program, that is designed to bring about improvement of rural conditions of health, education, communication and welfare. (Dregne 1983, 137).

### 4.6.3 United Nations Environment Program (UNEP)

The major outcome of the Stockholm Conference On Human Environment, 1972, was the creation of the United Nation Environment Programme, UNEP. UNEP was mandated to carry out its mission by working through other international agencies to the greatest possible extent. Nevertheless, UNEP has created and sustained such information programmes as: Global Environmental Monitoring System (GEMS); and International Register of Potentially Toxic Chemicals (IRPTC).

UNEP is responsible for overseeing the application of the principles of ecological management to the environment. But, more precisely, it is charged with the responsibility of seeing that the United Nations Plan of Action to combat desertification (PACD) becomes effective. To do these things UNEP has to act, to a large extent, as a broker among the United Nations agencies and concerned national governments. The principal objectives of a worldwide program of research and training have been defined by UNEP as:

In order to achieve the objectives of a worldwide program of research and training, UNEP has established an office called the United Nation Sudano-Sahelian Office (UNSO).

#### 4.6.3.1 United Nation Sudano-Sahelian Office (UNSO)

Most projects supported by UNSO are research-oriented and application-based. UNSO, being an operation oriented office, generally assists research activities as part of larger (operational) projects. Thus pilot projects, surveys, and feasibility studies often have an element of research built into them. The main areas of desertification control in which UNSO has been operating are: forestry, development of renewable alternatives to fuel wood, range management, water resource management, and sand dune fixation. Research projects include pilot schemes, and field trials for growing productive and economically viable drought resistant crops, and studies of agricultural waste products as renewable energy. (Randall 1985, 34).

## 4.7 ENVIRONMENT CONSERVATION

The term environment conservation means, the rational use of the environment to provide the highest sustainable quality of living for humanity. The most widely accepted definition of conservation, presented in 1980 in World Conservation Strategy by the International Union for Conservation of Nature and Natural Resources, is: "the management of human use of biosphere so that it may yield the greatest sustainable benefit while maintaining its potential to meet the needs and aspiration of future generations." (Encylopeadia Britannica 1993, 663). The document defines the objectives of the conservation of the living resources as: "maintenance of essential ecological processes and life-support systems, preservation of genetic diversity, and guarantee of the sustainable use of species and ecosystems". More generally, conservation involves practices that perpetuate the resources of the earth on which human beings depend and maintain the diversity of living organisms, that share the planet. This include such activities as the protection and restoration of endangered species, the careful use of recycling of scarce mineral resources, and the sustainable use of soils and living resources.

The environment and natural resources in Sudan had been degraded and managed in the most irrational and unconservational manner; and the results of these had been indiscriminate destruction of forest, and other woodlands, depletion of wildlife, destruction of rangelands through overgrazing, soil degradation and erosion, dropping yields, and consequently desertification of large arable lands.

The mismanagement of natural resources in Sudan is the result of:

(1) Lack of clear environmental policy to provide a base for positive and concrete actions. Added to this is the lack of unified definable land use policy. There are peace-meal policies dealing with the wide range of interests, e.g. forest policy, wild life policy, etc.

(2) Inadequate consideration of the environment and natural resources in planning process. All development plans since independence didn't contain any section on environment and resource management. This is clear in the priorities of the Ministry of Agriculture which put the natural resources at the bottom of the list.

(3) The absence of coordinating structure to organize the work of ministries and departments involved in environment and natural resources management.

(4) The absence of legislative support to deal with environmental issues in totality. (Atta Elmoula 1985, 21)

For better rational use of environmental resources available, and in order to reverse the trend of degradation, the followings measures have been suggested by IES:

(1) The creation of an institutional framework for environmental management, and the establishment of a national institutional structure such as the National Environmental Council. It should be entrusted witht he responsibility of carrying out:

  (a) Sound assessment of natural and human resources;

  (b) The formulation, planning, promotion, implementation, coordination and monitoring of environmental policies; and

  (c) The review and evaluation of the effects of such policies.

(2) The adoption of environmental laws and legislation. In order to ensure that the

proposed structure satisfies its objectives, a unified comprehensive environmental law is recommended. This law should be management-oriented, based on environmental criteria. Legislation concerning environmental planning, perpetuity of the natural environment, and negotiation concerning its implementation and management procedures need to be determined in order to define the responsibility and authority for the management of the environment and natural resources.

(3) The adoption of environmental education and training programme in order that, a full understanding of the objectives of the proposed structure is attained, and citizens be aware of their environment. It is recommended that environmental education, skills, and training programmes be provided in each sector and level of development, planning, and implementation. This is needed for educating and training people in management of natural resources and the environment. Educational lessons should be included in the curriculum of schools at all levels to motivate the youth to work together to save the environment. The participation of the mass media and other information services in environmental affairs must be further developed, extended and strengthened.

# CHAPTER 5

# EXISTING INFORMATION FACILITIES ON DROUGHT AND DESERTIFICATION IN SUDAN

## 5.1 INTRODUCTION

To understand the proliferation of environmental information services, it is necessary to view them in the context of socio-economic and political needs that spawned them. Such a service is largely a product of the era since 1960, when worldwide public opinion and consciousness perceptibly began to push the political institutions towards action on threats to human health, the quality of life, and even the long term stability of the earth's environment. To avert such threats, these services have been developed entirely to support the economic and social goals through environmental management and decision making process.

Abstracting and indexing services on environmental studies have been playing an important role in the dissemination of environmental information due to the following facts:

(1) As an interdisciplinary field, environmental science is rapidly expanding, and consequently the amount of existing mass of environmental and related literature is increasingly accumulating; and

(2) Environmentalists would like to stay abreast of recent knowledge and advancement in their respective research activities.

A substantial and still growing body of environmental literature is accessible to sustain development in the developed countries.

INFOTERRA is UNEP's international referral service to sources of environmental information, and moreover a perfect example to the cooperation in international information exchange. This programme established national focal points (NFP's) in different countries for information exchange.

The Institute of the Environmental Studies (IES), established in 1979 at the University of Khartoum, is the major institute engaged in studies and research on drought and desertification in Sudan. There are some other organizations (government departments and non-government organizations) in Sudan which are also concerned with different aspects of drought and desertification in the country.

This chapter presents a general overview of the existing information facilities on drought and desertification which serve the user community in these organizations. Results of a survey among users reveal the short-comings of the existing information provisions, and shows the need for a computer-based information support system that has been undertaken in this study.

## 5.2 THE INSTITUTE OF ENVIRONMENTAL STUDIES (IES), UNIVERSITY OF KHARTOUM

The Institute of Environmental Studies was established in 1979. It has four divisions, namely: The Fresh Water Ecosystems Management Division, the Arid Land Management Division, the Coastal Zone Management Division, and the Urban and Regional Management Division.

The Institute focuses on natural resource management and links up several development sectors. It offers M.Sc. in Environmental Studies and carries out basic research using multi-disciplinary teams drawn from several faculties within the University of Khartoum, as well as specialists in the government departments (Elkhalifa, et al 1988). The Institute has undertaken research projects on resource inventory preparation related to ecology and desertification.

The organizational structure of the Institute is composed of a director, training coordinator, project coordinator, the teaching staff, and an administration unit. The Institute offers short term courses in natural resource management as well as consultancy services, and admits twenty students per year. It has eight faculty members on its staff: 6 with Ph.D., 1 with M.Sc., and one teaching assistant, in addition to twenty five part-time teachers.

The mandate of the Institute is focusing on the following:

(1) To promote training in environmental studies;

(2) To conduct research on environmental issues; and

(3) To advise the government on environment.

The main emphasis of its M.Sc. programs is on arid land use and management. Its projects include environmental monitoring and baseline trend analysis; watershed management; prevention of sedimentation and the establishment and maintenance of tree and grass cover in the Blue Nile basin, particularly the Roseires Dam Catchment within Sudan; agroforestry systems development; and rural renewable energy systems (World Bank, 1986).

The service and support units include the Environmental Monitoring and Analytical Lab; Cartography and Reproduction Unit, and a specialized library supervised by a librarian.

### 5.2.1 Existing Information Service of IES

#### 5.2.1.1 Library

IES has a special library which is managed by a professional librarian. The library has a collection of 5,000 materials where books and monographs constitute 65% of the total

collection; bound volumes of serials 15%; technical reports 10%; and government publications constitute 10%. IES subscribes to 15 current serial titles.

The Institute uses the Dewey Decimal Classification (DDC) and Anglo-American Cataloguing Rules 2nd ed. (AACR2) for organizing the information materials. It also uses the Infoterra thesaurus as a means of vocabulary control.

There is no photocopying, duplication and binding facilities. There is one microcomputer. It is used primarily for word processing. To some extent, it is used for bibliographic information storage and retrieval. The softwares used for word processing are Word Perfect 5.0 and Word Star. The CDS/ISIS (mini-micro version) is used for bibliographic information storage and retrieval.

#### 5.2.1.2 Human Resources

In general, the number and quality of trained information professionals are inadequate. There is only one qualified graduate librarian in charge of the library, assisted by two persons with higher secondary school certificate to supervise and run the library.

The severe shortage of manpower is reflected in the insufficient, and poor provision of information service, and in the absence of reliable supportive information products. For better performance in information provision, the number of the qualified trained information personnel should be increased. Emphasis should be laid in the development of manpower, its quantity and quality in order to raise and enhance the productivity, and to improve the level of service in the Institute.

#### 5.2.1.3 Provision of Services

This is the area in which the IES library is deficient. At present the services of the IES library consists largely of the conventional routine services, such as lending services, reading room facilities, and reference assistance to the academic staff. Accession lists are issued from time to time, and those are circulated among the institute's academic staff, researchers, and students. Due to the lack of trained manpower the use of the micro computer for generating and rendering information services is still very much restricted in the IES. Such services could include selective dissemination of information to researchers, and value added information products to selected specialized groups. These services should

obviously be provided through cooperation and resource sharing with other institutions, specializing and working on environment.

The existing information services to researchers in drought and desertification, is poor due to the lack of trained information personnel, low level of appreciation about the role of information technology on the part of IES administration, low level of the application of information technologies, and the lack of coordination with the relevant institutions in the field of environment and natural resource management.

References books, rare materials, and periodicals are not meant for lending. Staff members are eligible to borrow selected materials usually for unspecified number of days. Some sort of data base search is rendered on a few topics. There is no referral service, current awareness service including SDI, and no technical query service. There is no CD-ROM database search service. As there is no photocopying facility, there is no photocopying service. The interaction between the library staff and the users is poor. The acquisition of documents is based on the staff request and choice. Due to the lack of adequate finance and foreign exchange, the acquisition policy is affected. One prominent reason for the poor provision of information services rendered by the IES library, is the severe shortage of appropriate machines and equipment that can assist in the rendering of reliable and satisfactory services. The lack of adequate and appropriate information facilities has resulted in a state of under utilization of the existing information sources that exist in the Institute library. It is also responsible for its inability to utilize the international environmental information services.

#### 5.2.1.4 Publications

The Institute publishes the following : Environmental Monographs Series; discussion papers; research reports; workshop proceedings; books; and its newsletter entitled Sudan Environment, published 3 times a year. The frequency of these publications is fluctuating and intermittent due to lack of finance and chronic printing problems.

## 5.3 OTHER INSTITUTIONS DEALING WITH DROUGHT AND DESERTIFICATION

There are various institutions, government departments, and non governmental organizations (NGO), which are mainly concerned with environment and natural resource management in Sudan. Although some of these institutions gain some support from international organizations, the majority are lacking the necessary finance to carry out their duties.

### 5.3.1 Ministry of Agriculture, Natural Resources and Animal Wealth (MANRAW)

The Ministry of Agriculture is responsible for the national agricultural policy; and it supervises activities relating to crops, livestock, fisheries, pasture, and forest and wildlife. The Ministry consists of fourteen departments. In addition, six semi-autonomous corporations work under it. They are as follows: The Agricultural Research Corporation, Gezira Scheme, Elrahad Agricultural Corporation, New Halfa Corporation, Mechanized Agricultural Corporation, and Jebel Marra for Rural Development. The Ministry contributes a great deal to the efforts regarding the environmental protection in Sudan. It incorporates

most of the departments involved in the utilization of the natural resources in Sudan.

The Ministry of Agriculture, is also responsible for food security; and it is mandated to realize national agricultural strategies, polices and programmes. MANRAW became aware of disasters due to drought and desertification in the sixties. Realizing the need for controlling the desertification in Sudan, MANRAW established National Drought and Desertification Unit in 1987.

#### 5.3.1.1 National Drought and Desertification Unit (NDDU)

NDDU was established by the Ministry of Agriculture in 1987. The Unit and its Coordination Council was restructured to incorporate a number of institutions working on environment and natural resource management. These include the

(1) Faculty of Agriculture, University of Khartoum;

(2) Agricultural Research Corporation (ARC);

(3) Game and Wildlife Centre;

(4) Institute of Environmental Studies (IES);

(5) National Forestry Corporation (NFC);

(6) Soil Conservation, Land use, and Water Programming Administrations;

(7) Range and Pasture Administration;

(8) Environment and Natural Resources Research Institute (ENRRI); and

(9) Desert Encroachment Control And Rehabilitation Programme (DECARP).

NDDU, is an organ for information dissemination. The Coordination Council comprising high level experts is responsible for formulating and updating the approved national plans, programmes of action, and for articulating elements and causes of the drought and desertification problems. They are also mandated to modify the projects for combatting desertification according to priority, the actual conditions, and the essential needs.

In addition to their major mandate, these institutions under NDDU, are involved in the study, research, and implementation of different projects in order to combat drought and desertification in Sudan.

### 5.3.2 Faculty of Agriculture, University of Khartoum

The Faculty of Agriculture at the University of Khartoum was established as a school of Agriculture in 1938 and became a faculty in 1956. Its activities were mostly teaching until the mid-fifties when some of its staff started contributing to agricultural research (Edris 1975). The faculty has nine departments, namely, Agricultural Botany, Agricultural Engineering, Agronomy, Animal Production, Biochemistry and Soil Science, Crop Protection, Forestry, Horticulture, and Economics and Rural Development (Ministry of Higher Education and Scientific Research, 1993). Now there is a plan to upgrade the Forestry Department to become a faculty of Natural Resources, and to include range management. The Faculty has 76 staff members. The intake for the year 1992/1993 was 375 students. It offers a five year B.Sc. degree in Agricultural Science and in Forestry program, and offers 2-year M.Sc. degree in Agricultural Science, Economics and Rural Development. It also offers an M.Sc. degree in Forestry.

### 5.3.3 Agricultural Research Corporation (ARC)

The ARC is a semi-autonomous national research body directly responsible to the Ministry of Agriculture, Natural Resources and Animal Wealth. Almost all the applied agricultural research in Sudan is now the responsibility of the ARC which was created by the Agricultural Research Corporation Act of 1967 to investigate the scientific basis of crop production in Sudan with a view to producing maximum yields of crops with minimum cost.

In 1975, the research functions of the Food Processing Centre (presently Food Research Centre), Fisheries and Marine Biology, Forestry, Range and Pastures and Game and Wildlife, were transferred to the ARC. ARC'S main focus is to carry out applied research to solve problems related to agricultural production and to provide realistic technology to improve and sustain productivity in agricultural sector.

The geographical mandate of ARC covers the whole of Sudan through a network of 17 stations and centres widely spread throughout the country. The scientific disciplines in research stations include: soil science, agronomy and crop physiology, botany and plant pathology, entomology, breeding, horticulture, statistics and agricultural economics, food technology, forestry, fish, wildlife, and range and pasture. In addition, the Corporation runs various specialized centres which were transferred to it in 1975.

### 5.3.4 Game and Wildlife Centre

The Game and Wildlife Centre is concerned with collecting baseline data on wildlife

population, their habitats, and the extent of areas occupied by them. Specific studies cover areas, such as, range evaluation, forage quality, intensity of use, trend of animal numbers, distribution, migration patterns, feeding habitats, breeding and diseases.

### 5.3.5 National Forestry Corporation (NFC)

NFC forms an important department in the Ministry of Agriculture. It is charged with the responsibilities of making the country self-sufficient in forest products in a constant and continuous way, and to ensure effective utilization of forest resources.

The strategy of the administration is to achieve the following objectives:

(1) Conservation and protection of forests;

(2) Implementation of tree plantation and afrostation projects to increase the production of wood; and

(3) Establishment of industries based on forestry raw materials.

The main objective of the Forestry Extension Service is to create an awareness among the people of Sudan about the benefits of forests and trees both in providing essential products for their daily needs and in protecting their environment. These products may include fuelwood, building poles, fruit, food, fodder etc. The environmental benefits include protection of the soil, crops and water supplies, shades for man and his livestock, and control and prevention of desertification. It aims to develop an appreciation of the forest and the natural resources of Sudan, and to develop the proper attitudes and interest to obtain

knowledge and skills to manage, develop and protect, on a day to day basis, these life sustaining resources. (World Bank 1986, 79).

During the drought years of 1981-85, and the famine in 1984-85, it was realized that the loss of soil fertility resulted in crop failure and famine. It was also realized that more trees were to be planted, more natural forests were to be reserved, and fuelwood energy was to be saved. As a result of all these, more emphasis was given to forestry extension services; and it has facilitated donor's contributions to the forestry extension sector.

### 5.3.6 Soil Conservation, Land Use and Water Programming Administrations

As its name indicates, the administration's main activities are:

(1) To plan for water supply to rural areas within the framework of rational utilization and protection of natural resources;

(2) To carry out land use studies and to prepare land use plan for Sudan; and

(3) To initiate rural development programmes by establishing pilot projects in rural areas.

In order to carry out these activities, the administration is divided into water use section, pilot project section, lab section, social affairs section, remote sensing section, and planning and follow up section. Efforts are made by the different sections to programme rural water supplies in accordance with land capabilities and population and animal pressure. The department tried to formulate a land use policy. A draft was suggested early in 1960's but was not approved.

### 5.3.7 Range and Pasture Administration

The major responsibilities of the Range and Pasture Administration are to ensure rational use of grazing resources, conservation, improvement, and management of range lands. To achieve these objectives the administration tries to :

(1) Conduct research by technical staff in order to carry out rehabilitation of lost pastures; and

(2) Prevent the spread of uncontrolled fires, building enclosures to protect valuable range lands and pastures.

### 5.3.8 Environment and Natural Resources Research Institute (ENRRI)

ENRRI, as a part of the National Council for Research (NCR), is mandated to undertake research on environment and natural resources. Therefore, it was decided to establish a department to search for alternative integrated approaches to desert and desertified land development.

The main aim is to develop systems that lead to sustainable development. This department was established in 1992 with the following major objectives:

(1) To conduct research on methods for desert development, and to search for biological, physical, and socio-economic problems of dry regions;

(2) To develop alternative energy for desert environment; and to monitor the process of desertification;

(3) To Provide data on climatic conditions;

(4) To Search for methods to enhance crop varieties which are drought resistant, and to introduce new crops; and

(5) To establish relations with similar institutes.

The research programmes proposed by the Institute include the followings:

- Desertification monitoring using remote sensing;
- Sand dune fixation;
- Desert ecology;
- Alternative energy;
- Soil conservation and reclamation;
- Soil crusting and compaction;
- Atmospheric modelling; and
- Biology of micro fauna and flora.

### 5.3.9 Desert Encroachment Control And Rehabilitation Programme (DECARP)

This programme has been conceived as a coordinating body entrusted with the responsibility of stream-lining activities designed to control desertification, and to seek funds for their implementation. The programme's major activities are:

(1) To review the project proposals for submission to external aid agencies, and to follow up ongoing projects;

(2) To survey, monitor and map out desertified areas; and

(3) To programme training, enlightment and extension campaign in regions affected by desertification.

In spite of the importance of the desertification problem, both nationally and regionally, only three projects out of those proposed by DECARP have been financed. These are:

(1) Rehabilitation of Gum Arabic belt in Northern Kordofan;

(2) Grazing management around permanent Water supply in Elodiaya- Kordofan; and

(3) Strengthening the National Drought and Desertification Control Program, NDDU.

### 5.3.10 Non-Governmental Organizations (NGO)

The drought and desertification and famine that took place in Sudan between 1983 to 1987, prompted many non-governmental organizations to work in Sudan; and thus offering extension services in agriculture and forestry as part of their activities. Among the most important NGOs

offering agricultural extension services are: Concern, Care International, Save the Children Federation, Oxfam U.K and Ireland.

### 5.3.11 Information Facilities

#### 5.3.11.1 Information Sources

The organizations and institutions associated with NDDU have their respective libraries. According to the opinions of the users of those libraries, the collections of those libraries are poor. The documentary sources of information available in those libraries do not meet the requirements of their users most of the time. The reference collection of those libraries

are too inadequate to meet the needs of the users. The number of periodicals subscribed by each of those is only a few. The lack of adequate financial resource for collection development is primarily responsible for this state of affairs.

**CD-ROM search service:** There are only two libraries that offer CD-ROM search service, and those two are attached to the National Forestry Corporation and Environment and Natural Resources Research Institute.

**Current Awareness Services**: There is only one library attached to the National Forestry Corporation that renders Selective Dissemination of Information (SDI) service.

**Photocopying Services:** There are only two library and documentation centres that offer photocopying service. These libraries are attached to the following institutions: the Relief and Rehabilitation Commission and the Wild Life Research Centre. The number of reprographic equipment is inadequate. Most of the time the equipment goes out of order, and it takes time to get it repaired.

**Micrographic services:** There is only one library that is doing its own microfilming. This library is attached to the Meteorological Department. The rest which are deprived from these facilities, depend mainly on commercially produced micro film/microfiche.

**Duplicating and Binding Service** : There are two institutions which have their programmes of own publications. Those are the National Forestry Corporation and the Environment and National Resources Research Institute. Those institutions have their duplicating and binding facilities.

#### 5.3.11.2 Library Services

**Conventional Services:** So far as the conventional library services are concerned, each of those library renders the following services

(1) Lending service;

(2) Reference service; and

(3) Reading room service including user-assistance service.

#### 5.3.11.3 Physical Facilities and Equipment

**Buildings :** Among the libraries and documentation centres located in Khartoum, only one has a good library building. The rest have no purposely built and well furnished library facilities. Those libraries are housed in one room, which is also used as their reading room.

#### 5.3.11.4 Human Resources

There is a general shortage of staff, adequately trained in environmental librarianship. Only two are there possessing academic qualifications relevant to the library work, and the assistant staff members are graduate of higher secondary schools.

#### 5.3.11.5 Technical Processing and Vocabulary Control

Three of the library and information service units use the Dewy Decimal Classification (DDC) for classifying their documents for physical storage. These are the libraries attached

to the National Drought and Desertification Unit; Soil Conservation, Land Use and Water Programming; and the National Forestry Corporation. The libraries of the Environment and Natural Resource Research Institute, and the Range and Pasture Administration use the Universal Decimal Classification (UDC) for the same purpose.

#### 5.3.11.6 Application of Information Technology

Concerning the use of computer technology for information work and services, the result of the survey shows that, only two environmental libraries have computers. Those tow libraries are forming part of the National Forestry Corporation and the Environmental and Natural Resources Research Institute. The type of computer systems available in those libraries are IBM compatible micros which are used mainly for word processing. Only one of the institutions, namely the National Forestry Corporation uses its computer for information processing and retrieval.

## 5.4 SURVEY RESULTS

### 5.4.1 Users' Opinion About The Existing Information Facilities For Environmental Information

The surveys carried out for this study reveal the opinions of the users of environmental information about the performance of the existing information facilities on the subject in Sudan. For the purpose of seeking these opinions, 40 individual users were contacted. Of these, 16 were researchers, 13 were faculty members engaged primarily in teaching and

doing research occasionally, and 11 were students. In regard to the poor performance of the existing information facilities all of them were unanimous in their opinions that it was all due to the lack of adequate funds. And, this was responsible for not having adequate library materials, and trained professional information personnel. In addition, they were of opinion that this was also the reason for many of these facilities not having computers for information work and service. Besides, it is also a fact that, at this point of time, there are only a few persons available in Sudan who are trained in information handling by using computers. In regard to the level of their satisfaction from the existing information facilities they were again unanimous in saying that none of them was satisfied. This inadequacy of the existing facilities affected their activities substantially. In the matter of getting help from facilities other than that of their's every one replied that hardly they got any such help. It could be ascertained earlier that there was no formal cooperation and coordination among the libraries concerned with the environmental information.

### 5.4.2 Information Needs of The Users

In regard to the scope of the information needs of the users in terms of specific subjects relating to the study and research in the field of "Drought and Desertification" there was a general consensus. What all were specified by the identified users can be summarised as follows:

| Study of | In general their |
|---|---|
| - Drought | -Origin/Genesis |
| & | -Causes |
| - Desertification | -Geographical distribution of affected areas |
| | -Adverse effects |
| | -Preventive measures |
| | -Remedial measures |
| | - Relationship with other environmental factors |
| | - Overall management |
| | - Contemporary incidences |
| | In particular |
| | - all these aspects relating to Sudan. |

So far as the sources of information are concerned, the researchers and the faculty members specified that they were interested in all forms of documentary sources of information dealing with all the aspects, as mentioned above, of the "Study of Drought and Desertification". The documentary sources of information included forms, such as, books and monographs, periodical publications, articles in periodicals, papers in conference proceedings, and technical/research reports. They were also asked to answer the following questions:

(1) Would you like to know about the institutions and organizations concerned, in some way or other, with "Drought and Desertification" ?

(2) Would you like to know about the different projects and programmes on "Drought and Desertification" ?

(3) Would you like to know about the persons engaged in research on "Drought and Desertification" ?

(4) Would you like to know about the areas affected by "Drought and Desertification"?

In reply to these questions all the researchers and the faculty members replied that they would be very much interested to know about those entities. In addition, they said that they had no means of knowing about those from the existing facilities. If the databases of the profiles of these entities are maintained by an information support system, it would be of great help to them.

In order to overcome the inadequacies in the field of information systems and services relating to the study of "Drought and Desertification" The study proposes a computer-based information support system. The details about the proposed system are given in Chapter 6

CHAPTER 6

# THE PROPOSED INFORMATION SUPPORT SYSTEM FOR RESEARCH ON DROUGHT AND DESERTIFICATION IN SUDAN

## 6.1 INTRODUCTION

Keeping in view the shortcomings of the existing information facilities in the areas of drought and desertification in Sudan, the present research aims to build a prototype information system that would help researchers, academics, planners and policy-makers in their activities on different areas of drought and desertification in Sudan. The computer-based system will comprise of several databases which may be accessed by local as well as remote users for data entry as well as for retrieval purposes. Detailed design features and functions of the proposed information support system are presented in this chapter.

The existing information facilities have proven to be inefficient, and incapable of providing reliable and timely information service and products to the researchers in drought and desertification. User group are not satisfied with the level of service rendered. The conduct of research is much affected, and therefore the problem of drought and desertification has not yet been solved for the lack of relevant information. There is the complete absence of the application of information technology that can facilitate the capture, process, storage, retrieval and dissemination of information.

The collection, development and organization of environmental information in all the institutions that are concerned with drought and desertification call for the application of

computers and other information technologies. These technologies are not only useful for processing and handling of information, but also for its dissemination among the users in the different institutions working on environment conservation and resources management in Sudan.

The promotion and enhancement of the level of information service through the application of computers can result in the proliferation of information, and can help in the generation of reliable information service and products that can serve the researchers and can meet their growing requirements for information.

Following are some of the major advantages of automation:

(1) Application of computers can lead to the better management of the operations of different activities of IES thereby leading to efficiency and effectiveness, and accuracy at a reduced cost. The proposed system intends to serve the Institute's various activities and aims to concentrate particularly on the enhancement of the information services and products for the staff members, researchers, and students who deal with drought and desertification;

(2) Computers can process information much faster, and more accurately than human beings, and are particularly suited to perform routine operations like acquisitions, cataloguing, etc. which are the typical of IES activities, and thus can reduce work load;

(3) It can also assist in providing new and improved services to satisfy the information needs of users. Such services include Current Awareness Services, SDI, Question answer services which do not exist at present; and

(4) Computers can promote information exchange and resource sharing through the development of networks.

## 6.2 OBJECTIVES OF THE SYSTEM

The primary objectives of an information system for the organization should be to provide the users, whether they are policy makers, administrators, academic staff, or researchers, with relevant, reliable and timely information, and to assist them in conducting their respective activities.

The overall objectives of the various information systems and networks are more or less similar, Neelameghan (1991, 10) summarized these objectives as follows:

- To improve awareness concerning new developments and applications among the participating entities (countries institutions, individuals) in their respective areas of interests;
- To transfer knowledge and expertise among the participating entities and to implement the concept of Technical Cooperation among Developing countries (TCDC);
- TO serve the information and data needs of researchers; decision makers, administrators, other professionals and para professionals, and all those who are involved in one way or another in the development programmes and activities in participating entities;
- To facilitate information and data flow, exchange, sharing and access among participating entities in their respective areas of interests;

- To stimulate and support the establishment and cooperation of information systems and services at the national, regional and international levels for the effective dissemination of information and data;
- To promote the effective use of information, data and research study results through the improved use of information products and services; and
- To develop and/or strengthen information infrastructures, information handling capacity, the production, marketing and dissemination of appropriate information products and services in and among the participating entities.

The general objective of the information support system for IES is to provide library and information services and products to meet the specific needs of the users on environment. The specific objectives of the system will be as follows:

(1) To survey the world literature on environment particularly the literature pertaining to drought and desertification, and to establish inhouse databases;

(2) To aid academic staff, researchers, and students and others by conducting computer searches and by providing copies of documents in the collection.

(3) To compile and publish specialized bibliographies on environment;

(4) To use of modern techniques to organize, classify abstract and disseminate information;

(5) To make information available to researchers through the library; and, and

(6) To link with national, regional and international networks in order to make information available from relevant data banks.

## 6.3 FUNCTIONS OF THE SYSTEM

With a view to achieving the objectives, the information support system will have to perform the following functions:

(1) To collect, and organize relevant documents (such as journal articles, chapters of book and reports) and to develop a retrieval capability;

(2) To store the data collected;

(3) To process and organize the data, retrieve data in response to and in anticipation of users queries;

(4) To analyze and interpret data as necessary.

(5) To present data in a form or format convenient to users; and

(6) To generate various information products and services.

## 6.4 STRUCTURE OF THE SYSTEM

IES, as a specialized institution at the University of Khartoum, is a semi-autonomous Institute that deals with environmental studies. The organizational structure of the Institute did not permit the existence of an information system to take an equal position like other divisions in the organizational structure. The Organizational structure of IES has neglected the existence of an effective information system. The organizational structure is composed of a director, training coordinator, project coordinator, teaching staff, and administrative unit. The existing structure doesn't allow the existing system to function properly. The library faces many problems and obstacles owing to the negligent and inferior position it takes in the organizational structure. These problems have impeded the overall practices,

tasks, and functions of the library in areas concerning the acquisition of information sources and the use of appropriate information technology. The recruitment of trained personnel is affected accordingly. There is a severe lack of trained personnel to run the library and supervise its information service activities. The poor location of the information system is the main cause of the poor information provision.

The proposed organizational structure of IES should allow the information system to take position equal to other divisions.

IES information system should be placed as high as possible in the organizational structure. The IES proposed information system, and its location should be at high level in the organizational hierarchy of the body, and it should report directly to the highest level official therein, e.g. director or director-general.

Beckman (1982, 154) pointed out that the rationale for placing the centre (the information system) as high as possible within the hierarchy of the institution is based on the following considerations :

- To encourage a sympathetic managerial attitude and the acceptance and full use of information centre services;
- To keep the needs and achievement of the centre constantly in front of the senior management;
- To obtain sponsorship by members of the senior executive; and;
- To relate budgetary request to financial management of the institution.

The components and organizational structure and objectives of IES should be carefully formulated. The selected structure should minimize effort i.e. each operation (collection, processing service, data bases, user services) should serve directly for as many subsequent operations as possible, and every thing needed for each service provided should be given a clearly defined role that is logical and interesting. (Guinchat and Menou, 1983).

## 6.5 SYSTEM REQUIREMENTS

### 6.5.1 Hardware

For the proposed system which would be a Local Area Network (LAN) The following are the minimum hardware requirement to start developing the system:

One file server;

- with storage capacity of 200 MB+;
- RAM 8 MB+;
- Processor 486;
- Novel Netware; and

Four Workstations;

- with Storage capacity of 80-100 MB;
- RAM 2MB;
- Processor 386.

### 6.5.2 SOFTWARE

There are a wide variety of software packages that can run on the micro computers. Among these are Micro CDS/ISIS, Lotus 1-2-3, Word Perfect, word for Windows, etc.

Considering the requirements of IES and the need of its users, Micro CDS/ISIS is recommended for use in data base development and information retrieval.

Micro CDS/ISIS a software developed and distributed by UNESCO free of cost to not-profit-organizations in its member states, is now widely used in several developing countries and in Europe, for the creation and manipulation of structured textual databases. Such databases include bibliographic, referral type, factual and object oriented databases. The software can be implemented on an IBM PC and compatible micro computer with a minimum of 512 KB, preferably 640 KB RAM, a floppy disk drive and a hard disk. DOS 3.0 or above is necessary. The powerful indexing/search language and data base import/export using ISO 2709 data exchange format are noteworthy features of the software.

- Defining databases containing user selected data elements;
- Modification, correction, and deletion of records in a data base; -Automatic creation of fast access files e.g. inverted index file for any or all of the fields (data elements) in a record in each database using nine indexing techniques; and
- Retrieval of records from one or more databases using simple or complex (including boolean, adjacency, greater than, less than, equal to, not equal to and other operators) expressions.
- It has a menu-driven interface, with different worksheets through which the user will

access the different functions;

- The menu-driven property makes CDS/ISIS very easy to use, since the user can access its function simply by pressing the appropriate key instead of typing long command lines. It is also provides function keys which are used for shortcut switching between the different layers of menus; and
- Furthermore, its generalized design allows user to accomplish a variety of information retrieval tasks without having to write expensive application programmes for each of them.

  Since, it is specially designed for handling structured non-numerical data bases it offers many of the features usually found in text retrieval systems.

Version 1.0 of Micro CDS/ISIS, released in December, 1985 consisted of a set of six programmes which functioned separately. In version 2.3, released in March 1989, the programmes were integrated and a main menu provided access to the different functions (data entry, searching, printing etc.) Version 3.0 released for public usage in 1992, introduced new facilities specially LAN (Local Area Network) support on Novel Netware, Banyan Vines, etc. providing for concurrent access to a data base by several users for both searching and data entry. Certain functions, such as, master file backup and restore, inverted file update, modifying records, and import operations, may only be performed by one user at a time. New indexing techniques, conversion of a Hit file to a master file, expanded memory manger, new print formatting parameters, CDS/ISIS Pascal procedures for array handling etc. some of the new features.

### 6.5.3 Network Activities

Organizations involved in research and development activities especially in environment and natural resource management are growing in number and complexity. As a result, vast amount of information is generated in the respective fields. The volume of information is increasing at an exponential rate which calls for systems for its effective and efficient management and utilization.

The activities of the proposed Network should cover the following:

(1) Information retrieval: The proposed Network should facilitate access to the system and secure fast information search and retrieval by the users from their respective institutions. Local users can retrieve available information through (LAN). The system should also facilitate the search and retrieval of information to the remote users when it is connected through the Wide Area Network (WAN) and thus would make possible file transfer, sorting and printing for both local and remote users.

(2) Cooperative acquisition: The first step to be undertaken by a library or documentation centre that wishes to participate in the environmental Network of IES a national network is the acquisition function. Basic requirement in cooperative acquisition is substantial funding on a regular basis "for each participant either to make direct contribution in the joint purchases or to fulfil responsibility of building collections and services in assigned specially area".

(3) The promotion of inter library lending and national union catalogues: Interlibrary lending is facilitated by the availability of union catalogues and directories of resources to identify items and to locate holding libraries. Periodical articles need

to be photocopied in order to prevent wasteful duplication and to secure optimum use of foreign exchange

(4) Exchange of publications: Subscribing libraries may make arrangements to exchange publications amongst themselves as a cheaper way of acquiring materials relevant to the need of their communities or publications with local emphasis.

### 6.5.4 Databases

Two prototype databases have been developed: one is an integrated database and the second is specialized database. The integrated database contains records of bibliographic, documents, and proflies of institutions, information systems, projects, and experts pertaining to information sources in drought and desertification in Sudan. This database will provide a variety of relevant and timely information on issues pertaining to drought and desertification. The specialized database is meant to give information on the affected areas, and its records contain information like, ecological zone, rainfall, region, place, year of drought, effect and measures necessary for its improvement etc. The specialized database will make accessible the relevant information related to the affected areas. Such kind of specialized database will be supportive to researchers who want to know about the affected areas, and therefore, it will facilitate their activities in conducting research.

The integrated database has been created according to the ABNCD structure that facilitated the integration of the records and provided Field Definition Table (FDT) and different worksheets for data entry. The FDT of the ABNCD structure and the different worksheets are given in appendix (1) and (2) respectively.

In developing the system a simple FST (Field Select Table) has been developed (see appendix 3) to create the index file .

The integrated database contains the following:

(1) The bibliographic records which include Monographs and collection: such as book, report thesis, and conference proceedings, Part of monograph (analytic/monograph), Serial whole, part of serial (analytic serial e.g. articles in periodical publications).

(2) Expert profile contains records on the experts who are refereed to as source of information and for consultation in environmental related matters. Each record gives information about the expert name, birth, nationality, address, qualification etc., and it gives information about the expert current and past employment and assignments.

(3) Institution profiles contains records of the existing institutions that have some relations with environment and particularly those which are concerned with drought and desertification.

(4) Information systems profile contains records about the information systems, documentation centres, and libraries concerned with drought and desertificationin the country. The record provides information about these institutions such as address, working language, objectives and activities, etc.

(5) The project profile contains records of the projects their titles, geographical coverage, objectives etc.

#### 6.5.4.1 The Prototype Moham Database

This database is an integration of 5 different kinds of records viz., experts, institutions, projects, information systems and bibliographic.

**Bibliographic Records**

The prototype Moham database incorporates bibliographic records like books, theses, reports and analytic from serials. Keeping the users in the area of drought and desertification in Sudan in view a simple display format (see appendix 4) has been designed to produce output of a bibliographic records as shown in Figure 1. This database can be searched through author, title, keywords etc.

Figure 1: Sample Bibliographic record

| | | |
|---|---|---|
| Author | : | Ahlcrona, E. |
| Title | : | The impact of Climate and Man on Land Transformation in Central Sudan: Application of Remote Sensing |
| Publisher | : | The Royal University of Lund. |
| Place | : | U. K. |
| Date of Publ. | : | 1988 |
| Key words | : | CLIMATE; SEMI-ARID REGIONS; CENTRAL SUDAN; SUDAN. |
| Abstract | : | This book focuses on the impact of Climate and Man on Land Transformation in semi-arid regions of Central Sudan. It argues that the major impact on the lands biological productivity have been caused by climatic factors and not by man. According to the author men have also contributed to the destruction of the vegetation. The study was based on remote sensing, interviews, rainfall and crop statistics, and analysis of environmental field data. |

**Project Profile**

The prototype Moham Database contains records of projects on drought and desertification in Sudan. A display format has been designed (appendix 5) which can produce output of project record as shown in Figure 2.

Figure 2: Sample record of profile of project

```
    *** Profile of Project ***

PROJECT TITLE   : Youth Forestation Project
START DATE      : 1994 - 05-01
DURATION        : 1993 - 1996
ADDRESS         : National Forestry Corporation
WORK. LANGUAGE: Ara
LOCATION        : Sudan
CURRENT STATUS: Ongoing project
HEAD            : Babikir, Ali Eisa
GEOG. AREA      : Africa, Sudan
INSTITUTE TYPE: Governmental, Research Centre
OBJECTIVES      : Originally arranging the plantation of
                  100,000 tree in rural Khartoum through the
                  Youth efforts
DESCRIPTORS     : Forestation
ABSTRACT        : The National Forestry Corporation had
                  initiated the project to attract the
                  Youth efforts to plant trees in degraded
                  Land.
```

**Institution Profile**

The institutions profile in the prototype database Moham contains records on the institutions.A simple display format has been designed (appendix 6) which can produce output as shown in Figure 3.

Figure 3: Sample Record of Institution

```
*** Profile of Institution ***

 INSTITUTIOION: Environment and Natural Resources
                Research Institute
 TYPE         : Governmental, Research Centre
 ADDRESS      : Environmental and Natural Resource
                Research Institute
 LOCATION     : Sudan
 WORK. LANG.  : Ara
 SERVICES     : Consultancy
 START DT     : 1991
 OBJECTIVES   : To conduct research on various
                environmental issues leading to effective
                management of natural
                resources and develop systems that lead
                to sustainable development. Propose and
                execute applied research on the impact of
                development on the natural resources and
                the environment.
```

**Information Systems Profile**

The prototypr MOHAM database contains records of information systems relating to institutions attached to drought and desertification. A display format has been designed (appendix 7) which can produce output of information systems as shown in Figure 4.

Figure 4: Sample Record of Information System

```
      *** profile of Information Systems***

INSTITUTION  : Institute of Environmental Studies Library
               IES, SUDAN
ADDRESS      : University of Khartoum, P. O Box 321,
               Khartoum Sudan.
LOCATION     : Khartoum
WORK. LANG.  : Eng
INFO.SERVICE: Reference service, reading and loan
CLASSI. SYS.: Dewey Decimal Classification
START DT     : 1979
OBJECTIVES   : To provide information services to academic
              staff, researchers and students on environment
ACTIVITIES   : Collection of environmental information
```

**Expert profile**

Expert profile contains records of the experts. A simple display format has been designed (appendix 8) which can produce the following output as shown in Figure 5.

Figure 5: Sample Record of Expert

```
  *** Sample record of Profile of Experts ***

NAME         : Hassan, Ahamed Musnad
SEX          : Male
ADDRESS      : Forestry Research Centre, Box 7089
               Khartoum, Sudan
AFFILIATION: Ministry of Agriculture, Forestry Research
               Centre, SU
NATIONALITY: SU
QUALIFICAT.: B.Sc. Botany, Chemistry and Zoology,
               University of Khartoum, 1960. Ph.D.
               Forestry, University of
               Edinburgh, Scotland, 1969
CURRENT WORK:R&D, Teaching, Forestry Research Centre
```

### 6.5.4.2 The specialized database

A specialized database called Areas has been designed which contains records on the affected areas. Each record contains such information as ecological zone, rainfall, area, region, effect, year of drought, and measure for improvements etc. Such information is usually sought for by the researchers, managers and decision makers etc.

The field Definition Table in (appendix 9) shows fields that appear in each record. A simple Display format (appendix 10) that can provide the output as shown in (fig. 6)

Figure 6: Sample Record of the Specialized database

```
 Sample record of the specialized database

Ecological Zone: Semi-arid
Rainfall (m m)  : 75 - 300
Area (Sq.Km)    : 486.4
Percentage (%)  : 18.4
Region          : Western Sudan
Place           : Northern Kordofan
Year of drought: 1984
Effect          : Shortage of food and water,migration for
                  work elsewhere, econonmic insecurity
Degree of sever: Moderate
Measures for    : Surface water conservation by the
improvement     : building of Merowe dam on the Nile in
                     The Northern region
```

This database can be searched through a number of keys like ecological zone, region, year of drought etc.

### 6.5.5 User Interface

CD/ISIS is widely used and version 3.0 can operate in a network environment enabling users to interact directly from different terminals with databases in the server.

SISA (System Interface Search assistance), written in CDS/ISIS Pascal at SISA (Abebe et al. 1992) is designed to assist end users in performing search and retrieval in Micro CDS/ISIS databases. Major functions provided for by SISA include:

- Selection of databases for searching;

- Formulation of search expressions using CDS/ISIS search language and use of the different search capabilities of CDS/ISIS;
- Retrieval and display of records using different display formats;
- Saving of retrieved records selectively; and
- Sorting of search queries and the results for review of search performances on each database.

## 6.6 SYSTEM DEMONSTRATION

The proposed system recommends the use of SISA (System Interface Search Assistance) to facilitate the search and retrieval of documents from the prototype databases. SISA interface provides and makes available some facilities that are not found in the standard CDS/ISIS, and it complements the function of searching and retrieval of the CDS/ISIS software.

If the user has a specific query and wants to search the integrated prototype database (MOHAM), SISA Interface will help him to search and retrieve the information on the database. SISA Interface is a menu-driven programme designed to assist the end user in performing search and retreival in Micro CDS/ISIS databases.

Option A in the main menu allows the user to access the system after switching on the system.

Modified CDS/ISIS Main Menu

SCHOOL OF INFORMATION STUDIES FOR AFRICA

ONLINE SERVICES

O - Online Catalogue Access (MOPAC)

A - Advance Search Service (SISA)

U - Service Utilities

X - Exit

Enter selection .....

SISA programme can be interfaced at option A when pressing X will exit to the normal or full CDS/ISIS main menu.

If the user wants to search the word DROUGHT in MOHAM prototype database, he has to select the database from among other databases, and he has to give the search expression; in his case it will be "DROUGHT". The system will display a blank screen with the prompt, and the user has to key in the term "DROUGHT"(in upper or lower case) at the cursor position. Afterwards the system will conduct the search and will display the results on the screen. If the user wants to search another database or another term he has to follow the same procedure from the main menu.

## 6.7 SYSTEM IMPLEMENTATION

### 6.7.1 Implementation Strategy

An implementation strategy is a prerequisite for success in meeting the objectives and goals of the system. The existing information resources, facilities and services will be utilized, their deficiencies corrected and, if and when necessary new systems and services will be supported.

Various steps are to be taken into consideration for implementing the system and the network.

It is important to identify the functions and services that will be provided by the focal point, IES as a coordinating institute, and by the participating organizations (nodes). The participating organizations will take part by:

- Performing their normal activities and services to their respective clientele; and
- Following and respecting the guidelines formulated for documentation and information processing for the network

Each participating organization through coordination and cooperation with the others, should be responsible for the following services to their respective clientele:

- Referral services;
- Reference services;
- Selective Dissemination of Information;

- Current Awareness Services;
- Data services;
- Information Analysis and Consolidation services and products;
- Document delivery; and
- Online search services.

The Participating organizations and IES should jointly plan to implement the following activities:

- Organizing and supporting training programme;
- Database construction; and
- User sensitization.

In order to facilitate information resource sharing, data exchange, and user friendliness of systems among the participating nodes in the network, it is desirable to use compatible formats for data entry, data structure and processing, output, etc. whether the information products and services are fully or partially computerized or operated manually. Several widely accepted norms and standards are available for cataloguing, indexing and data exchange. For example: MARC format for cataloguing; AACR2 Code for cataloguing; CCF/B for bibliographic description; CCF/F for factual records such as description of institutions, information systems, projects and experts; International Development Information Network (IDIN) format based on the CCF, MIBIS for bibliographic records; ISO 2709 for data exchange, and other ISO standards for documentation and computerized information storage and processing.

The software used should be able to implement the above standards, codes, etc., For instance, the ISIS family of software, ISIS (Unesco) for IBM main frame computers; MINISIS (IDRC) for HP 3000 series of minis, Micro/ISIS (Unesco) and MINIISIS version H for micro computers, are proven software packages widely used in textual databases and information retrieval that can implement the above norms and standards. There are programmes available to convert from one format to another e.g. CCF to MARC and vice versa; and for conversion of ISIS to MINIISIS, and MINISIS to Micro/ISIS format.

The participating nodes, including IES, should preferably choose norms and standards for cataloguing, indexing and data processing and software among those mentioned above to facilitate cooperative networking, information exchange and resource sharing.

### 6.7.2 Human Resources Development

The proposed information system and network will contribute to human resources development in a number of activities (e.g. continuing education courses, upgrading of training programmes) for enhancing the capacity and competence of the management personnel of library, documentation and information units to enable them to plan and perform their activities in a better way.

### 6.7.3 Introduction of New Technology

The nature and capacity of the chosen system must depend on an analysis of each centre's requirements viz. the number, size and characteristics of the data bases to be entered, the

forms of output required, the number and the location of terminals, the degree of local data processing to be done, etc.

### 6.7.4 User Sensitization

Programmes are to be developed to sensitize decision makers, planners, executives, researchers, students and people at the grass roots level involved in the environmental sectors in Sudan about the value of information, and sources of information. Users are also to be taught to define precisely their information needs, and how to use the information system.

### 6.7.5 Finance

Finance is an important element in the implementation of the system and the network. The lack of sufficient fund is the biggest obstacle for the implementation of the system. Administrations in all participating centres must realize the importance of such crucial source and should try to allocate and fix annual budget for the development and maintenance of the system.

To implement the system, the following major step has to be taken into consideration. There are only a few staff members with IT training. The training is to be on a continuous basis for efficiently running the system and to make the modification. The type of training required includes: teaching sessions, workshops and seminars for the staff and long term and short term training for users.

# CHAPTER 7

# CONCLUSION AND RECOMMENDARIONS

## 7.1 CONCLUSION

The protection of the environment from pollution and various other forms of degradation is one of the great concerns of all countries all over the world.'Drought' and 'Desertification' are the names of two most serious forms of degradation of the environment in any country where they occur. Wherever they occur, they adversely affect almost all the vital spheres of the life of the nation. Sudan is one of the countries of the world which is adversely affected in an incredible measure by the occurrences of drought and desertification. It is quite expected that the Government of Sudan should take all necessary steps within its means and resources to minimize their all pervasive adverse effects to the extent feasible. The government of Sudan has, indeed, taken the steps worthy of being appreciated. It has established organisations and institutions essential to take care of the problems due to drought and desertification. But, what these organizations and institutions have achieved so far is, according to their own versions, far below what is being expected from them. There are many factors which are responsible for this low level of achievement. One of those identified factors, as the persons in responsible positions admit it, is the lack of accessibility to pertinent information or sources of information at the time when they need it.

The management of environment, as it is well-known, involves activities which are largely information-intensive. The management of drought and desertification is a part of

environmental management. The activities involved in the management of drought and desertification also are highly information-intensive. It is true that each of the organization and institutions engaged in dealing with issues relating to the drought and desertification in Sudan has its own library, or documentation centre, or information centre, as the case may be, attached with it. But the general state- of-affairs of those information service units, as revealed by this study, may be summarized as follows:

(1) Manpower:

Most of the information service units are run by semiprofessionals with the assistance of a few skilled-persons. The number of such personnel is also too inadequate to serve the purpose of such information service units. Only two such units have one professional each. They are the only two persons who know the use of computers for information work and service.

(2) Materials:

The document collection of each of these units, as it stands today, according to the opinion of its own users, is too inadequate to meet their information needs. The development of the collection of each of these units has been largely dependent on ad hoc donations from foreign countries. The mechanism of consistent development is, more or less, absent.

(3) Machines and Equipment:

Except for two service units, no other unit has any computer facility. Where there is a computer, it is mostly used for word-processing purpose. It is, in a sense, rarely used for information work and service.

(4) Money:

The organizational/institutional annual budget for each of these service units for quite some time has been just the minimum required for the maintenance of the units. No allocation for

the recruitment of professionals, no allocation for purchasing appropriate machines and equipment; and the allocation of a very small amount for the purchase of new documents; have been the convention for quite some time.

(5) Information Services:

Except for two units, all other units render only the lending and reference services.

(6) Cooperation and Coordination:

Cooperation and coordination among these service units are totally absent. Even no users of one unit ever visit another unit to seek information.

Any new development in the field of information service activities today, must take into account all the trends in modern developments in the field. In this respect, the developments in the use of appropriate machines and equipment which are all the products of advances in modern information technologies are now considered to be most important .The use of information technologies, such as, those of computers, storage, networks, telecommunication, and graphics (including that of reprography), has become the trend in the field of information work and service even in many developing countries. The objective of ensuring and promoting the utilization of existing pertinent information to help its users to contribute to the development of a target sector by providing every user access to his required information at the right time, can be achieved only by using the products of modern information technologies. In the context of all these modern developments, this study has proposed a computer-based information support system for the study and management of drought and desertification in Sudan. The design of the system has been fully specified. Ultimately the system is to function as a network. In order to implement the system as a network, it would be necessary for certain other developments to take place. The recommendations of this study centre round those additional essential developments.

## 7.2 RECOMMENDATIONS

In the light of the above conclusions, the following recommenadtions are made for implementations and further improvement of the system:

(1) The Institute of Environmental Studies must attract qualified personnel that have adequate and wide background knowledge in computer applications, and the information specialist must have further training in order to provide effective information services.

(2) Closer collaboration between the information personnel and the end users (researchers, and academic staff of IES) is to be established. A close interaction between information professionals and end users should be the basis for the provision of a comprehensive and wide range of information services.

(3) The application of IT especially computer technology must be stepped up. More hardware and software must be acquired to alleviate the problem of low level computer technology. The acquisition of the computer resources must reflect the future requirement such as networking and functional compatibility of the hardware and and portability of the software.

(4) The information system at IES should be linked with other institutions working on drought and desertification in Sudan through /WAN/. In order to do this, the communication infrastructure of the country is to be developed up to the adequate level.

(5) Adequate resource is to be allocated to ensure continuous acquisition of environmental information sources and IT materials. Advanced computer

technology has made it much easier to access larger and richer databases in environment.

(6) All the institutions participating in the proposed information network must agree upon norms and standards, and guidelines for the harmonizations and standardization of hardware, software and database design in order to minimize problems of system incompatibility. User communities in the environment sector in general and drought and desertification in particular are to be made aware of the value of information and of the relevant resources of information, as well as in the use of information products and tools.

(7) The country should adopt a national policy of information systems and services that would ensure optimum information services and products in all sectors of the economy and society.

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**Appendix 1**

**Questionnaire for a Survey on Information Needs**

Your help would be highly appreciated

1. Name : ----------
2. Position : ----------
3. Name of the institution : ----------
4. Address : ----------
   Postal : ----------
   Phone : ----------
5. Academic qualification : ----------
   - Higher degree/Diploma ----------
   - Subject (major) ----------
   - Institution ----------
6. Field of specialization : ----------
7. Nature of work :
   Research ---------- Teaching/ academic ----------
   Consultancy ---------- Others (please specify) ----------
8. Are you courrently conducting any research?
   Yes---------- No----------
   If Yes, what is it about (please be brief and specific )

---

---

9. Does your institution have any of the following information system?
   Yes --- No --- ( Tick where appropriate )
   - Library ----------
   - Documentation ------
   - Information centre -----
   - Others (please specify) ----------
10. If any of the above information system is available, for what purpose do you use its facilities? (Tick where appropriate)
    - Borrow books and journals for preparation of research ----------
    - Consult journals in order to keep abreast with developments in your field ----------
    - Others (please specify) ----------
11. Does your information system provide you with any of the following services?( Tick where appropriate)
    - Current awareness services ( informing users of new items received)
    - Selective dissemination of information (giving specific information to specific users about items received relevant to their field of specialization).
    - Online searches of databases.
    -Question and answer services.
    - Reference services.
    - CD-ROM services
12. Do you feel that your library/Documentation/Information centre satisfies your information needs? (Tick one)
    Yes ---------- To some extent ---------- No ----------

13. If the answer to question (12) is No or to some extent, what other sources of information do you use to meet your information needs? ----------

---

---

14. If the answer to question (9) is No, in your opinion,why your institution did not establish any library or information unit?
    - Lack of need ----------
    - Lack of management awareness ----------
    - Shortage of fund --------
    - Any other reasons (please specify) ----------

---

15. Please, indicate if possible, the extent to which inadequate information facilities hamper your work as a researcher?
    - Does not hamper my work ----------
    - Hampers it but not serriously --------
    - Seriously hampers it (please explain) ----------

---

16. Do you get materials from other sources through your library/Documentation/Information centre? Yes ----- No -----
17. How long does it take to get them?
    - 1 -7 days
    - 8 - 15 days
    - a month
    - more than one month
18. How often do you use library/documentation centres of other institutions?
    - Frequently (at least once a day) ---------- Sometimes ----------
    - Rarely ---------- Not at all ----------
19. If not at all or rarely, why?
    - Do not know what is available ----------
    - Not relevant ----------
    - Do not have transport or easy access ----------
    - Others (please specify) ----------

---

20. What materials relevant to your field of specialization, would you like your library/Documentation/Information centre to add to its collection? (Name those materials that are currently not available in your institution)

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---

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Thank you.

**Appendix: 2**
**ABNCD Field Definition Table**

| ?3Tag3 | Name | 3Len | 3Type3Rep3Delimiters/Pattern3 | | |
|---|---|---|---|---|---|
| _ 1 | Participating centre code | 100 | X | | |
| _ 2 | Participating centre record no | 6 | N | | |
| _ 3 | Record status | 1 | P | | A |
| _ 5 | Date record entered | 10 | P | | 9999-99-99 |
| _ 6 | Date record changed | 10 | P | | 9999-99-99 |
| _ 7 | Bibliographical level | 5 | A | | |
| _ 8 | Bibligraphical level - parent | 1 | A | | |
| _ 9 | Country of origin of record | 2 | P | | AA |
| _ 10 | Record number of parent | 6 | N | | |
| _ 11 | Record number(s) of part(s) | 6 | N | R | |
| _ 12 | Record no of other lang ver(s) | 6 | N | R | |
| _ 20 | Language of analysis | 18 | A | | |
| _ 21 | Language of text(s) | 2 | A | R | |
| _ 22 | Language(s) of summaries | 2 | A | R | |
| _ 25 | Record heading | 50 | X | | |
| _ 100 | Title | 500 | X | | |
| _ 101 | Parallel title(s) | 500 | X | R | |
| _ 102 | Translated title - English | 500 | X | | |
| _ 105 | Translated title - other | 500 | X | | |
| _ 110 | Personal author(s) | 80 | X | R | ab |
| _ 111 | Corporate author(s) | 500 | X | R | abcdz |
| _ 112 | Affiliation | 500 | X | | abcdz |
| _ 113 | Other associated inst(s) | 500 | X | R | abcdez |
| _ 114 | Meeting | 500 | X | | abcde |
| _ 115 | Trans. name of instn. | 200 | X | | |
| _ 116 | Address | 300 | X | R | abcdefghi |
| _ 120 | Edition | 25 | X | | |
| _ 121 | Publisher | 250 | X | | abc |
| _ 122 | Date of publ/issue - free form | 30 | X | | |
| _ 123 | Date of publ/issue - ISO form | 10 | P | | 9999-99-99 |
| _ 130 | Collation (M/C) | 200 | X | | abc |
| _ 131 | Part statement | 150 | X | | ab |
| _ 140 | Monographic series | 200 | X | R | abz |
| _ 141 | Thesis | 200 | X | | abcd |
| _ 142 | Related project(s) | 200 | X | R | ab |
| _ 150 | Notes | 700 | X | | |
| _ 160 | ISBN | 13 | X | R | |
| _ 161 | Documnet number | 50 | X | R | |
| _ 162 | Availability | 100 | X | | |
| _ 200 | Title of serial | 400 | X | | z |
| _ 201 | ISSN | 9 | P | | 9999-99-99X |
| _ 202 | Title of parent (M/C) | 500 | X | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| _ | 210 | Personal author(s) - parent | 80 | X | R | ab |
| _ | 211 | Corporate author(s) - parent | 500 | X | R | abcdz |
| _ | 300 | Primary descriptors | 200 | X | | |
| _ | 301 | Secondary descriptors | 400 | X | | |
| _ | 302 | Geographic descriptors | 200 | X | | |
| _ | 303 | Local descriptors | 200 | X | | |
| _ | 303 | Proposed descriptors | 100 | X | | |
| _ | 310 | Abstract/Description | 1000 | | R | |
| _ | 320 | Broad subject heading | 100 | X | | |
| _ | 400 | Processing status | 4 | X | | |
| _ | 410 | Location | 10 | X | R | |
| _ | 411 | Call number | 40 | X | | |
| _ | 412 | Number of copies | 2 | N | | |
| _ | 415 | Accession numb. | 10 | X | | |
| _ | 420 | Type of material | 50 | X | | |
| _ | 430 | Documetalist (initials) | 10 | X | R | |
| _ | 500 | Acquisition type | 4 | X | | |
| _ | 509 | Order number | 25 | X | | |
| _ | 510 | Date ordered | 10 | P | | 9999-99-99 |
| _ | 511 | Date claimed | 10 | P | | 9999-99-99 |
| _ | 512 | Date received | 10 | P | | 9999-99-99 |
| _ | 513 | Number of copies ordered | 2 | N | | |
| _ | 514 | Requester | 25 | X | R | |
| _ | 515 | Supplier | 200 | X | | abcdez |
| _ | 516 | Price | 20 | X | | ab |
| _ | 517 | Acquisition notes | 200 | X | R | |
| _ | 901 | Corporate body | 500 | X | | abcd |
| _ | 902 | See refernce(s) | 500 | X | R | |
| _ | 903 | Other language version(s) | 500 | X | R | |
| _ | 904 | Former name(s) | 500 | X | R | |
| _ | 905 | Later name(s) | 500 | X | R | |
| _ | 908 | Reference code | 20 | X | | |
| _ | 911 | Serial title | 400 | X | | |
| _ | 912 | ISSN | 9 | P | | 9999-999X |
| _ | 913 | See reference(s) | 400 | X | R | Z |
| _ | 914 | See also other lang edition(s) | 400 | X | R | |
| _ | 915 | Former name(s) | 400 | X | R | |
| _ | 916 | Later name(s) | 400 | X | R | |
| _ | 921 | Supplier authority code | 4 | X | | |
| _ | 922 | Supplier name and address | 200 | X | | abcde |
| _ | 997 | Authority record notes | 200 | X | | |
| _ | 998 | Authority record date | 10 | P | | 9999-99-99 |
| _ | 441 | Duration | 50 | X | | |
| _ | 442 | Date:proposal/approval | 25 | X | | ab |
| _ | 443 | Date:starting | 10 | X | | |
| _ | 444 | Date:expect. compl. | 10 | X | R | |
| _ | 445 | Date:actual compl. | 10 | X | | |
| _ | 446 | Date:terminated | 10 | X | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| _ | 447 | Date of birth | 100 | X | | |
| _ | 830 | Nationality | 100 | X | R | |
| _ | 831 | Qualifications | 100 | X | R | abcd |
| _ | 832 | Specilization | 100 | X | R | |
| _ | 833 | Work experience (last) | 200 | X | | abcde |
| _ | 834 | Current work | 200 | X | | abcde |
| _ | 835 | Marital status | 10 | X | R | |
| _ | 836 | Sex | 6 | X | | |
| _ | 850 | Recommended by | 100 | X | R | abcd |
| _ | 855 | Honours and awards | 200 | X | R | abc |
| _ | 856 | Membership in societies | 200 | X | R | abcd |
| _ | 525 | Language competence | 100 | X | R | abc |
| _ | 556 | Assignments | 200 | X | R | abcd |
| _ | 895 | Databases | 300 | X | R | ndrfa |
| _ | 896 | Classification system used | 100 | X | R | |
| _ | 897 | Subject headings list | 100 | X | R | |
| _ | 898 | Thesaurus | 100 | X | R | |
| _ | 899 | Periodical publicat. | 300 | X | R | ij |
| _ | 890 | Patents taken | 200 | X | R | abcdefgh |
| _ | 900 | Services offered | 200 | X | R | |
| _ | 570 | Personnel | 100 | X | R | ab |
| _ | 625 | Objectives | 500 | X | R | |
| _ | 700 | Financial aspects | 200 | X | R | sacp |
| _ | 950 | Project status | 50 | X | | |
| _ | 952 | Training courses | 200 | X | R | |
| _ | 954 | Project number | 50 | X | R | a |
| _ | 955 | Contract number | 50 | X | R | |
| _ | 957 | Resources(equipment...) | 200 | X | R | |
| _ | 960 | Type of institution | 100 | X | R | |
| _ | 961 | Type of research | 100 | X | R | |
| _ | 965 | Research priority | 100 | X | | |
| _ | 966 | Commitee's decision | 100 | X | | |
| _ | 999 | Record type | 1 | P | A | |
| _ | 1000 | Name of object | 100 | X | | |
| _ | 1001 | Local name (Eng.) | 100 | X | R | |
| _ | 1010 | Function | 300 | X | R | |
| _ | 1015 | Source/Donor (Person) | 100 | X | R | sfh |
| _ | 1016 | Source/Donor (Organization) | 300 | X | R | |
| _ | 1017 | Vendor | 300 | X | | |
| _ | 1018 | Price | 100 | X | | cp |
| _ | 1020 | Provenance | 100 | X | | |
| _ | 1021 | Archaeological site | 500 | X | | |
| _ | 1025 | Ethnic group | 100 | X | R | |
| _ | 1028 | Date | 100 | X | | |
| _ | 1030 | Material | 300 | X | R | |
| _ | 1035 | Condition | 1000 | X | R | |
| _ | 1040 | Dimension (Front) | 100 | X | | hwld |
| _ | 1041 | Dimension (Back) | 100 | X | | hwld |

| | | | |
|---|---|---|---|
| _ 1042 Weight | 100 X | | |
| _ 1050 Description | 1000 X | | |
| _ 1055 Fine number | 100 X | | |
| _ 1056 Photo number | 100 X | R | |
| _ 1060 Negative number | 100 X | R | |
| _ 1065 Accession number | 100 X | | |
| _ 1070 Other numbers | 100 X | R | |
| _ 1075 Location/storage | 100 X | | rs |
| _ 1080 Location/exhibit | 100 X | | rs |
| _ 1085 Classification/Keywords | 100 X | R | |
| _ 1090 Treatment | 500 X | R | |
| _ 1091 Lab. treatment dates | 25 X | R | |
| _ 1100 Exhibitions | 300 X | R | |
| _ 1105 References | 300 X | R | |
| _ 1110 Remarks | 300 | | |
| _ 1115 Date of entry | 20 X | | |
| _ 1120 Date(s) of update | 20 X | R | |

**Appendix 3**
**Worksheets (For the Integrated Database)**

Worksheet for Bibliographic Records

Record status: .....
Date record entered..... Date record changed.....
Bibliographic level..... Bibliographic level of parent.....
Country of origin.....
Record number of parent.....
Record number(s) of other language version(s).....
Language of analysis..... Language of text.....
Language(s) of summaries.....
Title.....
Parallel title(s).....
Translated title- English.....
Translated title- French.....
Translated title- Spanish.....
Translated title- Other.....
Persona author(s).....
Corporate author(s).....
Affiliation.....
Other associated institution(s).....
Meeting.....
Edition..... Publisher.....
Date of publication/issue- free form.....
- ISO form.....
Part Statement.....
Project.....

Note(s).....
ISBN..... Document number.....
Title of Serial.....
Title of parent (M/C).....
Personal author(s) - parent.....
Personal author(s) - parent.....
Primary descriptors.....
Secondary descriptors.....
Geographic descriptors.....
Local descriptors.....
Proposed descriptors.....
Abstract.....
Broad subject heading.....
Processingstatus.....
Location.....
Number of copies.....
Documentalist.....

Worksheet for Records of Research Projects

Record type(999)P Record heading RESEARCH PROJECTS.....
Date record entered.....
Project title.....
Principal officers.....
Performing institutions.....
Type of institution.....
Other associated institutions.....
Address (Phone, etc).....
Projectnumber(s).....
Contract number(s).....
Language of project.....
Location.....
Duration.....
Current status of project.....
MFNs of Related Projects.....
Descriptor.....
Geographical area.....
Discipline.....
Financial aspects.....
Resources (equipment).....
Research priority.....
Committe's Decision.....
Date:Proposal/Approval.....
Date:Starting..... Expected completion.....
Date:Actual completion..... Date terminated.....
Type of research.....
Recommended by.....

Objectives.....
Resource Persons.....
Resource Persons type.....
Personnel.....
MFNs of publications.....
Note.....
Abstract/Description.....
Person entering data.....

Worksheet for Records of Profile of Institutions and
and Information Systems

Record type(999)i Record heading PROFILE OF INSTITUTIONS..... .....

Date record entered (5).....
Principal officers (110).....
Name of Institution (111).....
Trans. name of instn. (115).....
Parent organization (960)^a.....
Address (116).....
Location (410).....
Working language (525.....
Associated entities.....
Services offered.....
Descriptor.....
Geographical area.....
Discipline.....
Financial aspects.....
Resources (equipment).....
Membership in societies.....
Honours and awards.....
Date of establishment.....
Type of research.....
Objectives.....
Personnel.....
MFNs of publications.....
Note.....
Activities.....
Periodical publicat. .....
Person entering data.....
Record type(999)i Record heading PROFILE OF INSTITUTIONS.....
Date record entered (5).....
Principal officers (110).....
Name of Institution (111).....
Trans. name of instn. (115).....
Parent organization (960)^a.....
Address (116).....

Location (410).....
Working language (525.....
Associated entities.....
Services offered.....
Descriptor.....
Geographical area.....
Discipline.....
Financial aspects.....
Resources (equipment).....
Membership in societies.....
Honours and awards.....
Date of establishment.....
Type of research.....
Objectives.....
Personnel.....
MFNs of publications.....
Note.....
Activities.....
Periodical publicat. .....
Person entering data.....

Worksheet for Profile of Experts

Type of record(999)E Date record entered.....
Record heading PROFILE OF EXPERT.....
Name of person.....
Sex.....
Affiliation.....
Address.....
Date of birth.....
Assignments.....
Nationality.....
Formal educational qualifications.....
Language competence.....
Discipline.....
Work experience.....
Current work.....
Project title.....
Recommendedby.....
Honours and awards.....
Membership in associations.....
Marital status.....
Remarks/Notes.....
Person entering data.....

Appendix 4

**Field Select Table for the Integrated Database**

Data Base Name: MOHAM FST for inverted File FST name MOHAM

| ID | IT | Data extraction format |
|---|---|---|
| - 100 | 0 | V100 |
| - 110 | 0 | (V110^a/) |
| - 111 | 0 | mhl,v111^a |
| - 111 | 0 | mhl,v111^b |
| - 112 | 0 | (V112^a/,v112^b/,v112^c/) |
| - 123 | 0 | V123 |
| - 140 | 4 | V140^a |
| - 142 | 4 | V142^a |
| - 142 | 0 | (V142^b/) |
| - 160 | 0 | (V160/) |
| - 300 | 2 | V300 |
| - 300 | 3 | V300 |
| - 301 | 2 | V300,V301,V302,V303,V304 |
| - 303 | 0 | V303 |
| - 310 | 4 | V310 |
| - 320 | 0 | V320 |
| - 410 | 0 | (V410/) |
| - 420 | 0 | V420 |
| - 911 | 4 | V911 |
| - 830 | 0 | (V830/) |
| - 831 | 0 | (V831^a/,V831^b/) |
| - 832 | 0 | (V832/) |
| - 833 | 0 | (V833^a/,V833^b/) |
| - 834 | 0 | (V834^a/,V834^b/) |
| - 525 | 0 | V525^a |
| - 525 | 0 | (V525^b/) |
| - 556 | 0 | (V556^*/) |
| - 911 | 4 | V911 |
| - 912 | 0 | V912 |

**Appendix 5:**

**Simple Display Format for Bibliographic Records Profiles**

Data Base Name: MOHAM Format name: MOHAB

mdl,''Author :''v110/''Title :''v100(0,21)/''Publisher :''v121^b/''Place :''v121^a/''Date of Publication :''v122/''Keywords :''v300(0,21),v302(0,21)/''Abstract :v310(0,21)/##

**Appendix 6:**
**Simple Display format for Research project**

Data Base Name:MOHAM Format name:MOHPR

---

```
If v999:'P' then mhl,c8'*** PROFILE OF PROJECT *** '##/C2,'PROJECT TITLE
:'V100/C2,'START DATE :'V443/C2,'DURATION :'V441/C2,'ADDRESS
:'V116/C2,'WORK.LANGUAGE :'V525/C2,'LOCATION :'V410/C2,'CURRENT
STATUS :'V950/C2,'HEAD :'V110/C2,'GEOG. AREA
:'V302/C2,'INSTITUTE TYPE :'V960/C2,'OBJECTIVES
:'V625(2,16)/C2,'DESCRIPTORS :'V300/C2,'ABSTRACT :'V310(2,16) fi
```

**Appendix: 7**
**Simple Display Format for Profile of Institutions**

Data Base Name: MOHAM Format name:MOHIN

---

```
If v999:'I' then mhl,c8'***PROFILE OF INSTITUTION ***'##/C2,'INSTITUTION
:'V111(2,17)/C2,'TYPE :'V960/C2,'ADDRESS :'V116^A/C2,'LOCATION
:'V410/C2,'WORK.LANG. :'V525/C2,'SERVICES :'V900/C2,'START DT
:'V443/C2,'OBJECTIVES :'V625(17,17)/C2,'PERSONNEL
:'V570/C2,'ACTIVITIES :'V310(17,17)/C2/Fi
```

**Appendix: 8**
**Simple Display Format for Profile of Information Systems**

Data Base Name: MOHAM Format name: MOHIS

---

```
If v999:'S' then mhl,c8,'*** PROFILE OF INFORMATION SYSTEM
***'##/c2,'INSTITUTION :'V111(2,17)/C2,'ADDRESS
:'V116(2,17)/C2,'LOCATION :'V410/C2,'WORK. LANG. :'V525/C2,'INFO.
SERVICE :'V900/C2,'CLASSI. SYS. :'V896/C2,'START DT
:'V443/C2,'OBJECTIVES :'V625(17,17)/C2,'ACTIVITIES :'V310 Fi
```

**Appendix 9:**
**Simple Display Format for Profile of Experts**

Data Base name: MOHAM Format name: MOHEX

```
If v999:'E' then mhl,c8,'*** profile of experts ***'##/c2,'NAME :'V110/C2,'SEX
:'V836/C2,'ADDRESS
:'V116^a|,|,v116^b,|,|/c18,v116^c|,|,v116^e(17,17)|,|,'Phone
'v116^f(17,17)/c2,'AFFILIATION : 'V112(2,17)/C2,'NATIONALITY :
'V830/C2,'QUALIFICATION : 'V831(2,17)/C2,'DISCIPLINE : 'V832/C2,'CURRENT
WORK :'V834(2,17)/Fi
```

**Appendix: 10**

**Field Definition Table Specialized Database**

| ?\| Tag\| Name | \|Len\| | Typ\| | \|Rep\| | Delimiters/Pattern \| |
|---|---|---|---|---|
| - 10 Ecological Zone | 100 | X | | |
| - 11 Rainfall (mm) | 30 | X | | |
| - 12 Area (Sq.Km) | 30 | X | | |
| - 13 Percentage (%) | 30 | X | | |
| - 14 Region | 100 | R | | |
| - 15 Place | 100 | R | | |
| - 16 Year of Drought | 30 | R | | |
| - 17 Effect | 200 | X | | |
| - 18 Degree of Severity | 50 | X | | |
| - 19 Measures for Improvement | 300 | X | | |

**Appendix 11**
**Simple Display Format Specialized Database AREAS**

```
mhl,"Ecological Zone :"V10/"Rainfall (mm) :"v11/"Area (Sq.Km) :"V12/"Area
(million feddans) :"V13/"Percentage (%) :"V14/"Region :"V15/"Place :V16/"Year
of Drought :V17/"Effect :"V18/"Degree of Severity :"V19/Measures for Improvement
:"V
```