

**A TAXONOMIC STUDY ON TREES AND SHRUBS OF EL NOUR
NATURAL FOREST RESERVE, BLUE NILE STATE-SUDAN**

By

Haytham Hashim Gibreel

B.Sc. (Honours) Forestry

University of Khartoum

2003

**A thesis presented to the University of Khartoum in fulfillment of the
requirement for the degree of Master of Science in Forestry**

Supervisor

Dr. Maha Ahmed Yousif Al Kordofani

Faculty of Science

Department of Botany

Co-supervisor

Dr. Essam Ibrahim Warrag

Faculty of Forestry

Department of Silviculture

March 2008



)

((

DEDICATION

This work is dedicated to:

My parents in recognition,

My beloved brother *Wail*,

My sisters *Fadia* and *Hadia*,

My Dear *Suhair Mohammed Musa*,

My sincere fellows and colleagues,

for their nice advice and encouragement.

ACKNOWLEDGEMENT

Firstly, unspeakable, inexpressible, thanks to God who gave me the patience, the will, the ability and the good fortune to accomplish this study.

My appreciation and gratitude are expressed to *Dr. Maha Ahmed Yousif Kordofani* the supervisor of this study, and *Dr. Essam Ibrahim Warrag*, the co-supervisor, Faculty of Forestry, University of Khartoum.

Thanks are also extended to University of Khartoum, Academic Secretariat Affairs, Teaching Assistants Administration and DAAD Office (German Academic Exchange Service), for their financial support. Very special thanks are extended to my mother, father, brother and sisters. Many particular thanks and appreciation are due to *Suhair Mohammed Musa*, for her continuous help and close support.

At the field level, a river of thanks is due to *Bashir Abaker Adam* the forest respecter and his colleagues *Abdallah Saaid Salim* and *Hassan Gumaa Rageb*, for their hosting and unlimited support.

It gives me a great pleasure to express my appreciation to *Dr. Alawia* from Nilain University, *Dr. Abdalgabar. N. Gumaa*, *Dr. Kamal Fadl Elseed* and *Ustaza Enass Yousif*, *Hagir Mahjoub El Nasri*, *Wafa El Hag Adam* for their support. A lot of thanks are also due to the Forest National Corporation staff, Meteorological Station, Forestry Research Center, at the Blue Nile State.

I utilize this opportunity to express my thanks to my colleagues in the Faculty of Forestry, University of Khartoum and the Director and staff of the Medicinal and Aromatic Plants Research Institute.

My thanks are extended to *Dr. Daldom Mohammed Ahmed* and *Dr. Abdalla Gaffar* for their advice and support.

Thanks are also due to Forestry Research Center staff at Soba and College of Forestry and Range Science.

ABSTRACT

Title: A Taxonomic Study on Trees and Shrubs of El Nour Natural Forest Reserve, Blue Nile State-Sudan.

The study was carried out at El Nour Natural Forest Reserve, Blue Nile State, during the years 2007-2008. The objectives were to document the flora of El Nour Natural Forest Reserve through collection, identification and classification of the woody species (trees and shrubs) in the forest. The collected species were revised for botanical names, synonyms and vernacular names and their description were updated to the recent available literature. High quality digital images were used in the illustration of the prevailing flora in support and completion of the taxonomic description.

The study identified 54 plant species that belong to 36 genera, 17 families and 3 subfamilies (19 dicotelydonae and 1 monocotelydonae).

The family Ochnaceae has been reported for the first time in the forest and is represented by one species (*Ochna afzelii* R.Brenan. ex Oliver) which is known locally by Lesan El Kalb.

The update names for some families and subfamilies were used in this study as follows:

Capparaceae instead of Capparidaceae and Fabaceae instead of Leguminosae. At the subfamilies level, Mimosoideae, Caesalpinioideae and Papilionoideae were used instead of Mimosaceae, Caesalpinaceae and Papilionaceae respectively.

The subfamily Mimosoideae showed the highest species and genera frequency. The species density and composition is variable within the forest due to variation in soil type, topography, overgrazing and illegal cutting of the local inhabitants within and around the forest. Common uses of the identified species were extracted from the local knowledge and literature.

:

أجريت الدراسة بغابة النور الطبيعية المحجوزة بولاية النيل الأزرق في الفترة من 2007 – 2008م. هدفت الدراسة إلي توفير معلومات تصنيفية حديثة عن الغابة من خلال تجميع، تعريف، تصنيف و أخذ صور رقمية من الأنواع الخشبية (الأشجار و الشجيرات) بالغابة. تم مراجعة الأسماء العلمية، المترادفات، الأسماء المحلية و الوصف التصنيفي الكامل للأنواع و العوائل المدروسة بالإستعانة بالمراجع القديمة و المؤلفات العلمية الحديثة في مجال علم النبات. أستخدمت الصور الرقمية عالية جودة المعالجة في تكميل و تدعيم الوصف التصنيفي.

خلصت الدراسة بجمع، تعريف و تصنيف 54 نوع من الأشجار و الشجيرات الغابية ينتمون إلي 36 جنس، 17 عائلة و 3 تحت عائلة (19 من ذوات الفلقتين و واحدة من ذوات الفلقة الواحدة). سجلت العائلة *Ochnaceae* لأول مرة بمنطقة الدراسة بنوع شجري واحد هو *Ochna afzelii* و الذي يعرف محلياً بإسم لسان الكلب.

أستخدمت المسميات الحديثة لبعض العوائل و تحت العوائل في هذه الدراسة على النحو التالي: أستخدم المسمى *Capparaceae* بدلاً عن *Capparidaceae*، *Fabaceae* بدلاً عن *Leguminaceae* و على مستوى تحت العوائل أستخدمت المسميات الحديثة *Caesalpinioideae*، *Mimosoideae* و *Papilionoideae* بدلاً للمسميات *Caesalpinaceae*، *Mimosaceae* و *Papilionaceae* على التوالي.

سجلت العائلة الطلحية *Mimosoideae* (*Mimosaceae*) أعلى تكراراً في منطقة الدراسة من حيث عدد الأجناس و الأنواع الشجرية الغابية. التركيبية التصنيفية للمجموعات و كثافة الأنواع الشجرية و الشجيرات بالغابة يختلف من منطقة إلي أخرى داخل الغابة و ذلك نتيجة للإختلاف في نوع التربة، الطبوغرافية، الرعي الجائر و القطع غير القانوني من قبل السكان داخل و حول الغابة. تم الحصول على الإستخدامات المألوفة للأنواع المعرفة في هذه الدراسة من المعرفة المحلية و المؤلفات العلمية.

Table of contents

DEDICATION	III
ACKNOWLEDGEMENT	IV
ENGLISH ABSTRACT	V
ARABIC ABSTRACT	VI
TABLE OF CONTENTS	VII
LIST OF TABLES	IX
LIST OF FIGURES	X
LIST OF GENERAL PLATES	XI
LIST OF IDENTIFIED SPECIES PLATES	XII
CHAPTER ONE	
1. Background.	1
1.1 Sudan flora.	2
CHAPTER TWO THE STUDY AREA	
2.1 Description of the study area.	7
2.1.1 Location.	7
2.1.2 Topography and Soils.	7
2.1.3. Climate.	8
2.1.3.1 Temperature.	8
2.1.3.2 Rainfall.	9
2.1.3.3 Relative humidity.	9
2.1.3.4 Evapo-Transpiration.	9
CHAPTER THREE MATERIALS AND METHODS	
3.1 Field Work.	16
3.1.1 Reconnaissance Survey.	16
3.1.2 Species sampling.	18

3.1.2.1 A flora survey and specimens collection.	18
3.1.2.2 Pre-preparation of the herbarium specimens.	20
3.2 Laboratory and office work.	20
3.2.1 Specimens examination.	20
3.2.2 Specimens mounting.	20
3.2.3 Species identification and citation.	20
3.2.4 Species description.	21
3.2.5 Key construction.	21
3.2.6 Illustration and printing.	21
3.2.7 The tree vegetation covers (Ecological parameters).	21
3.2.8 Genera and species frequency by families.	22
3.2.9 Local uses of the identified tree and shrub species.	22
CHAPTER FOUR RESULTS AND DISCUSSION	
4.1 Morphological description of families and studied species.	23
4.1.1 Check list of the identified families and species.	156
4.2 The tree and shrub vegetation cover in the forest area.	158
CAPTER FIVE CONCLUSION	164
REFERENCES	167

List of Tables

Table 1: Working sites showing their location, description and areas, El Nour natural forest reserve, Blue Nile State.	16
Table 2: List of the plant species in the flora of the study area.	156
Table 3: Genera and species Frequency by identified families.	158

List of Figures

Figure 1: Blue Nile State maps showing location and localities.	6
Figure 2: Histogram showing the Blue Nile State Mean Maximum Temperature for the years 1993-2006.	11
Figure 3: Histogram showing the Blue Nile State Mean Minimum Temperature for the year 1993 - 2006.	11
Figure 4: Histogram showing Blue Nile State Mean Total Rainfall (mm) for the year 1993-2006.	12
Figure 5: Histogram showing the Blue Nile State Mean Annual Rainfall (mm) for every 10 years 1962-1970; 1971-1980; 1981-1990; 1991-2000.	12
Figure 6: Histogram showing the Blue Nile State Mean Relative Humidity (%) for the years 1993-2006.	13
Figure 7: Map showing Climatic Zones of Sudan (After Walsh, 1991).	14
Figure 8: Maps showing Vegetation zones of the Sudan.	15
Figure 9: Location map of El Nour Natural Forest Reserve, showing the forest boundaries and sites A and B.	17
Figure 10: El Nour Natural Forest Reserve map, showing the forest boundaries and samples distribution in site A and site B.	19
Figure 11: Histogram showing the average density (tree/ha) in sites A and B of the forest.	160
Figure 12: Histogram showing the average density (tree/ha) of the dominant species in site A.	161
Figure 13: Histogram showing the average density (tree/ha) of the dominant species in site B.	162
Figure 14: Showing the species composition of El Nour natural forest area.	163

List of general plates

General plate 1: showing El Nour forest status in the rainy seasons.	10
General plate 2: showing El Nour forest status in the dry seasons.	10

List of identified species plates

Plate 1: <i>Lannea fruticosa</i>	26
Plate 2: <i>Lannea schimperi</i>	28
Plate 3: <i>Sclerocarya birrea</i>	31
Plate 4: <i>Calotropis procera</i>	34
Plate 5: <i>Balanites aegyptiaca</i>	37
Plate 6: <i>Adansonia digitata</i>	40
Plate 7: <i>Stereospermum kunthianum</i>	43
Plate 8: <i>Boswellia papyrifera</i>	46
Plate 9: <i>Boscia angustifolia</i>	49
Plate 10: <i>Boscia senegalensis</i>	51
Plate 11: <i>Cadaba rotundifolia</i>	53
Plate 12: <i>Capparis decidua</i>	56
Plate 13: <i>Capparis tomentosa</i>	58
Plate 14: <i>Crateva adansonii</i>	60
Plate 15: <i>Maerua angolensis</i>	62
Plate 16: <i>Anogeissus leiocarpus</i>	65
Plate 17: <i>Combretum aculeatum</i>	68
Plate 18: <i>Combretum ghasalense</i>	70
Plate 19: <i>Combretum glutinosum</i>	72
Plate 20: <i>Combretum hartmannianum</i>	74
Plate 21: <i>Combretum lamprocarpum</i>	76
Plate 22: <i>Combretum molle</i>	78
Plate 23: <i>Terminalia brownii</i>	81
Plate 24: <i>Terminalia laxiflora</i>	83
Plate 25: <i>Cassia arereh</i>	86

Plate 26: <i>Piliostigma reticulatum</i>	88
Plate 27: <i>Tamarindus indica</i>	90
Plate 28: <i>Acacia polycantha</i>	93
Plate 29: <i>Acacia senegal</i>	95
Plate 30: <i>Acacia seyal</i> var <i>fistula</i>	97
Plate 31: <i>Acacia seyal</i> var <i>seyal</i>	99
Plate 32: <i>Acacia nubica</i>	101
Plate 33: <i>Acacia mellifera</i>	103
Plate 34: <i>Albizia lebbek</i>	105
Plate 35: <i>Dichrostachys cinerea</i>	107
Plate 36: <i>Entada africana</i>	109
Plate 37: <i>Pithecellobium dulce</i>	111
Plate 38: <i>Dalbergia melanoxylon</i>	114
Plate 39: <i>Lonchocarpus laxiflorus</i>	116
Plate 40: <i>Pterocarpus lucens</i>	118
Plate 41: <i>Strychnos innocua</i>	121
Plate 42: <i>Azadirachta indica</i>	124
Plate 43: <i>Moringa olifera</i>	127
Plate 44: <i>Ochna afzelii</i>	130
Plate 45: <i>Hyphaene thebaica</i>	133
Plate 46: <i>Ziziphus abyssinica</i>	136
Plate 47: <i>Ziziphus spina-christi</i>	138
Plate 48: <i>Gardenia lutea</i>	141
Plate 49: <i>Xeromphis nilotica</i>	143
Plate 50: <i>Sterculia africana</i>	146
Plate 51: <i>Sterculia setigera</i>	148

Plate 52: <i>Grewia flavescens</i>	151
Plate 53: <i>Grewia mollis</i>	153
Plate 54: <i>Grewia tenax</i>	155

CHAPTER ONE

1. Background

Identification of basic units in ecology, forestry and related fields usually begins with basic identification of trees and shrubs and progresses toward understanding of how they interact and compete, where they are located in time and space, and what combinations make up community types. The vegetation composition of a particular area is the result of interaction of species with varying ecological tolerances and requirements, and any changes in the physical or biotic environment that alter this balance of interactions cause change in vegetation with time (Ikram, 1997). During the past decades there has been considerable discussion at the local state, and federal levels regarding a national biological survey as part of a study of biological diversity. The success of management, whether for economic return and sustainability or for ecosystem restoration depends on correct plant identification, and development of a flora, which means a list of all plants within an area possibly as large as a national forest or park or as small as a watershed, natural area, or protected natural reserve. A flora as presently perceived includes considerably more, such as plant ranges, descriptions, phenology, names, intra specific variation, endemism, environmental conditions, and information on genetics, cytology and morphology. In general the flora of an area is a description of the vegetation composition that is prepared by a professional taxonomist. It contains list of species, taxonomic keys, descriptions, illustrations and distributional notes. The Floristic studies are taxonomic studies of a flora, or of a major segment of a flora, of a given area.

The vegetation cover and natural forests in the subtropical arid and semi-arid regions are changing and losing their capacities for natural regeneration (Elobeid, 2000). Although Sudan had a large base of natural resources, the rate of

annual forest cover change is considerable due to the increased exploitation of the natural forests with the increase of illegal human activities to satisfy their own needs and their livestock, and other factors such as edaphic, physiographic, climatic and biological factors. The adoption of effective production as well as protection measures is very necessary for reforestation of the degraded lands and better conservation of the endangered tree species.

1.1 Sudan flora

Studies on general Sudan's flora started since the work of Braun and Massey, (1929). Furthermore, the studies of Andrews, (1950, 1952 and 1956); followed by the study of El Amin, (1972 and 1973) and his second work in the year (1988A); Badi and Ahmed, (1989) and Wickens, (1991).

The provincial flora of the Sudan include the work of Crowfoot, (1928); Andrews, (1947); Andrews, (1948); Obeid and Mahmoud, (1968); Sahni, (1968); Hassan, (1974); Wickens, (1976); Brenan, (1983); Thirakul, (1984); Daoud, (1985); Sommerlatte, (1990); Bebawi and Neughbohrn, (1991) and Ibrahim, (1996).

In parallel to floristic studies, a number of vegetation ecology studies had been conducted in the Sudan, and this include the work of Smith (1949); Halwagy, (1961 and 1963); El Awad, (1995); Abdalla, (1997) and Adam, (1998).

From the above information, it is clear that the studies in Sudan's flora were few and with low intensity of sampling and may have missed some of the tree and shrub species existing in the Blue Nile State in the Southeastern part of the Sudan. Also they are outdated since they were carried many years back. Although, there are considerable changes in the environmental conditions and human practices that could have affected the presence and the natural floristic composition, in addition to the continuous introduction of exotic species to different areas within the Sudan which had not been recorded before, these studies are still in use as

standard references.

Within the Sudan's States, the Blue Nile State has a distinct geographical location in the Southeastern part of the Sudan, between longitude (12° - 30° and 9° - 30° N), and latitudes (3° - 35° and 5° - 33° E). The total area of the State is 385, 000 Km². The State is divided into five localities as shown in figure 1. The State is highly populated with main ethnic groups of *Burrum*, *Hamai*, *Fallata*, *Angasna* and *Funji* (Sudan Annual Needs Assessment, 2001). The main livelihood activities in the State are agriculture, forestry activities and livestock. The environmental variation in the Blue Nile State in terms of climate, land, water, vegetation cover and animal resources resulted in variation in natural vegetation and landscape. Also, it contributes to various agricultural, forestry, industrial and social revolution on the basis of the country's economic policies.

According to zonal vegetation studies of the Sudan the Blue Nile State was classified under different vegetation zones as shown in figure 3. The vegetation cover of the Blue Nile State and the species composition vary with the amount and distribution of rains, soil type and elevation above sea level, further more; the State is characterized by a thick cover of trees and shrubs. The state is, therefore, the richest in trees cover compared to other Sudan's States. The studies dealing with the ecology and the flora were few in the Blue Nile State. The species occurring in the Blue Nile State have earlier been recorded in the general and regional vegetational surveys by different authors such as Andrews, (1948); Smith, (1949); Harrison and Jackson, (1958); Gumaa, (1988); and El Amin, (1990) in his study on Trees and Shrubs of the Sudan mentioned 106 species to occur in the Blue Nile State, belonging to 31 families including 62 genera. These two mentioned studies insure the richness of the Blue Nile State in term of the natural vegetation. According to the ecological classification of the vegetation of the Sudan (Harrison and Jackson, 1958), the species of *Acacia* were predominant

in the drier part while the broad leaved deciduous trees were predominant in the wetter parts. There are also more annual grasses than perennials and a valuable proportion of herbs are always found. Four important vegetation types and subdivisions can be classified in this region according to soil types and amount of rainfall and the main types are:

1. Sites under rainfall of over 600 mm and mainly distinguished from the high rainfall woodland savanna, by the different soil type, the slightly poorer variety of trees and the mixture of annual grasses with the perennials. Trees attain 10-15 m in high. Dominant species are *Terminalia laxiflora*, *Sclerocarya birrea*, *Anogeissus leiocarpus*, *Prosopis africana*, *Tamarindus indica*, *Guiera senegalensis*, *Acacia seyal* and *Dalbergia melanoxylon* may be found in the drier parts.

2. Well-drained sites with over 800 mm of rainfall, trees of 10-15 m high are nearly always mixed with a few species of *Acacia seyal*, alternating with Broadleaves trees such as *Sterculia setigera*. The dominant species are *Combretum hartmannianum* and *Anogeissus leiocarpus*.

3. Dark cracking clay soils with over 600 mm of rainfall and flood surface soil with about 700 mm of rainfall, dominant species are *Acacia seyal* and *Balanites aegyptiaca*. In these sites the disappeared trees are replaced by open grasslands.

4. The rocky hills areas under rainfalls of 400-100 mm, vegetation is generally moister in character than on the surrounding plain and shows erosion catena development. Species composition depends on soil distinctive features (Blue Nile province- Landsat report Vol-1- Metrology-July, 1984).

During the last years a considerable increase in the rainfall has been reported for the Blue Nile State that may contribute positively in enriching the natural flora in different parts of the Blue Nile State figure 5. The updating of the flora of the Blue Nile State and revision of the taxonomical identification will

generate information that can be used for understanding the species changes which would help planners, researchers, students in their work as well as for information of the public at large.

The general objective of this study is to survey and investigate the changes in the natural vegetation and species composition in the Blue Nile State through the studies of the natural regional flora, that constitute the floristic composition of the Blue Nile State. The specific objectives of the study are:

1. To update the identification and classification of the tree, shrubs and other woody species in EL Nour Natural Forest Reserve, Blue Nile state, by herbarium material, highly quality digital images and possibly line drawing illustrations.
2. To construct scientific taxonomic keys for easy identification of the species in El Nour Natural Forest Reserve.
3. To investigate the floristic and taxonomic composition of the study area by determination of the species density, and genera and species frequency by families.
4. To identify the common local uses of the trees, shrubs and other woody plant species in El Nour Natural Forest Reserve.

THE STUDY AREA

2.1 Description of the study area

2.1.1 Location

The study was carried out at El Nour Natural Forest Reserve, southeast of Ed Damazine locality, at a distance of about 6-7 Km. Geographically located between latitude $11^{\circ} 52.5$ 33.4 & $11^{\circ} 48$ 31.8 N; longitude $34^{\circ} 30$ 38.2 & $34^{\circ} 29.5$ 23.05 E. The forest has been reserved in 15.6.1959 with gazette number 934. The total area of the forest is about 4667.17 hectare (11112.3 Feddan).

2.1.2 Topography and soils

Generally the landscape of the Blue Nile State region is undulating and hilly and is characterized by highly fertile clay soils in the central, southern and western part and a higher precipitation area with mountain woodland savannas near the Ethiopian border.

The State is characterized by the presence of various soil types; the most important being the southern central clay plain. This soil is heavy cracking clay with dark grey or dark brown colour. The areas far from the Blue Nile banks are covered with soils known as " Karab". The plateau soils comprise two million feddan, and include the slope of the Ethiopian plateau and hills. These soils are clayey while others are sandy. The surface layers in some of them are acidic and lower layers are alkaline. These areas are used for growing various crops, trees and as pasture land. The newly developed soils, hill and mountain soils and reservoir basin soil are suitable for a variety of investments in crop and animal production.

The topography of El Nour Natural Forest Reserve is slightly flattened with presence of some depressions in the central and northern clay part of the forest. Two type of soils are covering the forest area, namely dark cracking clay soil, with some alluvial patches around water courses, this type of soil constitutes

about 64.2% of the forest area (2994.31 ha) (7129.3 Feddan), and it occurs in the north, northwest and northeast parts of the forest, and 35.8% of the forest area (1672.86 ha) (3983 Feddan), covered by sandy-loam to gravelly soil at the central and southeastern parts.

El Nour (El Azaza) is the nearest village to the forest, belonging to Hamag civil administration, under the Mayer Obied Abou Shotal, the main tribes is Kenana (Arab), Rufaa (Arab), Bargo, Masalit, Fallata, Dinka, El broon and Tama. The inhabitants in the village are enjoying the privileges of collecting the small dry branches, twigs as fire wood; fruits, leaves, barks and roots for local medicine and other possible materials for building their local homes. The forest is considered as a natural range particularly in the dry seasons from March to May, so grazing and browsing are a right for all livestock owners in all forest areas, and the grazing is prevented in the areas where the new regenerations are established. In terms of economic and land use activities, the year 2004 was the starting point in preparation of working plan for sustainable management of the forest to drive more economical, sociological and environmental benefits from the forest, in addition to protection and conservation of the vegetation cover in and around the forest area.

2.1.3 Climate

According to the study of climatic zones of Sudan (Walsh, 1991), the Blue Nile State was classified under Tropical sub-humid region Figure 10. The Climatological Data were interpolated from Ed Dmazine Metrological Station for the years 1971-2002 and 1993-2006, and were analyzed to describe the following climatic factors:

2.1.3.1 Temperature

The State is characterized by the high solar radiation also during the rainy seasons; sun light energy is enormous and amounts to 17.5 mega joule/m²/day.

Variation in day length is small (11.4 - 2.8 hours).

The mean maximum temperature is not greater than 35 C⁰, and the mean minimum temperature is not less than 20 C⁰ during the rainy seasons. The highest temperature occur in April where the mean daily maxima is (41.48 C⁰), and (39.91 C⁰) in May as the second mean daily maxima Figure 2, 3.

January is recorded as the coldest month with mean daily minima (15.62 C⁰) and (16.41 C⁰) in December as the second mean daily minima Figure 4, 5.

A considerable change in mean daily temperature occurred in the rainy period from June to the end of October due to the high relative humidity.

2.1.3.2 Rainfall

Blue Nile State is characterized by heavy rainfall. The rainy season begin in April to November with peak months being July – September with averages of 140.49 – 103.94 mm/month for the mentioned months respectively Figure 4. In the last tenth years (1991 – 2000), the amount of rain slightly increased Figure 5.

2.1.3.3 Relative humidity

The average relative humidity (R.H) during the dry season is less than 50%, and increase to 80% in the wet season. August shows the highest mean relative humidity (69.57%), followed by September and July with (65.86%) and (63.00%) respectively, and started to decrease gradually tell December. The lowest mean relative humidity is recorded during March (17.71%) and April (19.07%) Figure, 8 and 9.

2.1.3.4 Evapo-Transpiration

The mean annual estimate of evapo-transpiration for the period (1993 – 2006) for Ed Damazine Metrological station is 257 (Penman). The highest amount of mean monthly evapo-transpiration occurred in August and October with 46 and 78 respectively.



General plate 1: showing El Nour Natural Forest Reserve, status in the rainy seasons.



General plate 2: showing El Nour Natural Forest Reserve, status in the dry seasons.

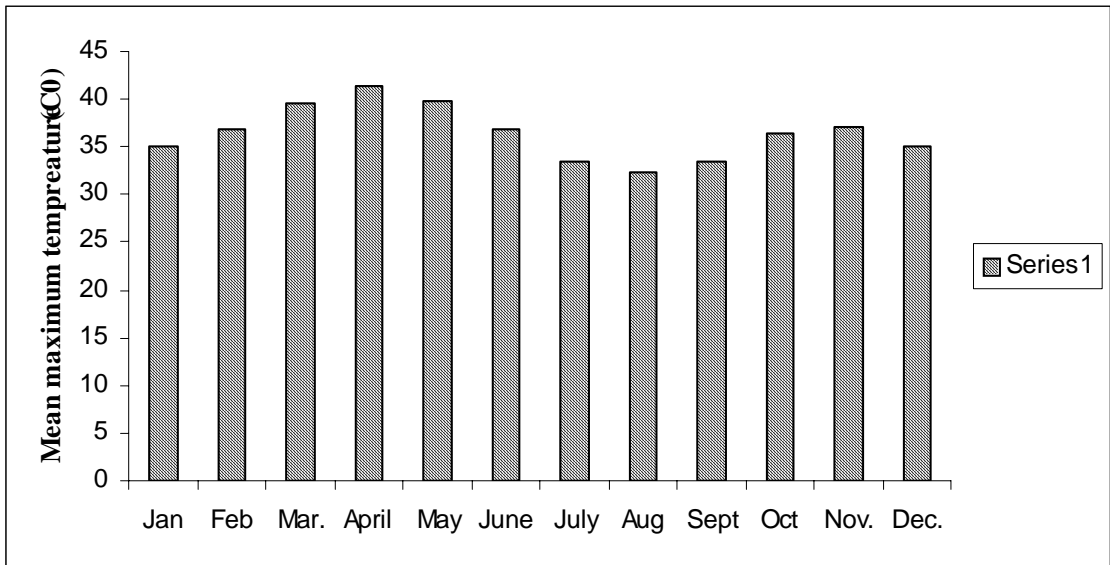


Figure 2: Blue Nile State, Mean Maximum Temperature (C⁰) for the years 1993 – 2006 (Source: Ed Damazine Metrological Station.).

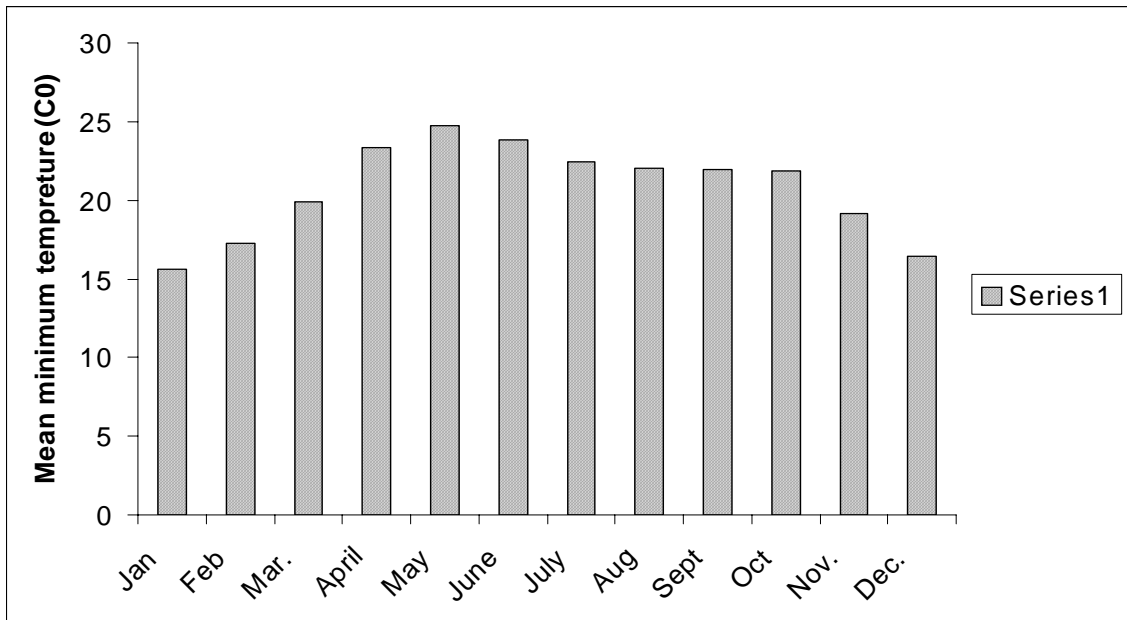


Figure 3: Blue Nile State, Mean Minimum Temperature (C⁰) for the years 1993 – 2006 (Source: Ed Damazine Metrological Station.).

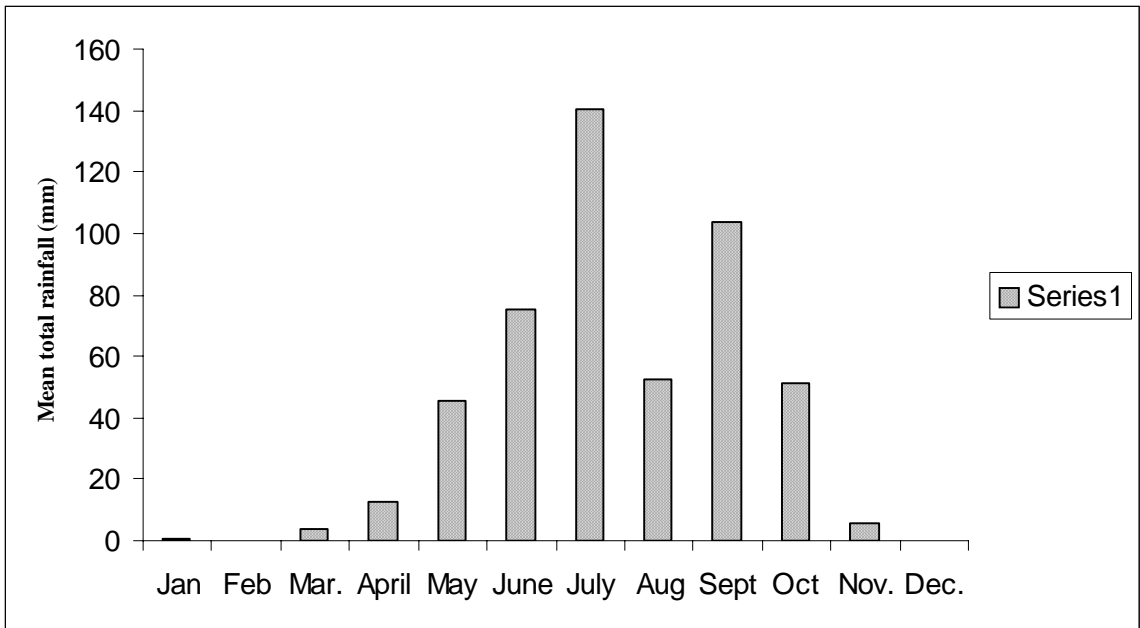


Figure 4: Blue Nile State, Mean Total Rainfall (mm), for the years 1993 – 2006 (Source: Ed Damazine Metrological Station.).

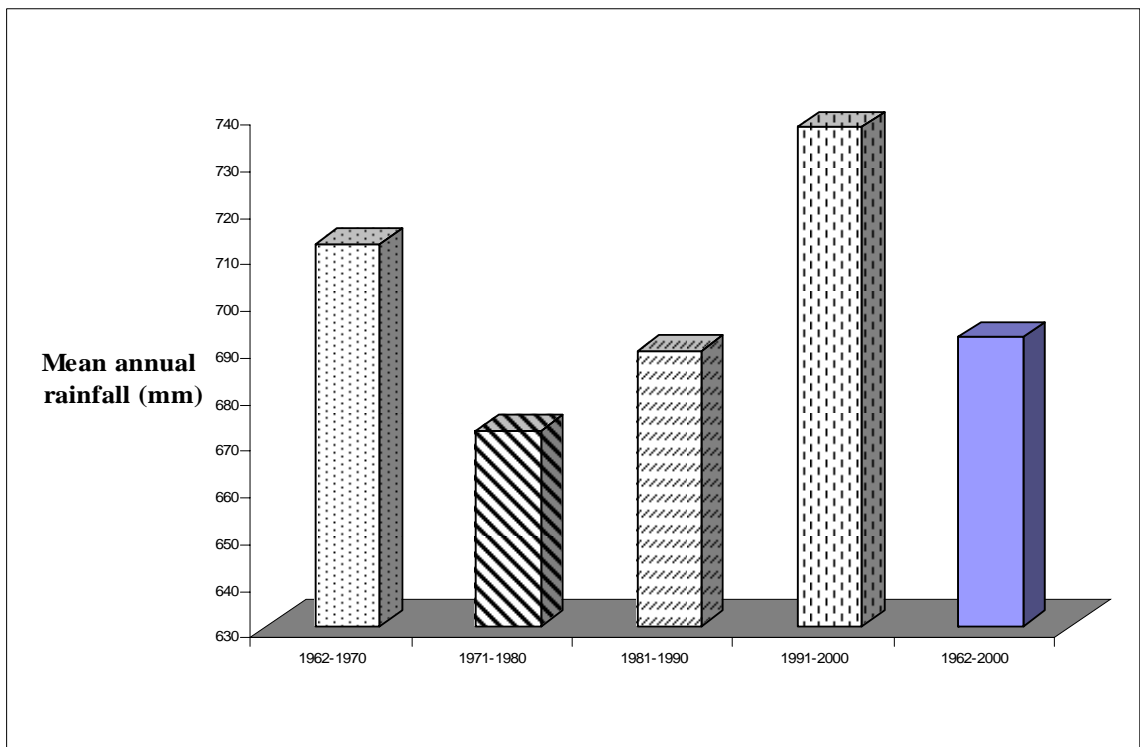


Figure 5: Blue Nile State, Mean Annual Rainfall, for every ten years 1962-1970; 1971-1980; 1981-1990; 1991– 2000 (Source: Ed Damazine Metrological Station.).

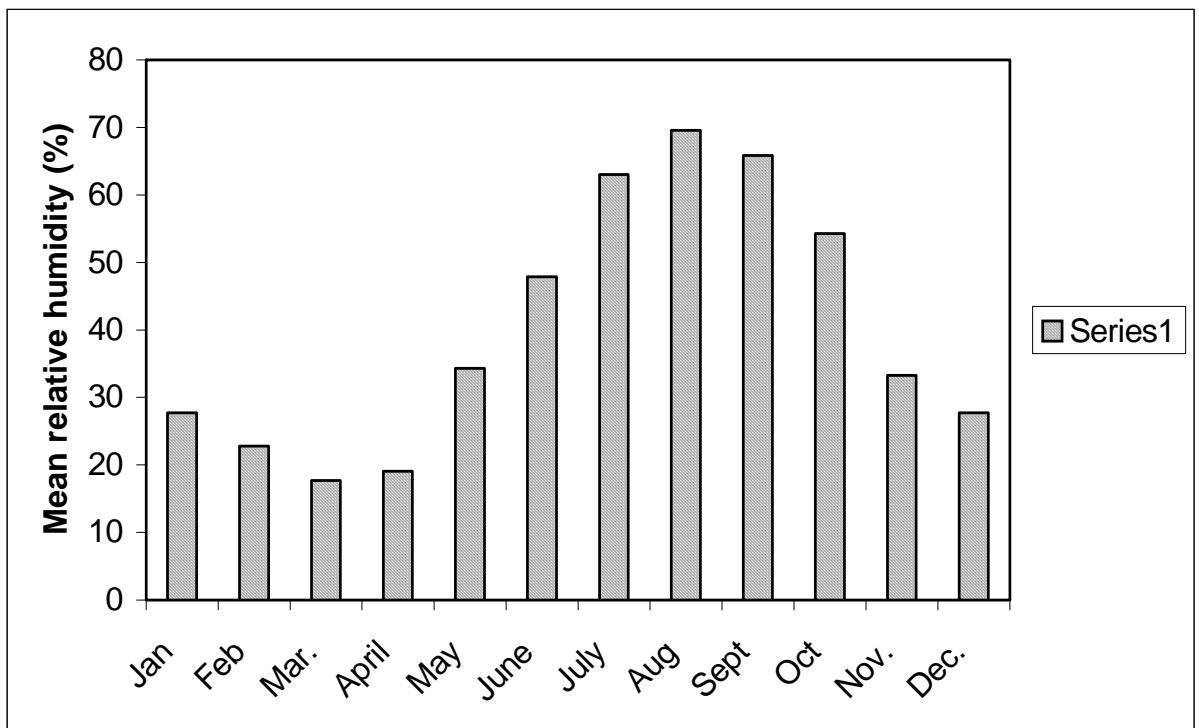
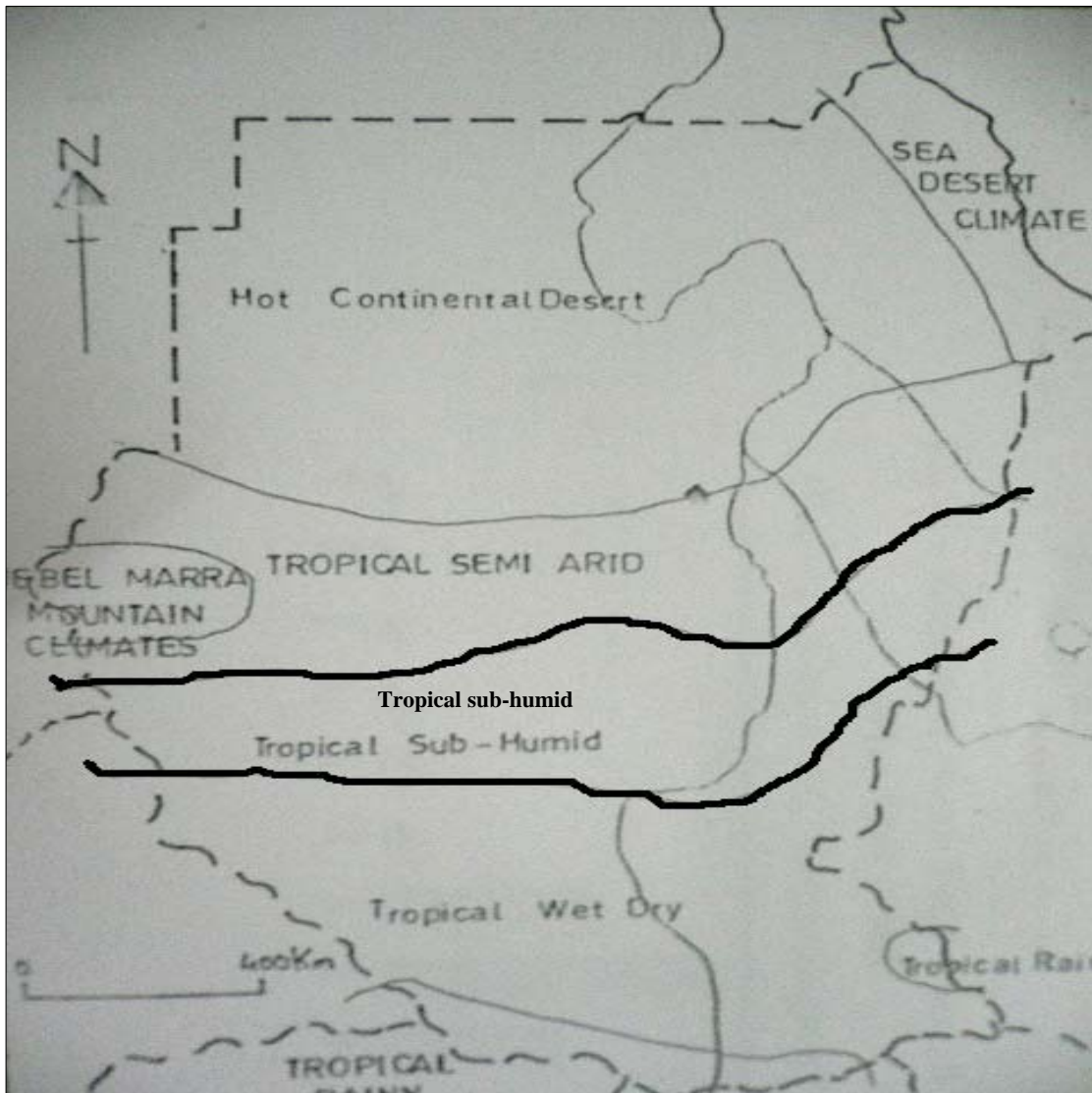
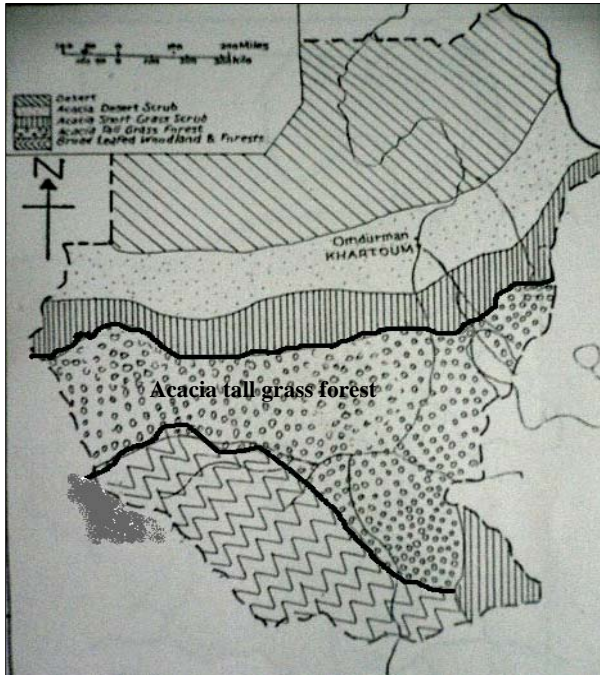


Figure 6: Blue Nile State, Mean Relative Humidity (%), for the years 1993 – 2006 (Source: Ed Damazine Metrological Station.).

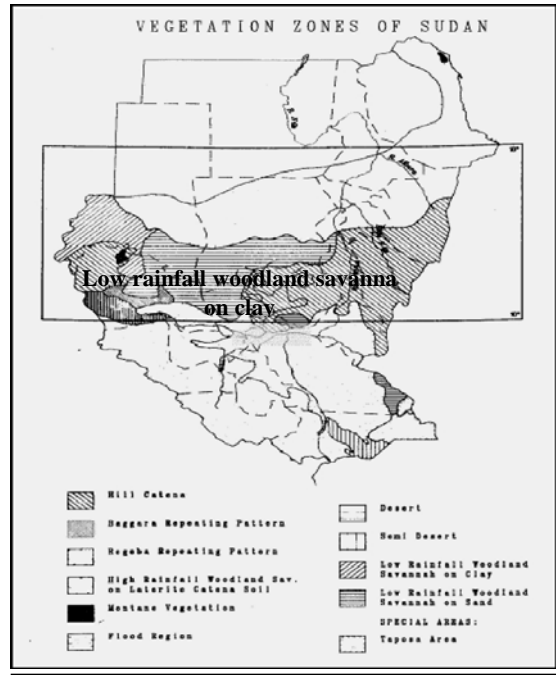


Climatic zones of the Sudan (After Walsh, 1991)

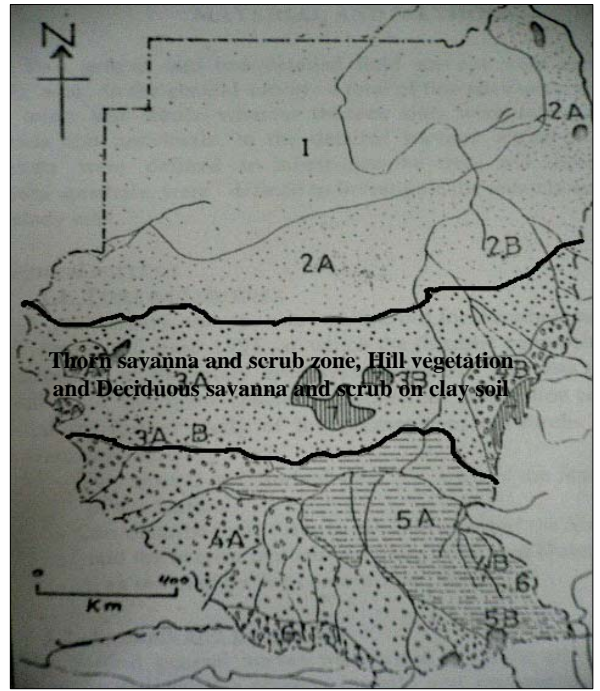
Figure 7: Map showing the Climatic Zones of Sudan (After Walsh, 1991)



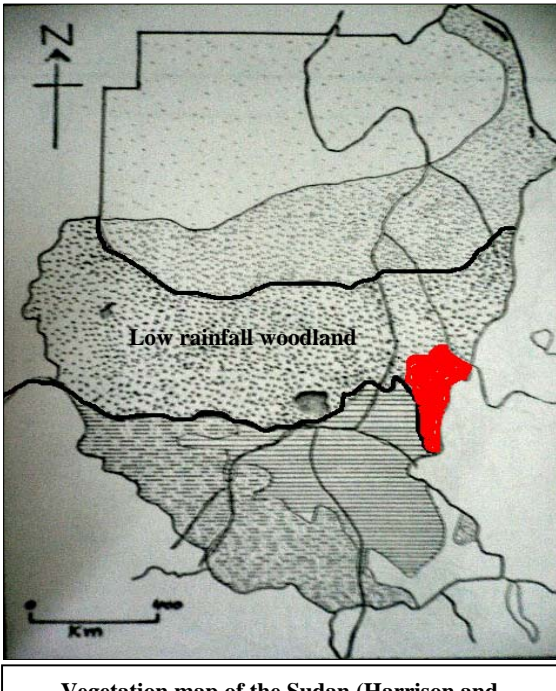
Vegetation map of The Sudan (after Andrews, 1948)



Vegetation zones of Sudan Harrison and Jakson, 1952



Sudan vegetation map (Parry and Wickens, 1981)



Vegetation map of the Sudan (Harrison and Jakson, 1953 modified by El Ghazali 1989)

Figure 8: Maps showing Vegetation zones of the Sudan.

CHAPTER THREE
MATERIALS AND METHODS

3.1 FIELD WORK

3.1.1 Reconnaissance Survey

Reconnaissance surveys were carried out at Al El Nour natural forest reserve, south-east of the Blue Nile State during June, August and September 2006. GPS (Global Positioning System) supported by terrestrial surveying were used to map the forest boundaries. The study area was stratified into two sites (sites A and B) according to soil type, where A is hard cracking clay soil and B is Sandy-loam and Clay soils, furthermore the two sites were demarcated and their actual areas were determined and summarized as shown in Table 1 and Figure 12.

Table 1: Working sites showing their location, description and areas, El Nour natural forest reserve, Blue Nile State.

Site	Definition and location	Area (ha)
A	Hard cracking clay soil, north and northeastern part of the forest (Talih working circle).	2994.31
B	Sandy-loam and Clay soils, south and southeastern Part of the forest (Broad-leaved trees working circle).	1672.86

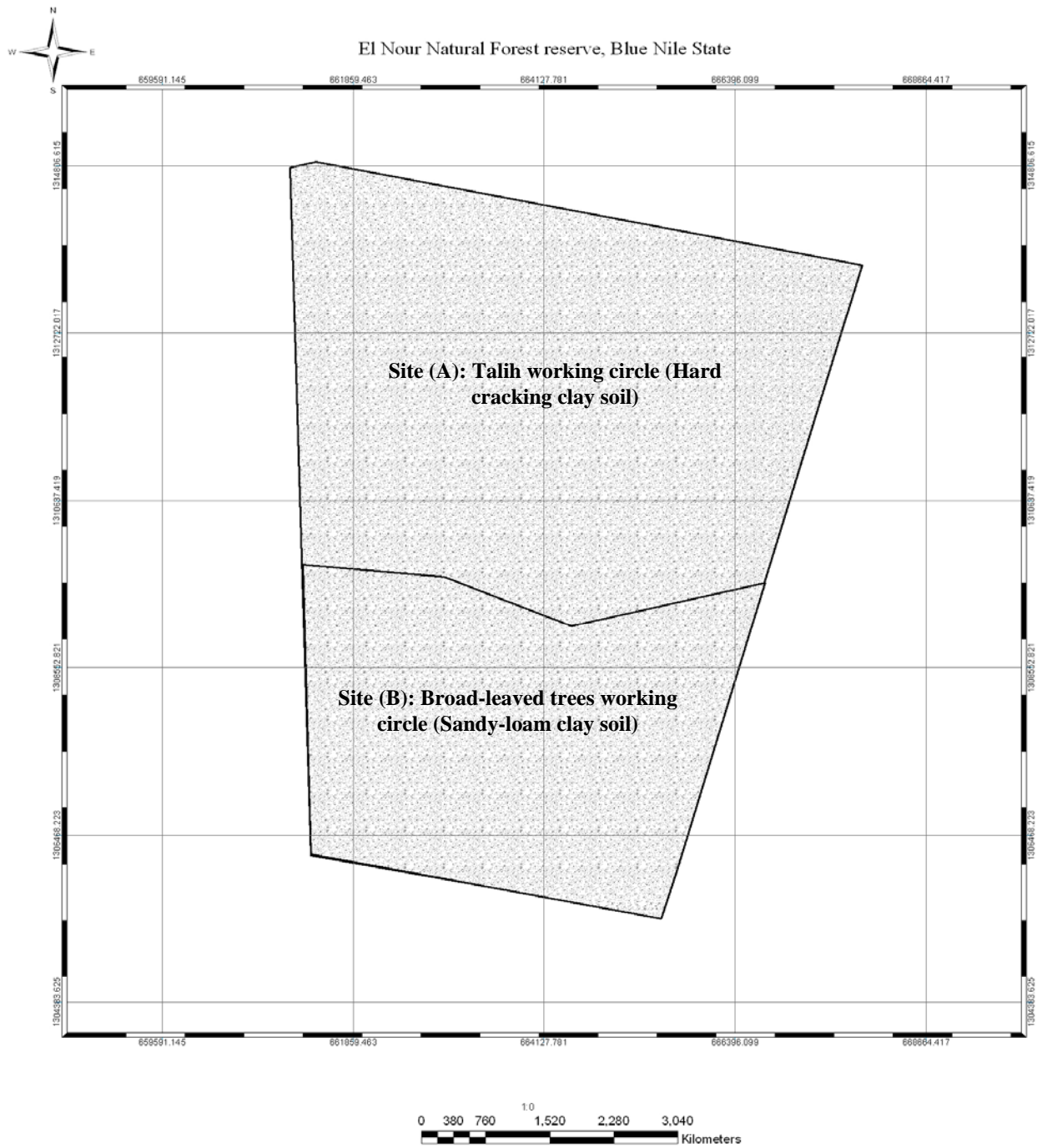


Figure 9: Location map of El Nour Natural Forest Reserve, showing the forest boundaries and sites A and B.

3.1.2 Species sampling

3.1.2.1 A flora survey and specimens collection

The two working sites (A and B) were systematically surveyed during four trips (July 2006, October 2006, January 2007, and May 2007) in which the floristic composition of the plant communities mainly trees, shrubs and woody climbers were examined. Sampling percentages of 75% were used in this study. Circular sample plots ($r = 21.86$ m) with an area of 1500 m^2 (0.15ha) each were laid out using GPS (Global Position System), along West-East parallel inventory lines with an interval of 400 m between plots along the survey lines, and 500 m intervals between survey lines. The information in each sample plot represents an area of about 20 hectare (0.15ha/0.0075). A total of 231 sample plots were studied in the two sites (A and B), of which 87 plots in site B and 144 plots in site A, Figure 10. The parameters measured and the other observations carried out in each sample plot included:

- 1- The number of individual tree and shrub species.
- 2- The total number of tree and shrub species.
- 3- Height and diameter measurements of all trees and shrubs.
- 4- Collection of fresh herbarium specimens from the different tree and shrub organs (twigs, foliage, bark, flowers or inflorescence, and fruits).
- 5- Photographs of the whole plant and the diagnostic organs were taken from each species using digital camera (Lumix, Panasonic DMC-FX7).
- 6- Habit, habitat, distribution and other possible observation (over cutting, over grazing) were recorded for each species from inside the sample plot and along the distance between successive sample plots.

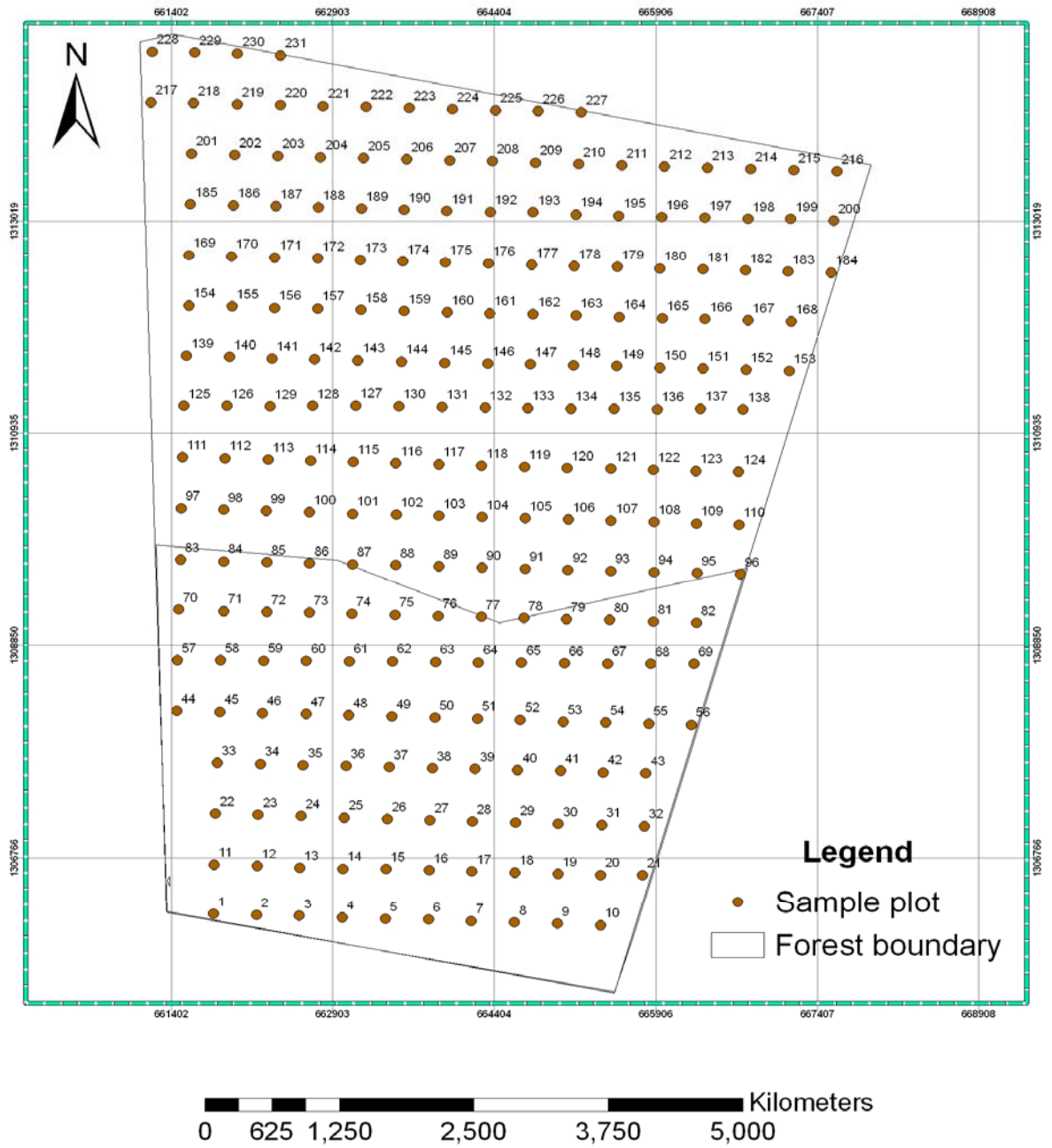


Figure 10: El Nour Natural Forest Reserve map, showing the boundaries and samples distribution in site A and site B.

3.1.2.2 Pre-preparation of the herbarium specimens

Collected specimens were directly stretched between newspapers for easy drying, and firmly pressed inside herbarium press. A continuous change to the newspapers had been done during the days of the field collection to avoid material rotting.

3.2 Laboratory and office work

3. 2.1 Specimens examination

At the herbarium level further analysis and/or identifications were done, initially by examining the various parts of the collected specimens by using hand-lens.

3.2.2 Specimens mounting

The specimens were mounted on herbarium sheets (41 x 29 cm), labeled and deposited at the herbarium of the Department of Botany- Faculty of Science University of Khartoum, and Department of Silviculture Faculty of Forestry University of Khartoum. The material examined was documented with reference to collector name, serial number, date of collection and the place of collection.

3.2.3 Species identification and citation

Keys formulated by Andrews (1948, 1950, 1952 and 1956) and Braun *et al* (1929) were used in identification of the specimens. The unknown specimens were compared with the identified specimens at the herbaria of the Forestry Research Centre, Suba; Faculty of Science, U of K and Medicinal and Aromatic Plants Research Institute. The identified families and species were arranged and listed in an alphabetical order, as shown in table 2. A number of scientific publications were consulted for the taxa citation and synonymy (designated as Syn.), Hutchinson and Dalziel (1927); Milne-Redhead and Polhill (1952, 1967 and 1991); selected volumes of Kew Bulletin, and Index Kewensis and supplements (1895, 1985); Turrill and Milne-Redhead (1952-1991). Vernacular

names (designated as Vern.) of the identified species were drawn from the botanical manuals of Andrews, (1949 and 1953); El Amin, (1990) and Thirakul, (1984) and from knowledge of local inhabitants within the study area.

3.2.4 Species description

The identified species were described and revised from the above mentioned references, recent scientific publication and journals with aid of the field observation. The description included the habit, bark shape, leave types, flower or inflorescence types, type of fruits and the distribution of each species in the Sudan.

3.2.5 Keys construction

The indented keys were designed to differentiate between families with more than one genus, and genera more than one species. The morphological diagnostic features such as leave types, blade shape, venation and texture, bark, flowers or inflorescence types and fruit types were used in the construction of the taxonomic keys.

3.2.6 Illustrations and printing

The illustrations were made by using high quality digital images (digital camera and Ulead-photo editor in a PC computer) and produced by a colored printer.

3.2.7 The tree vegetation covers (Ecological parameters)

The average density (tree/ha) by sites and dominant species, were calculated by the formula used by Elsafori, 2006 to investigate quantitatively the trees and shrubs which form the woody vegetation of the study area with its two sites (A and B). The data were recorded during the field survey as a total number of all the individuals per sample plots, and the total number of each individual species per sample plots in each site. Finally the data were arranged into Excel sheet and analyzed simply by the following formulas:-

Density (D) = $\frac{\text{Total number of individual species}}{\text{Total area of sample plots}}$

Total area of sample plots

3.2.8 Genera and species frequency by families

The Genera and species frequency (%) by the identified families were calculated to show the taxonomic composition of the forest, by using the following formulas:

$$\text{Genera frequency (\%)} = \frac{\text{Total number of genera in each family}}{\text{Total number of genera in all families}} * 100$$

$$\text{Species frequency (\%)} = \frac{\text{Total number of species in each family}}{\text{Total number of species in all families}} * 100$$

3.2.9 Local uses of the identified tree and shrub species

The uses and values of the identified trees and shrubs were extracted from the botanical manuals such as Maydell, (1986) and from local knowledge and information of the inhabitants and Herbalists.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 MORPHOLOGICAL DESCRIPTION OF FAMILIES AND STUDIED SPECIES.

The study identified 54 plant species that belong to 17 families and 3 subfamilies (19 dicotyledonae and 1 monocotyledonae), and 36 genera (Tables, 2 and 3). The collected species were revised for botanical names, synonyms and vernacular names and were updated to the recent available literature nomenclature. The identified species were grouped according to height into 22 species large trees, 12 small trees, 18 shrubs and 2 woody climbers.

The identified species were briefly described in an attempt to highlight their diagnostic features, and arranged into alphabetical order. High quality digital images were used in the illustration of the prevailing flora in support and completion of the taxonomic description (Plates, 1 - 54).

Family characteristics were extracted and the taxonomic keys were constructed for the identified genera and species. The results are as follows:

1. Family: Anacardiaceae

Trees or shrubs, leaves alternating rarely opposite, simple or compound, usually exstipulate. Inflorescence axillary or terminal panicles or spike like racemes. Flowers hermaphrodite (bisexual) some times unisexual, mostly actinomorphic (regular); sepals united or free, imbricate or valvate; petals absent or 3-7 free or rarely united; stamens as many as or twice as many as petals rarely numerous; ovary 1-6 locular; loculi with one anatropous ovule; style 1-5. Fruits mostly drupaceous, rarely dry; seeds erect, horizontal or pendulous with membranous or coriaceous testas.

Key to genera:

A. Flowers bisexual (hermaphrodite).....*Lannea*.

AA. Flowers unisexual (dioecious).....*Sclerocarya*.

1. Genus: *Lannea* A. Rich., in Guill., Perr. & Rich., Fl. Seneg. Tent. 1: 153 (1831).

Key to species:

A. Bark deeply and longitudinally fissured, flaking off in elongated patches blackish or dark grey, rough..... *L.fruticosa*. Plate (1).

AA. Bark rough, fibrous and twisted grey to almost black.....*L. schimperi*. Plate (2).

1. *Lannea fruticosa* (Hochst. ex A. Rich.) Engl., in Engl. & Prants, Pflanzenfam. Nachtr. 1: 213 (1897); F.W.T.A., ed 2, 1: 732 (1958).; **Plate (1)**.

Syn.: *Odina fruticosa* A. Rich. in Cent. Fl. Abyss. 1:141 (1847); Oliver., F. T. A. 1: 446 (1868).

Vern.: Leyun, Ghallub, Amzaq (Ar.).

Deciduous tree 8-11 m high. Crown umbelliform or rounded, dense and heavy foliage. Bole fairly straight and cylindrical, often slightly enlarged at the base. Bark blackish or dark grey, rough, deeply and longitudinally fissured, flaking off in elongated patches. Branches rough thickly lenticellate with leaf scars at their ends. Leaves imparipinnate, 22-44 cm long, tufted at the branch ends and usually deciduous, leaflets 11-15 pairs, sessile, lanceolate, apex acute, base cuneate, margin entire, minutely pubescent at first, then glabrous. Flowers yellowish-white in racemes in stout axillary peduncles 4-12 cm long, reddish, pubescent. Fruits drupes oblong-ellipsoid, brown, with 4 raised marks near the apex, stone surrounded by thin fleshy pulp. Flowers January-March; fruits February-April.

Habitat and Distribution

Widespread in high rainfall and tall grass savanna of Central Sudan,

and is found on rocky hill slope in Red Sea (Ata Hashu), Blue Nile (Haroun forest, Hedubat), Kassala (Galabat), Kordofan (Kadogli), Darfur (Radom, Tulus, Zalingi, Nyertete, Martegello and Kalikoting), Equatoria (Imatong).

Uses

The wood is very hard, used by the local people for mortar tools, building posts and fuel. Medicinally, the equous extract from the bark is use for treating stomach diseases; leaves are a good fodder for animals. Fruits edible and can be eaten by local people in various part of the Blue Nile State.



Plate1: *Lannea fruticosa* (Hochst. ex A. Rich.) Engl., (June 2006).

**2. *Lannea schimperi* (A. Rich.) Engl., E & Pr. Pf. II. 1V, Nacht. 1:213
(1897). Plate (2).**

Syn.: *Odina schimperi* Hochst. ex . Rich. Tent. Fl. Abyss. 1:140 (1847).

Vern.: **Leyun, Amzaq** (Baggara), **Hammadai** (Hadendowa) **Suda tree** (Ar.)

Evergreen tree up to 11 m high. Bark grey to almost black, rough, fibrous and twisted. Leaves imparipinnate, 15-24 cm long, clustering at end of branches, reddish tomentose when young; leaflets 5-11 subsessile, opposite, elliptic to ovate-lanceolate or ovate, apex acuminate, base rounded, margin entire, upper surface covered with pink tomentum dense at first but easily rubbed off and soon disappearing, tomentum on lower surface very dense, lanate, pink or pinkish grey entirely composed of long armed stellate hairs not obscuring tertiary nervation or concealing lamina. Rachis and petiole densely pink-tomentose. Flowers yellow are clustering at end of twigs in simple racemes, are appearing when tree is leafless or with young leaves. Sepals 4, tomentose. Fruits drupes brown, obliquely or irregularly ovoid or suborbicular. Flowers April-July; fruits January-May.

Habitat and Distribution

Widespread in tall grass savanna near slopes on rocky hilly ground. In Darfur (Radom, Hofrat El Nahas), Red Sea Hills (Erkowit, J. Seila), Kordofan (Nuba Mts, J. Daier, Um Ruwaba), and Bahr El Ghazal (Nyin Akok).

Uses

The fruits are eaten by the local people specially Hadendowa. The bark makes good ropes. The wood is soft, white and used for firewood (El Amin, 1990). The bark leaves and fruit for local medicine (Reported by local inhabitant from Azaza village- Blue Nile State, 2007).



Plate 2: *Lannea schimperi* (A. Rich.) Engl., (June 2006).

2. Genus: *Sclerocarya* Hochst., in Flora 27, Bes. Beil.: 1 (1844)

1. *Sclerocarya birrea* (A. Rich.) Hochst., In flora 27, Bes. Beil.1 (1844).

Plate (3).

Syn.: *Spondias birrea* A. Rich., in Hochst. in Flora 27, Bes. Beil.: 1: (1844);

Vern.: **Humeid** (Ar.); **Mango** (Eng).

Medium sized to large deciduous trees 10-15 m high. Crown rounded much-branched, dense and rather heavy foliage. Bark pale grey, with reddish, blackish thin, rough slightly fissured, and flaking off in scales. Branchlets grey in colour, stout and corrugated. Leaves imparipinnate, reddish when young, clustered at the end of branches; leaflets 5-10 pairs, opposite, entire or toothed, elliptic to obovate, apex acute, mucronate or rounded, base shortly cuneate, margin entire or dentate, glaucous and glabrous. Flowers dioecious, appearing usually before the leaves, each in the axil of small red bract; male flowers in small erect terminal spikes 5-7.5 cm long and sweet-scented; female flowers 2-3 together at the end of the twigs on stout pedicils; sepals purple red, free; petals recurved, green with purple red tips; stamens yellow. Fruit drupes, globose or obovate, when ripe, mango-like, with tough skin and mucilaginous acidic juicy flesh, with edible fibrous pulp surrounding the hard stone. Flowers January-March; fruits March-April.

Habitat and Distribution

High rainfall and tall grass savanna of Central and South Sudan associated with *Lannea* and *Combretum* species. In the Blue Nile (Damazein, Ingessena Hills, Saolil Forest), Kordufan (Nuba Mts, Taloddi), Darfur (Boram, Tullos, Radom, Daein), Upper Nile (Malakal), Bahr El Ghazal and Equatoria (Torit-Malongeri). It occurs naturally in various types of woodland, on sandy soil or occasionally sandy-loam.

Uses

The wood is dirty white, hard, used in carvings, furniture, and match manufacture and also suitable for flooring and veneer. The tree can be used

for fuel wood, charcoal, shade tree, ornamental tree, shelterbelts, Agroforestry, live hedge, fodder, cure, insecticide and sand dune fixation (Sahni, 1968 and El Amin, 1990.); for medicinal uses the water extracts from leaves and barks are used for stomach pains and diarrhea of children, and the powder is used for healing up wounds and with starch for dysentery (El Ghazali, 1985 and 1997). The bark yields a strong fiber, and has a medicinal value as remedy for rheumatism (Kokwaro, 1993). The wood is grey brown, soft, coarse grained, used recently for paneling, doors, windows and second class furniture. The wood is also use locally to make food bowls and mortars. The fruit is edible and used as drink or pudding. The tree exudes a clear gum and the kernel produces oil (El Amin, 1990).



Plate 3: *Sclerocarya birrea* (A. Rich.) Hochst., (June 2006).

1. Family: Asclepiadaceae

Perennial herbs, shrubs or rarely trees, containing milky juice. Leaves simple, opposite, entire and no stipules. Inflorescence cymose, corymbose or

subumbellate; flowers hermaphrodite (bisexual), actinomorphic (regular); calyx tube more or less; corolla lobes 5; stamens 5; styles only united at the apex; ovary superior. Fruits many-seeded and composed of 2 usually diverging follicles with plumed seeds.

1. Genus: *Calotropis* R. Br.

1. *Calotropis procera* Aiton., f., Hort., Kew, ed., 2, 2:78 (1811). **Plate (4).**

Syn.: *Asclepias procera* Aiton., in Hort. Kew 1:345 (1789).

Vern.: Usher, Baras (Hadendowa) (Ar.); **Dead Sea shrubs** (Eng.).

Soft woody shrub up to 6 m high; any part exudates a white milky latex when cut. Bark is thick and croky yellow-brown or whitish-grey. Leaves simple, opposite-decussate, pale green, succulent, sessile or shortly petiolate, ovate, obovate, apex apiculate, base cordate-auriculate, margin entire. Flowers in 3-10 flowered sub-umbellate cymes, white to purplish in colour, raising from between the bases of the leaves on peduncles; corollas campanulate with 5 greenish-white lobes with purple tip; corona purple at the top with white spurs below. Fruits follicles paired, green, subglobose to obliquely ovoid, with a sticky spongy inflated pericarp.

Habitat and Distribution

Low lands and waste sites. The shrub is widespread in Central Sudan, recently extending southwards and it found as scattered shrubs in El Nour (Alazaza) natural forest reserve, Blue Nile State.

Uses

Bark fiber for ropes and the tree for dead hedging. Medicinally the roots are used for treating dysentery, dephantiasis, syphilis, ulcers, stomach and diaphoretic; bark and latex used in veterinary medicine. The infusion of

the roots mixed with flour is used for jaundice, the latex for treating scorpion and snake bites, while a decoction of root is used as part for the eradication of hookworms and also used as medicine for camel diseases (El Ghazali *et al*, 1987 and Kokwaro, 1993).



Plate 4: *Calotropis procera* Aiton., (June 2006).

**3. Family: Blanitaceae (Simaroubaceae,
Zygophyllaceae, Agialidaceae)**

Small trees or shrubs with simple or forked spines. Leaves alternate

bifoliolate, petiolate or sessile; leaflets coriaceous or subsucculent, entire; flowers hermaphrodite (bisexual), actinomorphic, fragrant; sepals 5 free glabrous or hairy; stamens 10; anthers 2-locular; filament free filiform, disk succulent, conical or invertedly cup-shaped or copular, surrounding the ovary; ovary superior, subglobose, 5-locular with 1-pendulous ovule in each loculus. Fruit 1-2 seeded of drupes; endocarp often woody; mesocarp spongy or fibrous; exocarp crustaceous or coriaceous, usually oily, seeds non endospermic.

1. Genus: *Balanites* Del.

1. *Balanites aegyptiaca* (L.), Del. In Descr. Aegypt. Hist. Nat. 2:221, t. 28, (1813). **Plate (5).**

Syn.: *Ximenia aegyptiaca* L., Sp. Pl. 2:1194 (1753).

Vern.: Hegleeg (Ar.); Desert date (English.)

Tree 8-10 m high. Crown spreading usually with dense drooping vertical green branchlets. Bark rough, fissured grey to dark brown. Older trees are recognizable by the dark bark, which has deep vertical fissures through the length of the trunk. Leaves bifoliolate, with leaflets of ovate to ovate-lanceolate or rhomboid blade shape. Prickles in pair, greenish, with yellowish tip. Flowers are yellow-green, supra-axillary clusters. Fruits are drupes oblong-elliptic, egg shaped green in colour turning yellow or brown when ripped. Flowers November-April; and fruits December-July.

Habitat and Distribution

Very common on dark cracking clay soils of Central Sudan often associated with *Acacia seyal* on short grass savanna.

Uses

Wood is pale yellow, coarse grained, hard, is used as local furniture, joinery, walking sticks, bend wood chair, and turnery, charcoal and fuel (El Amin, 1990). Medicinally embryo and fruits are eaten to cure diabetic, balharzia, and also as a purgative (Reported by locals, El Nour, 2007). The aqueous extract from the bark is used for jaundice and the branches are used as fumigant for rheumatism (El Ghazali, 1985 and 1986). The leaves for healing wound, and as anti-rehumatic when mixed with sesame oil. The decoction of the root is taken against malaria, while bark fumigant is used to heal circumcision wound, and the fruits are mild laxative, antidote to arrow poisons (Boulos, 1983). The fruits are eaten by man and animals. The inner core of the seed is crushed to provide oil for cooking. The pulp contains 40% sugar. The kernel oil is used in soap making (saponin). Saponin also occurs in roots, bark, wood chips and fruits hence their use in washing clothes. The foliage is eaten by animals. The bark yields strong fibers. The hard seeds are used as praying beads (Sibha) or as necklaces. It is also a good shade tree in the hot savanna (El Amin, 1990).



Plate 5: *Balanites aegyptiaca* (L.) Del., (January 2007).

4. Family: Bombacaceae

Trees often with stout stems and buttress roots. Leaves alternate, simple or digitate; stipules deciduous. Inflorescence solitary; flowers hermaphrodite (bisexual), large, showy; sepals 5; petals 5; stamens free or

united into tube; anthers 1-locular; ovary superior, 2-5 locular; style simple; stigmas capitate or lobed; ovules 2-many in each loculus. Fruits indehiscent or loculicidally dehiscent capsules; seeds often imbedded in pulp or hairy from the wall of the fruit.

1. Genus: *Adansonia* L.

1. *Adansonia digitata* Linn., Sp. Pl. 2: 1190 (1753). Plate (6).

Syn.: *A. baobab* Gaertn., Spreng, Syst. 3: 124 (1763).; Spreng, Syst. 3: 124 (1763).

Vern.: Tebeldi, Gonglais (Fruit) (Ar.), Baobab (Eng.).

A deciduous tree up to 20 m high, with a trunk of vast thickness, and buttress roots. Branches short, stout and stiff, wide-spreading. Bark smooth, grey or pink, fibrous. Leaves digitately foliate; leaflets sub-sessile, oblanceolate to elliptic, apex acuminate, base cuneate, margin entire or denticulate, stellate-pubescent or nearly glabrous beneath; petioles about 12.5 cm long. Flowers axillary, large, white; calyx cup-shaped, 5-cleft, tomentose; petals 5, leathery and ultimately reflexed, hairy inside; stamens many, staminal column dividing into many filaments of 1-celled anthers; styles long with stigma of 7-10 rayed. Fruit capsules, woody, oblong, grey-green, tomentose, and pendulous on long stalks; seeds grey, reniform, oblong, embedded in dry white powdery pulp, edible. Flowers May-July; fruits August-October.

Habitat and Distribution

In short grass savanna, especially on sandy soils and by Khors. Very common in Central Sudan, in Kordofan, Darfur, Blue Nile (Saolil, Disa, wad El Gizouli, Roesires), Upper Nile and Bahr El Ghazal.

Uses

The hollow trunk is used as a reservoir for the storage of rain water, and in some places as a burial place for dead. The bark yield strong fibers used for ropes, baskets, etc. The fruit, called GONGOLEIS by Arabs, contains a subacid pulp which makes a pleasant drink with water, and is used as a cooling medicine for stomach pains (El Ghazali, 1985). A decoction of the root is taken as a remedy for lassitude, bark boiled as cure for pain in body, bathing infants if they are weak, in steam baths, and as a diaphoretic (Kokwaro, 1993).



Digitally foliate leaves



Plate 6: *Adansonia digitata* Linn., (June 2006).

5. Family: Bignoniaceae

Trees, shrubs often climbers, rarely herbs. Leaves exstipulate, opposite ternate or rarely alternate, usually compound, digitate or pinnate, sometimes the terminal leaflets tendril-like. Flowers often showy, hermaphrodite more or less zygomorphic campanulate, truncate or 5-toothed petals united, imbricate,

5-lobed, often 2-lipped, the upper lip of 2 lobes, the lower of 3-lobes; stamens alternate with the petals, 2 or 4 with or without staminodes; anthers 2-locular, united in pairs rarely free; ovary superior, 2-locular with 2 placentae in each loculus or 1-locular with parietal placentation; styles terminate; stigma 2-lipped; ovules numerous. Fruits capsules or fleshy and indehiscent; seeds often winged.

1. Genus: *Stereospermum* Cham., in Linn. 7:720 (1832).

1. *Stereospermum kunthianum* Cham., in Linn. 7:720 (1832). **Plate (7).**

Syn.: *S. dentatum* A. Rich.

Vern.: Khashkas Abiad, Suweid (Ar.); Pink jacaranda (Eng.).

Tree 10-15 m high. Bark light grey to brown with blue-grey blotched scale-scars. Young branchlets pink coloured. Leaves imparipinnate, opposite; leaflets ovate, oblong-elliptic or lanceolate. Inflorescence panicles, large and drooping.; flowers pale pink or lilac with purple markings, occasionally dark-pink or rarely almost white, fragrant, appearing before the leaves; peduncles tomentose; sepals 5-lobed, 3-5 mm long, red or violet, lined with a hair outside; stamens 4. Fruit cylindrical capsules up to 60 cm long, dark brown or pinkish brown, spirally twisted; valves persistent; seeds winged at each end. Flowers January-May; fruits May-June.

Habitat and Distribution

Widespread on light silty soils often near streams and valleys in the Blue Nile state, White Nile State, Kassala, Kordofan, Darfur, Upper Nile, Bahr El Ghazal and Equatoria. In gardens all over the Sudan, the tree is also found in West Africa.

Uses

The wood is white and very soft. Decorative in gardens, homes and roadside. The tree is extensively exploited by local people for firewood and

valueless charcoal. Bark, root and fruits are used for curing the wounds, skin inflammation, sexual diseases and cough (Reported by locals, 2006)



**Twig showing
imparipinnate leaves**

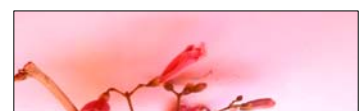


Plate 7: *Stereospermum kunthianum* Cham., (June 2006

6. Family: Burseraceae

Trees or shrubs secreting resin or oil. Leaves exstipulate, alternate or rarely opposite, pinnate or rarely simple. Flowers small, hermaphrodite or rarely unisexual; sepals 3-5 imbricate or valvate, petals 3-5 or rarely absent, free or rarely connate, imbricate or valvate; disc present; stamens as many as

or twice as many as the petals; filaments free; ovary superior, 2-8 locular; ovules 1 or 2 in each loculus, placentation axile; fruits drupes or rarely capsules.

1. Genus: *Boswellia* Roxb.

1. *Boswellia papyrifera* (Del.) Hochst., Flora 26:81 (1843). Plate (8).

Syn.: *Amyris papyrifera* Del., Cent. Pl. Afr. Meroe.: 99 (1826).

Vern.: Gafal, Tarag tarag, Shaggar El Luban, Mistika, Luban (Ar.), Frankincense tree (Eng.).

Deciduous tree up to 10 m high. Crown spreading or irregular. Bark pale yellow-brown, papery, peeling off in wide strips. Slash reddish exuding a fragrant resin. Leaves imparipinnate, leaflets 10-13 pairs, with serrate margin, sessile, opposite to sub opposite (the one near the base smaller), oblong-lanceolate. Inflorescence lax panicles clustered at end of thick branches; flowers white-creamy, tinged with pink appearing before the leaves, sweet-scented, on red peduncles 2.5 cm long with shorter vertical wings. Fruits capsules red-brown in colour. Flowers March-April; fruits May.

Habitat and Distribution

Rocky hill slopes. It distributes in high rainfall savanna in Blue Nile, Kordofan Darfur, Bahr El Ghazal, Upper Nile and Equatoria (El Amin, 1990). The species is found in Al Ghari Mountain, and El Nour natural forest and Baw locality in the southwestern part of the Blue Nile State.

Uses

Wood is yellowish white, fine grain, hard (Thirakul, 1984). The wood is used in local carpentry, particularly for item such as mortars, pestles and bed frames, and is also suitable for making matchboxes, particle board, pencils, plywood, picture, frames, and veneer (Vogt, 1995). Medicinally the

boiled water extract of the bark is used for jaundice (El Ghazali, 1985).



Plate 8: *Boswellia papyrifera* (Del.) Hochst, (June 2006).

7. Family: Capparaceae (Capparidaceae)

Trees, shrubs or climbing herbs. Leaves usually alternate, or digitally 3-7 foliolate; stipules where present minute and spiny. Inflorescence variable, axillary or terminal; flowers usually hermaphrodite, actinomorphic, hypogynous; sepals free united, imbricate or valvate, usually 4; petals 4-

many, free or absent, stamens free many, free or attached to a gynophore; anthers 2-locular, longitudinally dehiscent; ovary superior sessile or carried on long or short gynophores, 1-locular with parietal placentation, or divided into 2 or more loculi; ovules free-many. Fruits capsules or berries or winged and indehiscent, sometimes elongate or torulose, seeds reniform or angular.

Key to genera:

- A. Leaves simple.....*Boscia, Cadaba, Capparis* and *Mearua*.
 - B. Deciduous and very small..... *Capparis*
 - BB. Leaves not deciduous.....*Boscia, Cadaba* and *Mearua*
 - C. Fruits capsule, fleshy.....*Boscia* and *Mearua*
 - D. Cylindrical, worm-like.....*Mearua*
 - DD. Spherical or globose.....*Boscia*
- AA. Leaves compound, 3-foliolate.....*Crateva*

1. Genus: *Boscia* Lam., Tabl. Encycl. Meth. Bot.: t. 395 (1793) & text. Vol. 2: 517 (1819); Pax & K. Hoffm. in E. & P. Pf., ed. 2, 17B : 188 (1936), *non* Thunb. (1794).

Key to species:

- A. Armed woody scrambling shrub or small trees... *B. angustifolia*. Plate (9).
- AA. Armed woody not scrambling.....*B. senegalensis*. Plate (10).
- 1. *Boscia angustifolia*** A. Rich., in Fl. Seneg. 1: 26. t. 6 (1831).
- Syn.: *B. patens*** Sprague & M. L Green., in K. B. 1913: 178(1913). **Plate (10).**
- Vern.: Al Sarh or El Shebait** (Ar.).

Armed woody scrambling shrubs or small trees 5-12 m high. Bark white to grey, smooth, shiny on trunk and branches. Leaves alternate, clearly spaced on shoots of the current year, in fascicles of 2 or more on the older wood, shortly lanceolate, oblanceolate-elliptic. The petiole 3-7 mm long. Inflorescence many-flowered oblong, 2-5 x 0.8-2cm, coriaceous, glabrous

beneath; terminal and axillary corymbose racemes, accompanied by many leaves; sepals ovate or ovate elliptic, 2 -5 mm long; petals absent; stamens 5-9; filaments 2-4 mm long; gynophores shorter than the filaments, glabrous. Fruit pitted, globose, 10-12 mm across, warted and sometimes papillose. Flowers November-February; Fruits March.

Habitat and Distribution

Common in deciduous woodlands in tall grass savanna in South Darfur, South Kordofan (Nuba mountains); Red Sea Hills, Kassala (Jabal Kassala), South Blue Nile and Southeastern Equatoria.

Uses

The wood can be use as firewood and building material. The leaves are suitable as fodder and medicinal purposes.



Plate 9: *Boscia angustifolia* A. Rich., (February 2007).

2. *Boscia senegalensis* (Pers.) Lam. ex Poir., In DC., Prod. 1: 244 (1824).

Plate (10).

Syn.: *Podoria senegalensis* Pers., Pl. Syn. Pl. 215 (1806); *Boscia octandra*

Hochst. ex. Rodlk. In Sitzb., Math.-Phys. Acad. Muench. 15:62 (1884).

Vern.: Mokheit, UmKheit, Kursan (fruit) (Ar.).

Shrub or small trees up to 7 m high. Bark dark grey to black, smooth

sometimes with small scales. Leaves simple, elliptic, ovate-elliptic, obovate-elliptic or ovate, coriaceous, rough, obtuse, mucronate or sometimes emarginated at apex, cuneate at base, glabrous or finely pubescent, 10-13.5 long, 3 cm wide. Inflorescence accompanied by the leaves, short, crowded corymbose; flowers green, sweetscent. Fruit globose up to 1.5 cm across, brown, warted. Flowers November-April; fruits January-July.

Habitat and Distribution

It is a short grass savanna species especially on sandy gravelly soils, in the Red Sea Hills, Kassala, Blue Nile, Kordofan, Darfur, Upper Nile, Equatoria and Bahr El Ghazal.

Uses

The timber is white and hard, used for firewood and handles of tools. Toothbrushes are made from twigs. Fruits are eaten by men and livestock especially during famine. Leaves fodder for animals, the fruits can be eaten after sweetening. Medicinally aqueous extract of the root is used for treating bilharzias, the leaves used as poultice for muscular pains and the fruit water extract against tuberculosis (El Ghazali, 1985), powdered roots mixed with milk are taken against gonorrhoea and urinary tract inflammations and the leaves mixed with sesame oil are used as anti-rheumatic (El Ghazali *et al.* 1994). The shrubs have environmental benefits.



Simple leaves, with ovate-elliptic blade shape



Plate 10: *Boscia senegalensis* (Pers.) Lam. ex Poir, (February 2007).

2. Genus: *Cadaba* Forsk., F1. Aegypt. Arab. : 67 (1775); Pax & K. Hoffm. in E. & P.Pf., ed. 2, 17B : 185 (1936).

1. *Cadaba rotundifolia* Forssk., F1. Aegypt-Arab.:68 (1775). **Plate (11).**

Syn.: *Ca. farinosa* Forssk. (193-195; valaya); ***Ca. trifoliata*** Wight et Arn. (194-195).

Vern.: Kurmut (Ar.).

Shrub up to 2.5 m high. Branches densely covered with glandular hairs becoming glabrescent. Bark slightly smooth, dark-grey. Leaves simple, orbicular or ovate to elliptic, apex obtuse or rounded to retuse never mucronate, base rounded to subcordate, glabrous; petioles 1-1.7 cm long. Inflorescence dense short corymb; pedicels 1-1.2 cm long; outer sepals 7 -8 mm long glandular, tomentose on margins; petals absent; androphore 2- 3 mm long; stamens 5; filaments 16 cm long; gynophore 2 cm long. Fruit linear, slightly torulose, up to 5 cm long, 7 cm across, densely pubescent. Flowers October-April; Fruits May-July.

Habitat and Distribution

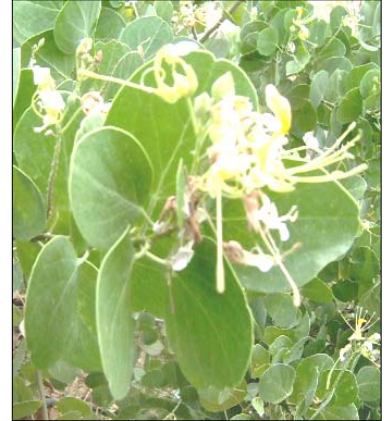
Short grass savanna, often growing on roots of various species of trees. In the Red Sea, Kassala, Northern Sudan, Blue Nile state (Kassab, Suki, Damazin), White Nile State, Kordofan and Darfur. The shrub is also found in Kenya, Ethiopia and Somalia.

Uses

The leaves of the shrub are a good fodder for camel. The plant is said to be powerful purgative. In the Blue Nile State, the dry leaves transformed to thick suspension after mixing with water, and then used for treating rheumatism (Reported by local, Damazein, Roseirs and El Nour or El Azaza village, 2007).



Twig with alternate simple leaves



**Twig with leaves and
inflorescence**

Plate 11: *Cadaba rotundifolia* Forssk., (June 2006).

**2. Genus: *Capparis* L., Sp. P1. : 503 (1753) & Gen. P1., ed. 5 : 222 (1754);
Pax & K. Hoffm. in E. & P.Pf., ed. 2, 17B : 172 (1936).**

Key to the species:

- A.** Fruits capsules, indehiscent, woody and hard when ripe; leaf-blade ovate-lanceolate.....***C. tomentosa***. Plate (13).
- AA.** Fruits Berries, fleshy, green turning to purplish when ripe; leaf-blade

linear lanceolate.....*C. decidua*. Plate (12).

1. *Capparis decidua* (Forssk.) Edgew., F.W. Andr., Fl. Pl. A.-E. Sudan 1: 41, fig. 33 (1950). **Plate (12)**.

Syn.: *Sodada deciduas* Forssk. Fl. Aegypt-Arab:81 (1775); *Capparis aphylla* Hayne, ex Roth. Nov. Pl. Sp.: 238 (1821).

Vern.: **Tundub** (Ar.).

Armed much-branched shrub or small tree up to 3 m high. Bark smooth green when young turning to deeply fissured whitish grey when old. Branches with stipular prickles, brown-yellowish. Leaves simple, blade linear or linear-lanceolate; petioles about 1 mm long, glabrous, leafless except on young shoots. Inflorescence lateral and terminal corymbose racemes; flowers pink; pedicel about 1 cm long; sepals unequal, anterior outer sepals larger and deeply saccate, slightly imbricate or subvalvate (at least the 2 outer); gynophore 1-2 cm long. Fruits berries, globose, pointed, pink when ripe, edible; seeds many. Flowers December-March; fruits March-May.

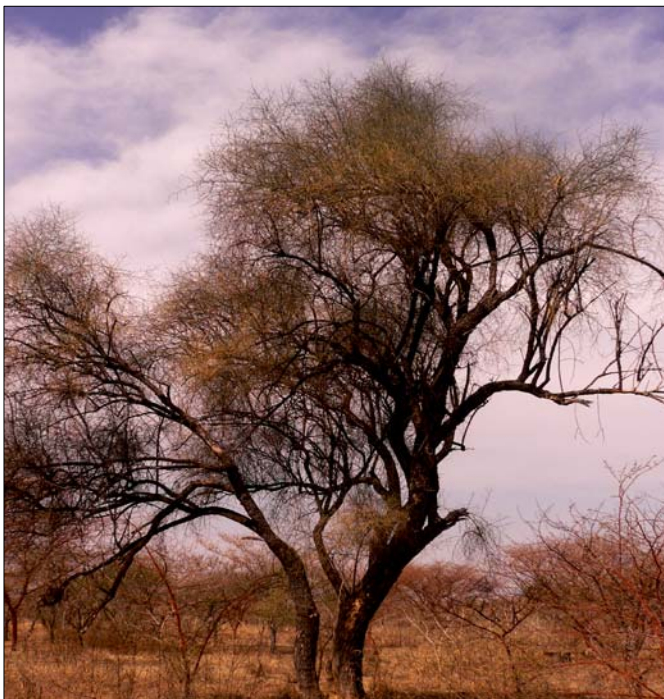
Habitat and Distribution

Low land plains, desert and semi-desert of Northern and Central Sudan, especially on sandy soils and in low rainfall savanna on clays spreading as far southwards as Bahr El Ghazal, sometimes mixed with *A. seyal* or *Balanites aegyptiaca*. It is found as scattered shrubs in El Nour (El Azaza) natural forest reserve.

Uses

The aqueous extract of the stems is used against jaundice, where as the stems are used as a poultice for swelling and joint pains (El Ghazali, 1985). The poultices of the twigs are used against head-ache and the fumigant of the stems are used as anti-rheumatic. Green branches are used for stringent, cardiac problems, boils, swelling, and tooth-ache, as laxative, diaphoretic,

anthelmintic, cough, athma, inflammation and fever (El Ghazali, *et al* 1994).



**Branches with stipular
prickles**



Plate 12: *Capparis decidua* (Forssk.) Edgew, (January 2007).

2. *Capparis tomentosa* Lam., Encycl. 1: 606 (1785); F.W. Andr., Fl. Pl. A.-E. Sudan 1: 41, fig. 33 (1950). **Plate (13).**

Syn.: *C. polymorpha* A. Rich., Fl. Seneg. 1:24, t. 5 (1831).; *C. biloba* Hutch. & Dalz., F.T.W. A. 1:85 (1932).

Vern.: Irg Al Gulum, Sheibait, Murdu and Takhreit (Ar.).

Armed scrambling shrub or small trees up to 10 m high. Young branches green and tomentose becoming brown, straight and glabrous;

stipular spines curved. Bark whitish grey and finely fissured. Leaves simple ovate, ovate-lanceolate, elliptic or elliptic-lanceolate; petiole 4-12 mm long. Inflorescence clusters on terminal branches or on short leafy lateral branches; pedicels 1.5-5 cm long, densely yellow brownish tomentose outside; petals 5 oblong; stamens many, whitish or pinkish or with a crimson base; gynophore 2.5-5 cm long, stout in fruit. Fruit indehiscent capsules, globose, orange brownish, smooth; seeds many, embedded in pinkish flesh. Flowers November-March; fruits March-October.

Habitat and Distribution

Tall grass savanna, near water courses. Common on terminate hills. In Northern Sudan (Atbara), Red Sea, Blue Nile (Disa), Kordofan (Nuba Mts., J. Dair), and Equatoria provinces (Torit).

Uses

The use of the leaves as a fodder is controversial as they are poisonous to camels. The pounded leaves are used locally for ophthalmia. Chewed leaves are used against snake bites and other local medicinal treatment (El Amin, 1990).



Twig with, simple leaves and flowers



Plate 13: *Capparis tomentosa* Lam, (February 2007).

4. Genus: *Crateva* L., Sp. Pl.: 444 (1753) & Gen. Pl., ed. 5: 203 (1754).

1. *Crateva adansonii* DC. Prodr. 1: 243 (1824); F.W.T.A. 1: 86 (1927).

Syn.: *Cr. religiosa* Oliv.F.T.E.A. 1: 99 (1868). Plate (14).

Vern.: Dabker Um Bukheisa (Ar.).

Deciduous tree 6-15 m high. Crown round, loose. Bark smooth and light grey in colour. Leaves 3-foliolate, petiolate; leaflets ovate-lanceolate, shortly petiolate, elliptic or elliptic-lanceolate, acuminate at the apex, cuneate at the

base, glabrous. Flowers are arranging in corymbs inflorescence; sepals 4, deltoid or lanceolate; petals 4, ovate, the 2 adaxial ones generally the larger, clawed, white or yellowish; stamens white with purplish anthers. Fruits capsule, spherical, 4-5 cm diameter, yellow or pale brown on a long gynophore, pericarp hard and yellow; seeds numerous, dark brown, kidney shaped. Flowers August-September; fruits January-September.

Habitat and distribution

Common to savanna zone and widespread in Kassala, Blue Nile State, S. Kordofan, S. Darfur, Upper Nile and Equatoria.

Uses

The wood is yellowish-white and soft. It is used locally for saddles, cart wheels, mortars and tools, also for furniture, doors, windows, shelters and for firewood and charcoal.



Trifoliolate leaves



Shrubs with foliated and flowered crown

Plate 14: *Crateva adansonii* DC., (June 2006).

5. Genus: *Maerua* Forssk., Fl. Aegypt. Arab. : 104 (1775); Pax & K. Hoffm. in E. & P. Pf., ed. 2, 17B : 195 (1936).

1. *Maerua angolensis* DC., Prodr. 1: 254 (1824); F.W.T.A. ed. 2, 1 : 88 (1954); K.T.S.: 125 (1961). **Plate (15).**

Syn.: *M. tomentosa* Pax., E. J. 14:305 (1891), *M. bukobensis* Guill. & Bened., E. J. 53:255 (1915); T.T.C.L. : 119 (1949).

Vern.: Shagar ElZaraf (Kordofan), **Shagar ElDud** (Fung.), **Rauerau**

(Kordofan at Birket).

Small tree up to 10 m high. Crown spreading with branches drooping, spotted with white round lenticels. Bark smooth greyish white. Leaves simple ovate, elliptic or ovate-elliptic, coriaceous; petioles 1-3 cm long. Inflorescence terminal or axillary leafy short corymbose racemes; pedicels 8 - 12 cm long; sepals 4, white to pale green, about 1.25 cm long; petals absent; stamens many, white with yellow anthers. Fruit cylindrical capsules, torulose, up to 22 cm long, verrucose, glabrous and yellow-brown; seeds 10-20, orbicular, surrounded by pulp. Flowers September-January; fruits March-April.

Habitat and Distribution

In dry short grass savanna. In Kassala, Red Sea Hills (Erkowit), Blue Nile State (Disa), White Nile, Kordofan (J. El Dair), Darfur (Nyrtete, Tora), Upper Nile and Equatoria province.

Uses

Wood is yellowish, hard, fine grained, heavy, takes good polish but brittle, used for handles of equipment and cabinet making. Leaves are eaten by sheeps and goats. An application of leaves relieves pain and is used for the treatment of rheumatism. The ash from burnt twigs and leaves yield salt (El Amin, 1990).



Twig showing simple ovate



Plate 15: *Maerua angolensis* DC., (February 2007).

8. Family: Combretaceae

Trees, shrubs, subshrubs or climbers. Leaves simple opposite, whorled or alternate, exstipulate and entire. Inflorescence axillary or supra-axillary spikes or racemes or axillary and terminal panicles; flowers hermaphrodite or hermaphrodite and staminate on the same inflorescence; sepals and petals 4 or 5 or absent.; stamens usually twice as many as the petals , biserrate or rarely uniserrate; anthers versatile styles usually free; ovary inferior, 1-locular;

ovules 2, pendulous, anatropus. Fruit variable in shape and size, fleshy or dry, stipulate or sessile, usually indehiscent, often winged, 1- seeded.

Key to the genera:

A. Fruits with 2-winged.....*Anogeissus* and *Terminalia*.

B. Fruits winged in cone-like.....*Anogeissus*.

BB. Fruits not in cone-like.....*Terminalia*.

AA. Fruits 4-5-winged.....*Combretum*.

1. Genus: *Anogeissus* (DC.) Wall.

1. *Anogeissus leiocarpus* (DC.) Guill. & Perr., F. T. A. 2: 418 (1927). **Plate (16).**

Syn.: *A. schimperi* Hochst. ex Hutch. & Dalz., F. W. T. A. edl. 1:227 (1927).

Conocarpus leiocarpus DC. Prod. 3:16 (1828).

Vern.: **Sahab or Seilag** (Ar.)

A medium sized to large tree up to 20 m high. Bark greyish white, becoming very dark grey, scaly in old trees. Branches often drooping and slender; branchlets softly pubescent. Leaves light green, alternate, rarely opposite or subopposite; elliptic to ovate-lanceolate, 2-8 cm long, 1.3-5 cm wide; densely silky becoming pubescent beneath. Flowers in globose head. Inflorescence small, greenish-yellow in colour; petals absent. Fruits in globose or subglobose cone-like heads, coriaceous, broadly winged brownish-yellow to dark grey. Flowers June-October; fruits July-February.

Habitat and Distribution

Deep light soils or alluvial sites along streams, rivers and valleys. Survive best in well drained light soils, and it is constitute of gallery forests on high rainfall savanna. It is found in Kassala, Kordofan, Darfur, Blue Nile, Upper Nile, Bahr El Ghazal and Equatoria.

Uses

Sapwood is greyish white; heartwood dark brown, very hard (Thirakul, 1984). Infusion of the boiled powdered leaves is used to dye fabric yellow. The wood is used mainly in the round for transmission and building poles, fence posts, forked poles, tool handles, axiles and as beams in local building and bridges construction. It is also used for firewood and charcoal. The leaves and bark contain a tanning material and are recognized by the Sudan Tanning Industry (Sahni, 1968.; El Amin, 1990).



Twigs with alternate leaves



Plate 16: *Anogeissus leiocarpus* (DC.) Guill. & Perr., (June 2006).

2. Genus: *Combretum* L.

Key to species:

A. Leaves simple verticillate, 3-whorled.....*C. glutinosum*, *C. lamprocarpum*, *C. molle*, *C. hartmannianum* and *C. aculeatum*.

B. Shrubs or scrambling.....*C. aculeatum*. Plate (17).

BB. Not shrubs.....*C. glutinosum*, *C. lamprocarpum*, *C. molle* and *C. hartmannianum*.

C. Fruits 4-winged.....*C. glutinosum*, *C. lamprocarpum* and *C. hartmannianum*.

D. Winged fruits yellow in colour...*C. glutinosum* and *C. hartmannianum*.

E. Bark rough rectangular, brownish in colour
.....*C. glutinosum*. Plate (19).

EE. Bark not as above, irregular
scales.....*C. hartmannianum*. Plate (20).

DD. Winged fruits dark brown to brownish in
colour.....*C. lamprocarpum*. Plate (21).

CC. Fruits 5-winged.....*C. molle*. Plate (22).

AA. Leaves simple verticillate in 4-whorl..... *C. ghasalense*. Plate (18).

1. *Combretum aculeatum* Vent., in F. T. E. A. Vol, page 1 (1973) Author: G. E. WICKENS. **Plate (17).**

Syn.: *C. Ovale* G. Don., T. L. S. 15: 434 (1827).; *Poivrea aculeata* (Vent.) DC., Prodr. 3: 18 (1843).

Vern.: **Shekheit** (Fung), **Shuheit** (Dongola).

A scandent or scrambling shrub with lax branches, 2-5 m high. Bark on the young stems and branches grey brownish, pubescent; older branches brownish white, covered with recurved spines of the old petioles. Leaves simple alternate or subopposite, elliptic, pubescent on both sides and ciliate margins; apex rounded, shortly acuminate, base cuneate. Inflorescence axillary racemes. Flowers brownish white or grey, scented; sepals deltate, densely pubescent; petals oblanceolate, lightly pubescent externally; stamens 4-9 mm long; anthers orange. Fruit 5-winged, obovate; wings papyraceous, whitish brown. Flowers March-June; fruits July-October.

Habitat and distribution

Wide spread in the *Terminalia-Combretum* belt within the tall grass savanna in Central and Southern Sudan. Usually found in sandy or loamy

soils, in areas of rainfall 550 mm and above.

Uses

The wood no much is known for its structure, but used in Central Sudan as firewood. The roots are used by the locals as a purgative.



Multi-stemmed shrub with light leaved crown



Twig with alternate leaves and flowering buds



Twig showing inflorescens



5- Winged papyrous fruits

Plate 17: *Combretum aculeatum* Vent., (June 2006).

2. *Combretum ghasalense* Engl. & Diels., in F. W. T. A. Vol 1, part 1 (1973)

Author: G. E. Wickens. **Plate (18).**

Syn.: *C. fragrans* F. Hoffm., in Burkill, H.M. 1985. The useful plants of west tropical Africa, Vol 1.

Vern.: **Habeel Um Ismaeel** (Fung) and (Ar.).

Tree up to 10 m high. Crown irregular or narrowly triangular, light, open. Branches oblique ascending, branching low down at the ends. Bole straight, cylindrical, slightly twisted in the drier savanna regions. Bark greyish to dark grey, flaking off in long irregular patches, leaving lighter coloured bark. Leaves simple, opposite or ternate, verticillate, 4-whorled; blade oblanceolate to lanceolate-elliptic; petiole slender and slightly twisted.; apex broadly cuneate to obtuse, base attenuate-cuneate, margin entire sometimes wavy, dark green on both surface, thinly coriaceous, glabrous; midrib prominent in both side, secondary nerves upcurving and usually with the tufts of hairs at the base, compatodrome. Flowers, in spikes 4-5 cm long, cream or yellow in colour, sweet smelling. Fruits 4-winged red and glutinous when young, ultimately pale to dark brown. The flowers November-February; and the fruits February-March.

Habitat and Distribution

High and low rainfall savanna, loamy soils in central and Southern regions. In Blue Nile, Kordofan, Darfur, Bahr El Ghazal and Equatoria. The tree is found in small number within the Azaza natural forest reserve.

Uses

The species is closely similar to *Combretum glutinosum*, can be recognized by its long petiole leaves with markedly subopposite or ternate arrangement. The wood is pale brown and hard, and used locally as building materials, tool handles, mortars, and sometimes for furniture. The aqueous extract from bark in treating stomach diseases. The different parts of the tree are medicinally benefits (reported by local in Azaza village, 2007).



Small tree with flabellate crown



Twig with verticillate leaves



Twig of 4- winged brown fruits



Axillary Spike inflorescence

Plate 18: *Combretum ghasalense* Engl. & Diels., (February 2007).

3. *Combretum glutinosum* Perr. ex DC., in Roy. Bot. Gard. Kew, Lond, Engl UK, K000232552; Verified by Jongkind, C., 01-1991. **Plate (19).**

Syn.: *C. cordofanum* Engl. & Diels., in Engl. Mon. fr. P1. 3:50, t, 14 (1899).

Vern.: **Habil Khrisha, Habil El Gebel** (Ar.).

Small tree 7-10 m high. Bark grey, smooth and some times scaling into dark plates. Leaves simple, verticillate in 3-whord, opposite or sub-opposite, elliptic, thick, coriaceous and glutinous; petioles hairy 1 cm long. Inflorescence axillary panicles 4-5 cm long; flowers 4-merous greenish brown, densely hairy; 1.5 mm long. Fruit ovate angular, 4- winged, 1- seeded, 2.5-3.5 x 2 cm, truncate at base, puberulous. Flowers December-March; Fruits April.

Habitat and Distribution

It is found in the southern parts of the short grass savanna zone and extending southwards in the tall grass savanna in the Central Sudan. It tends to prefer light silty or loamy soils. Found in Central and Southern Sudan, in Southern Darfur, Kordofan, Jebel Marra, Nuba Mountains and Equatoria.

Uses

The timber is whitish yellow, hard and heavy. It is used for firewood, charcoal, poles for local building and fence posts. Roots and bark are used to dye fabrics yellow (El Amin, 1990). The leaves and young branches are good fodder for animals.



Tree with round, triangular crown



Rough, rectangularly fissured bark



**Imparipinnate leaf,
opposite, elliptic-ovate**



Axillary panicle inflorescence



4- Winged brownish fruits

Plate 19: *Combretum glutinosum* Perr. ex DC, (January 2007).

4. *Combretum hartmannianum* Schweinf., Beitr. Fl. Aethiop. 24, t. 3 (1867).
Plate (20).

Syn.: *C. denhardtiorum* Engl. & Diels. *C. leuconili* Schweinf.

Vern.: **Habil El Gebel, Habila and Subagh soda** (Ar.).

Medium sized tree up to 10 m high. Bark is grey with small irregular scales. Leaves simple, verticillate in 3-whorl, opposite or subopposite, lanceolate, cordate, elliptic, apex acuminate-caudate, margin undulating, base rounded, cuneate, glabrous, glossy punctuate; petiole punctuate, 1-2.5 cm long. Inflorescence short axillary spikes; flowers small; calyx 4-lobed, petals 4, minute, orbicular, shortly clawed; stamens 8 in 2 rows. Fruit 1-seeded, 4-winged about 3 x 2.5 cm, wing 1 cm broad, glutinous when young turning to yellow when ripe. Flowers January-May; Fruits April-May.

Habitat and Distribution

Rocky hills slopes and low land plains. Found in the tall grass savanna zone on clay or loamy soils. Existing as solitary trees in Central Sudan, Southern Kordofan, Darfur, Red Sea Hills, Southern Kassala, Bahr El Ghazal, Upper Nile and Equatoria (El Amin, 1990).

Uses

It is used mainly for firewood and charcoal. It is used locally for fence posts and the framework of arched houses. Root and bark are used to dye fabric yellow (Sahni, 1968). Medicinally the boiled leaves are used to cure asities (Reported by locals, El Nour village 2007). Aqueous extract of the bark is used for jaundice, while the infusions of the leaves are used locally against jaundice (El Ghazali, 1985, El Ghazali *et al*, 1994).



Large tree with dense rounded crown



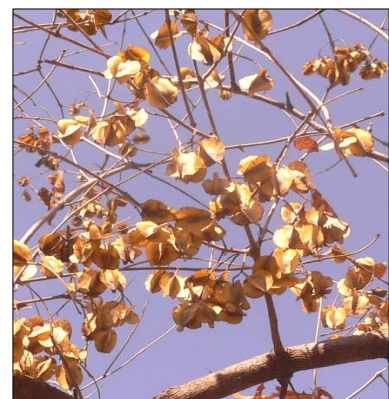
Twig with 3-whorled leaves, and long cuspidate apex



Axillary spike inflorescence



Bark with small irregular scales



4- Winged fruit

Plate 20: *Combretum hartmannianum* Schweinf, (June 2006).

5. *Combretum lamprocarpum* Diels., in Engl. Bot. Jahrb. 39: 500 (1907).
Plate (21).

Syn.: *C. kerstingii* Engl. & Diels.; in Engl. Bot. Jahrb 39: 499 (1907).

Vern.: **Habeel El Gouruz** (Fung, Ar.)

Shrub or small tree up to 7 m high. Crown spreading, much-branched, fairly dense. Branches spreading usually low down. Bole short, often divided from the lower portion forming shrubby habit. Bark grey to dark grey, fissured, peeling off in ragged strip leaving a red-brown powder under rhytidome. Twigs angular, more or less stout softly grey-pubescent. Leaves simple, verticillate in 3-whorl, rarely in four; petiole short slender and flattened on the upper surface; blade oblanceolate to oblong-oblanceolate, apex obtuse-retuse, base cuneate and margin entire, thick, coriaceous, glossy and dark green above, pale green and grey puberulous beneath. Flowers in spikes, at leaf-axils, greenish white to cream. Fruits 4-winged, the wings greenish at first turning to brownish green tinged red. Flowers January-February; and fruits January-March.

Habitat and Distribution

Low land plains, a widespread shrubby species of Southern Sudan. The species is now spreading through the Blue Nile State, Darfur and Kordofan (Personal contact, 2006).

Uses

The species has an environmental effects through the soil conservation particularly in the lowlands. The wood can be used in local building, tools handle. Some parts of the species have medicinal uses, particularly leaves and bark (Personal contact, 2006).



Tree with rounded crown



Twig with 3-whorled leaves



Rough and finely fissured bark



**Spike inflorescence, with
creamy flowers**

Plate 21: *Combretum lamprocarpum* Diels., (February 2007).

6. *Combretum molle* R. Br. Ex G. Don., In F. T. E. A, Vol 1, page 1 (1973)

Author: G. E. WICKENS. **Plate (22).**

Syn.: *C. trichanthum* Fresen., Mus. Senckenb. 2:155 (1837); *C. gueinzii* Sond. Linnaea 23:43 (1850)

Vern.: **Habeel Khrisha Kabira** (Fung) and (Ar.).

Small tree or shrub 5-17 m high. Bark dark grey to black, rough, reticulately fissured. Leaves opposite or verticillate, in 3-whorl, coriaceous sometimes papery, lanceolate-elliptic or obovate elliptic up to 21 x 12.5 cm; scales white or reddish, often hidden by indumentum; petioles swollen, hairy, 5 mm long. Inflorescence axillary spikes; flowers yellow or greenish yellow, fragrant; sepals deltate; petals minute or absent, irregularly obovate-deltate to reniform, ciliate. Fruits sub-globose to elliptic, winged, 1.3-2.5 x 1.5-2.5 cm, yellow to yellow-brown, and tomentose to nearly glabrous. Flowers October-December.; fruits November-March.

Habitat and Distribution

Gravelly soil in mountains areas in high rainfall savanna. In South kordofan (Jebel El Daier), Equatoria (katire, Mangalla, Loba, Imatong Mts), Bahr El Ghazal (River Busseri) and Kassala (J. Kassala).

Uses

The timber resembles the other *Combretum* species and is used in South Kordofan for building local huts. Beni Amer ladies in Kassala use the burnt leaves as aromatic smoke (El Amin, 1990).



Tree with umbelliform crown



Obovate-lanceolate leaves



Axillary spike inflorescence



Dark grey rectangularly fissured bark



Yellowish 4- winged fruits

Plate 22: *Combretum molle* R. Br. Ex G, (June 2006).

3. Genus: *Terminalia* L., in F. T. E. A, Vol 1, page 1 (1973) Author: G. E. Wickens.

Key to species:

A. Fruit 2-wings broadly elliptic-ovate, reddish purple turning to dark brown when ripe.....*Terminalia brownii*. Plate(23).

AA. Fruit 2-wings oblong to oblong-elliptic yellow brown when ripe.....*Terminalia laxiflora*. Plate (24).

1. *Terminalia brownii* Fresen., in U. P. W. T. A, Vol 1, Burkill, H.M. (1985). **Plate (23).**

Syn.: *T. brownii* Fresen., var. *albertensis* Bagshawe & Bak. F., J. B. 46:7 (1908).; *T. semlikiensis* Dewild; Pl. Bequaert. 4:346 (1928).

Vern.: Subagh, Darot, Subaraya (Ar.).

Tree 7-25 m high. Young bark smooth, whitish, becoming greyish longitudinally fissured in old trees. Young shoots tomentose becoming glabrous. Leaves spirally arranged, tufted at the ends of branches, broadly obovate-elliptic, apex obtuse to acuminate, base rounded to cuneate at the equal base, tomentose when young becoming pilose beneath. Petiole about 1.5-4 cm long. Inflorescence axillary spikes; flowers white-cream, with strong unpleasant smelling, fragrant, glabrous. Fruit broadly elliptic to ovate 2-winged, reddish purple turning to brown when ripe, with obtuse to rounded apex and acute to obtuse base. Flowers February-June.; fruits October-March.

Habitat and Distribution

Rocky hill slopes and low land plains. In high rainfall savanna and on loamy soil of Central and Southern Sudan. Widespread in southern Darfur, Kordofan, Blue Nile and Kassala State.

Uses

The wood is yellow brown, medium-hard, strong and durable. The wood provides an excellent building material and is used in local construction, beams and rafters, firewood and charcoal (Vogt, 1995). Medicinally the barks are used for cough and bronchitis and fumigant is used for rheumatism (El Ghazali, 1997). The young leaves are a good fodder for livestock.



Large tree with dense rounded crown



Alternate leaves and axillary slender spikes, white flowers



Longitudinally fissured bark



Samara oblong-lanceolate, oblong-elliptic, brown fruits

Plate 23: *Terminalia brownii* Fresen., (June 2006).

2. *Terminalia laxiflora* Engl. & Diels., In E. M. 4:12 (1900). **Plate (24).**

Syn.: *T. schweinfurthii* Engle. & Diels., E. M. 4:12 (1900).

Vern.: **Darout or Sufaraya** (Ar.).

Tree up to 10 m high. Bark dark grey to black, deeply anastomosis fissured in old trees. Branches grey to brown, glabrous. Leaves simple spirally arranged, elliptic or broadly lanceolate or elliptic oblong, 13-30 long, 4.5-9.5 cm wide, apex rounded to obtuse or shortly acuminate, base cuneate; petioles 3 cm long. Inflorescence of axillary slender spikes; flowers white or cream, fragrant, densely tomentose. Fruit oblong to oblong-elliptic, 2-winged, 5-8 x 2.5-3.5 cm, yellow brown. Flowers February-May; Fruits March-December.

Habitat and Distribution

High rainfall savanna in black loamy soil. The species is found in Darfur (J. Marraa), Kordofan (J. Daier, Nuba Mts), Blue Nile State, S. Kassala, Upper Nile, Bahr l Ghazal and Equatoria.

Uses

The wood like the other *Terminalia*, yellow and hard and can be used as a sawing timber for railway sleeper. It is used locally in huts building, charcoal and firewood. Roots are used for darkening bark cloth. Charcoal is used for smelting iron. The leaves and twigs are a good fodder for animals.



Plate 24: *Terminalia laxiflora* Engl. & Diels., (February 2007).

9. Family: Fabaceae (Leguminosae)

9.1. Sub-family: Caesalpinioideae (Caesalpinaceae)

Trees, shrubs, often lianes or rarely herbs, unarmed or often armed. Leaves usually bipinnate, rarely unifoliolate or simple. Inflorescence usually of spike racemes or panicles of racemes; flowers usually zygomorphic, hermaphrodite or unisexual; sepals usually imbricate, rarely valvate, free or united; petals imbricate in bud, usually with the dorsal one within and overlapped by the adjacent lateral ones, free or united; anthers various; ovules anatropous. Fruit pods or legumes; seeds generally with apical or sub-apical hilum.

Key to the genera:

A. Leaves compound.....*Tamarindus* and *Cassia*

B. Leaves bipinnate; large petals 3; fertile stamens.....*Tamarindus*.

BB. Leaves nonpinnate; Petals usual 5..... *Cassia*.

AA. Leaves simple, bilobed; flowers unisexual.....*Piliostigma*.

1. Genus: *Cassia* L., Sp. Pl.: 376 (1753) & Gen. Pl., ed. 5: 178 (1754).

1. *Cassia arereh* Del., F.T.A. 2:270; Benth. I.c. 517. **Plate (25)**.

Syn.: *Cassia marginata* Roxb.,

Vern.: **Shajar Al Gaga** (Fung.) and (Ar).

Small trees or shrubs and resembles to *Cassia sieberiana*. Crown rounded some times umbelliform. Bark slightly fissured, grey-brownish. Leaves imparipinnate, leaflets 7-9 pairs, ovate-elliptic, margin entire. Inflorescence terminal, short; racemes; petals yellow. Fruits cylindrical pods, brown, longitudinally dehiscent; seeds numerous surrounded by green pulp, dark brown in colour. Flowers March - April; fruits May.

Habitat and Distribution

In tall grass savanna of the Northern State, Blue Nile State, Kordofan,

Bahr El Ghazal and Equatoria.

Uses

In Agri-horticulture as as ornamental and cultivated or partially tended. The fruit-plup as laxative. Locally the species is highly exploited by herbalists for local medicine (fabrifuges; venereal diseases) mainly the roots of the mature trees. In phytochemistry the fish-poisons can be extracted from roots and fruit-pod. The stem-bark against cutaneous and subcutaneous (under skin) parasitic infection (Burkill, 1985). The aqueous extract from the leaves is used for stomach pains (Personal contact).



Plate 25: *Cassia arereh* Del., (June 2007).

2. Genus: *Piliostigma* Hochst., in F. T. E. A, Vol, page 1 (1967) Author: J. P. M. Brenan.

1. *Piliostigma reticulatum* (DC.) Hochst., in F.T.W.A 29 (1846). **Plate (26).**

Syn.: *Bauhinia reticulata* DC.; F. T. A. 2: 291. (1846).

Vern.: Abu Khemeira, Harub, Kharub, Tambarib and Khuf el Gamal (Ar.).

Evergreen sometimes deciduous shrub or small tree with a twisted bole up to 9 m high, and a bushy spherical canopy. Bark dark grey to brown, fibrous and corky, slash dark red. Leaves simple large, thick, leathery, grey-green; split in half in camel-hoof shape, apex bilobate, obtuse; 9 palmate conspicuous central nerves. Flowers dioecious clustered in short, hairy, axillary racemes measuring 4-5 cm; petals white with pink stripes. Fruits indehiscent pod, large, long, straight, undulate or twisted and hard, either glabrous or sparsely pubescent and brown in colour when ripe. Flowers August-September; fruits November-February.

Habitat and Distribution

Common in fallows, often in well watered sites along water courses, around ponds and in flood plains. Found on various kinds of soils from sandy to clay.

Uses

Leaves used for drinks. Bark used for cordage Twigs and leaves are consumed by cattle, sheep and goats, the latter prefer pods. Bark contains 18 % tannins, wood reddish, darkening to brown, attacked by various insects including termites. A blue dye is obtained from the pounded roots, seeds and pods. Tea from the leaves to treat colds, bark is astringent and used against diarrhoea and dysentery; leaves and bark have haemostatic and antiseptic properties, cures also boils, wounds and syphilitic cancer. Other medical uses are against coughs, bronchitis, malaria, hepato-biliary ailments, hydropsy, sterility, rachitis and kwashiorkor (Burkill, 1985).



Plate 26: *Piliostigma reticulatum* (DC.) Hochst., (February 2007).

3. Genus: *Tamarindus* L., in F. T. E. A, Vol , page 1 (1967) Author: J. P. M. Brenan.

1. *Tamarindus indica* L., Sp. Pl.: 34 (1753). Plate (27).

Syn.: *T. occidentalis* Gaertn.; *T. officinalis* Hook., in www.desert-tropicals.com/Plants/Fabaceae/Tamarindus_indica.html - 9k

Vern.: **Aradeib, TamrHindi** (Ar.).

Evergreen trees up to 20 m high in favorable ecological condition. Crown rounded, dense compact. Bark is pale grey, rough, finely fissured, cracking off longitudinally in small thin rectangular patches. Leaves imparipinnate, alternate. Flower buds red; sepals 4.8-12 mm long, pale yellow inside, reddish outside. Fruits curved or straight, sausage-like pods, obtuse above and bellow, sometimes irregularly constricted, closely covered outside with brown scurf and a brittle pale brown shell. Flowers August-December; fruits March-May.

Habitat and Distribution

Near Khors and valleys in tall grass savanna, usually of rainfall above 500 mm. it is common to terminate mounds. Distributed in the southern parts of Central Sudan from east to West, and continuing southwards to the Southern region (El Amin, 1990).

Uses

The sapwood is pale yellow; heartwood purple-brown, very hard, heavy, tough, fine grained and resists the insect attacks. The wood in house utensils, furniture, cabinet work, pestles and mortar, tool handles, constructional work, house posts, boat building, carts and oil mills. The bark contains 7.1% tannins. The fruit edible with sweet pulp, and made into fresh cooling drink. The oil from the seeds used as varnish. The tree is a host of silk worm that made into fabrics. The roots are used for chest complaints. The leaves are used in curries while the seeds powder mixed with gum Arabic gives a very good adhesive. The tree has a decorative and shade values in gardens and avenues and also produces firewood and charcoal.

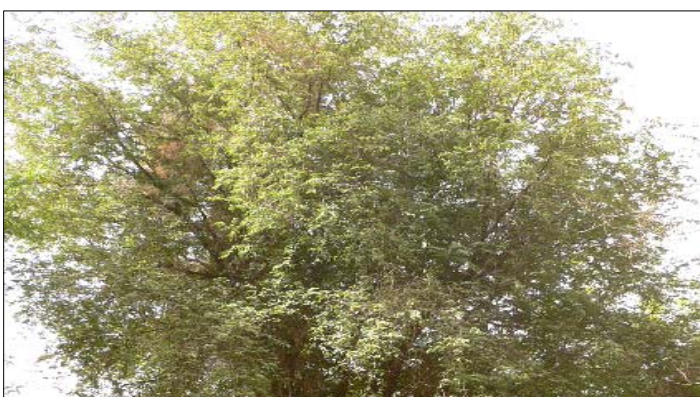


Plate 27: *Tamarindus indica* L., (February 2007).

9.2. Subfamily Mimosoideae (Mimosaceae)

1. Genus: *Acacia* Mill., Gard. Dict., abridge. Ed.: 4 (1975).

Key to species:

A. Prickles in pairs.....*Acacia seyal* var. *seyal*, *A. seyal* var. *fistula*, *A. polycantha*, *A. mellifera* and *A. nubica*.

B. Prickles straight and sylender....*A. seyal* var. *seyal*, *A. seyal* var. *fistula* and *A. nubica*.

C. Bark smooth and powdery....*A. seyal* var. *seyal* and *A. seyal* var. *fistula*.

D. Bark covers with white powder, smooth.....*Acacia seyal* var. *fistula*. Plate (30).

DD. Bark red, dark brown, greenish yellow or orange-red.....*Acacia seyal* var. *seyal*. Plate (31).

CC. Bark not powdery, rough, green to grey or white green.....*Acacia nubica*. Plate (32).

BB. Prickles in pairs strongly recurved..*Acacia polycantha* and *A. mellifera*.

E. Prickles totally dark brown to black, sharp and slightly small.....*A. mellifera* plate (33).

EE. Prickles dark brown at the tip, sharp and slightly big.....*A. polycantha* Plate (28).

AA. Prickles three, recurved in each node.....*A. senegal*. Plate (31).

1. *Acacia polycantha* Willd., Sp. Pl. 4: 1079 (1806), subspecies. *Campylacantha* (Hochst. ex A. Rich.) Brenan., K. B. 1956 : 195 (1956); F.W.T.A.,ed. 2, 1: 499 (1958). **Plate (28).**

Syn.: *A. campylacantha* (Hochst. ex) A. Rich., Cent. FL. Abyss. 1: 242 (1847).

Vern.: Kakamoot (Ar.).

Tree up to 15 m high. Bark yellow-brown, flaking or fissured; stipules

non-spinescent; prickles below nodes in pairs, falcate, 0.4-1.3 cm long, yellow or brown blackish or base yellow and black tips, glabrous. Leaves 8 - 27 cm long; pinnae 3 -33 pairs; leaflets 13 -16 pairs, linear-oblong, 2-6 x 0.4- 1.25 mm. Inflorescence spicate, 7-11.5 cm long on pubescent peduncles 0.7- 3 cm long; flowers creamy white, sessile; sepals 1.8 x 0.8 mm, pubescent; petals 3 x 0.7 mm, glabrous; stamens 5 mm long, glandular. The fruit oblong dehiscent pods, brown, coraceous, glabrous; seeds rhombic to subcircular, brown; areoles crescent-shaped, central, 2 x 2 mm; funicles 4 mm long. Flowers August-September; Fruits December-March.

Habitat and Distribution

Gregarious along rivers and valleys on rich alluvial valleys in tall grass savanna, riverine and ground water forest of South Central Sudan.

Uses

The wood used as firewood and charcoal. The foliage is a good fodder for various animals. Some parts of the tree can be used locally as medicines. The gum is light brown in colour and is used locally for treating stomach complains. The small bole is used in a round as building materials. In recent time it is a promising tree for sawing timber.



Plate 28: *Acacia polycantha* Willd., (June 2006).

2. *Acacia senegal* (L.) Willd., Sp. Pl. 4: 1077 (1806). Plate (29).

Syn.: *Mimosa senegal* L., Sp. Pl.: 521 (1753); *Acacia companulata* Hochst.

T.S.K.: 69 (1936); *Acacia somalensis* sensu. T.T.C.L. 330 (1949).

Vern.: Hashab, Alloba (Ar.); Gum Arabic, Three thornes Acacia (Eng.).

Shrub or small tree, usually 2-12 m high. Bark yellow to light brown or grey, rough fissured or flocking. Prickles spine-scent in threes 2 lateral, pointing upwards or forwards and one central pointing downwards or backward. Leaves bi-imparipinnate 1-6 cm long, with small glandular petiole. Each leaf contains 1-5 pinnae and 8-18 pair of leaflets. Inflorescence made up of creamy flowers, more or less scented. Fruits: pods, brown to straw coloured dehiscent and membranous, compressed, flat. Seeds yellow or pale brown 2 -8 per pod. The tree has a diagnostic feature which is three thorns at each node. Flowers November-February; fruits January-April.

Habitat and Distribution

Low land plains. Widespread on sandy and clay plains in short grass savanna forming a continuous belt from east to west in central Sudan. More common on the western sand plains of Kordofan and Darfur as pure stands associated with *Acacia mellifera* (El Amin, 1990).

Uses

The wood is used for firewood, charcoal, local buildings, and fence post. The tree is used for soil stabilization, and dead hedging and making ropes from roots and bark, the tree is an important source of gum Arabic. Medicinally it is used to treat cold, stomachaches, diarrhea, hemorrhages, etc. The gum is used to cure urea ulcer and to stop diarrhea. The root decoction is slightly purgative, and is drunk in the case of constipation or for stomach-ache, and is also used for the treatment of gonorrhoea. A decoction of the bark is used to treat diarrhea and stomach disorders (Kokwaro, 1993).



Spike with, creamy flowers

Plate 29: *Acacia senegal* (L.), (June 2006).

3. *Acacia seyal* var. *fistula* (Schweinf.) Oliver. L.T.A.: 844; T.T.C.L.: 338 (1949). Plate (30).

Syn.: *Acacia fistula* (Schweinf.) in *Linnaea* 35: 344 (1867-1868).

Vern.: Sufar Abiad (Ar.), Whistling Thorn (Eng.).

Tree 3-17 m high. Bark is powdery, smooth or sparsely flaking, whitish, greenish yellow or orange red. Leaves bi-imparipinnate, pinnae 3-9 pairs, alternate. Prickles whitish, in pairs in each node, swollen at the base by ant-galls. Flowers axillary globular heads, pedunculate, yellow in colour. Fruits are falcate, dehiscent pods. Flowers November-April; fruits January-May.

Habitat and Distribution

It is found on dark cracking clays on higher slopes of rivers and valleys on the hard clay plains of Central and Southeastern Sudan and on clay of seasonally wet depressions (El Amin, 1990)

Uses

The wood is used by local peoples, as fuel wood and for charcoal, hedging (live and dead). Flowers, seeds and leaves used as fodder (Reported by locals, Azaza village). Its wood is white-cream hard (Thirakul, 1984). It produces a good fuelwood and charcoal. The timber is used in construction but is susceptible to insect attack (Vogt, 1995).



Plate 30: *Acacia seyal* var. *fistula*. Schweinf.Oliver., (June 2006).

4. *Acacia seyal* var. *seyal* Del., Fl. Aegypt: 142, t, 52, Fig. 2 (1813). **Plate (31).**

Syn.: *A. fistula* (Schweinf.) in Linnaea 35: 344 (1867-8).

Vern.: Talih (Ar.), whistling Thorn (Eng.).

Tree up to 3-12 m high. Bark smooth, red brown. Young branchlet with numerous reddish glands, stipules spine-scent. The tree has diagnostic feature, the bark of the species is recognizable even at a distance with a pair of thorn, long slender and white. Leaves bi-imparipinnate, inflorescence capitate, yellow and pedunculate. Fruits pods, curved and dehiscent. Flowers November-April; fruits January-May.

Habitat and Distribution

Low land plains. Widespread on dark cracking clays on higher slopes of rivers and valleys on the hard clay plains of Central Sudan and on clay of seasonally wet depressions.

Uses

The wood is used as fuel wood and for charcoal, hedging (live and dead). The tree produces tannins and gum, which is inferior to gum from *Acacia Senegal*. The stem is used as aromatic smoke by women in Sudan to smoother and perfume their skins and give the skin a yellowish colour. Flowers, seeds and leaves used as fodder. Medicinally the tree is also used for rheumatic pains and to protect women against colds and fever two weeks after birth, where as the bark and leaves are used in treating gastric ulcers. In addition the gum is effective against rheumatis and inflammations of respiratory system (El Ghazali, 1985).





Tree with leafless crown and reddish-brown bark



Twig with prickles and inflorescence



Linear falcate pods

Plate 31: *Acacia seyal* var *seyal* Del., (June 2006).

5. *Acacia nubica* Benth, in Hook., Lond. Journ. Bot. 1:498 (1842). Plate (32).

Syn.: *A. virchowiana* Vatke., in Oesterr. Terr. Bot. Zeitschr. 30: 275 (1880);

A. merkeri Harms., in E. J. 36:208 (1905); *A. orfota* sensu., auct. Mult., e.g. L. A.: 839 (1930).

Vern. Laot (Ar.).

Shrub 1-5 m high, with basal branching. Bark smooth, green-grey or whitish green; stipules spinescent, straight, white with brown tips, pubescent. Leaves bi-paripinnate, alternate, pinnae 5-11 pairs, 1.5-1.8 cm long; leaflets 5-15 pairs. Inflorescence capitate on pubescent peduncle; floral bracts white to cream, spoon-like, 2 mm long; sepals pink, green-tipped, glabrous; stamens free, 5 mm long, red. Fruits straight pods, margin flattened into wing-like projections, yellow or straw-coloured, coriaceous, pubescent; seeds 10-12, longitudinal or oblique in pod, globose, wrinkled, and grey to olive-grey; areoles circular, closed, marginal; funicles, dark brown. Flowers November-January; fruits January-May.

Habitat and Distribution

Low land plains. In semi-desert or short grass savanna woodlands on dry hard clays on denuded, over-cultivated clay field in central and Northern Sudan.

Uses

The leaves are used as poultice for swelling. The root juice for scorpion bites (El-Ghazali, 1985). The smoke of stems and branches is used to cure rheumatism and backpains (El-Ghazali, *et al*, 1998). The ash from the burned plants is used as a protection against anthrax, while bark decoction taken as emetic (Kokwaro, 1993).

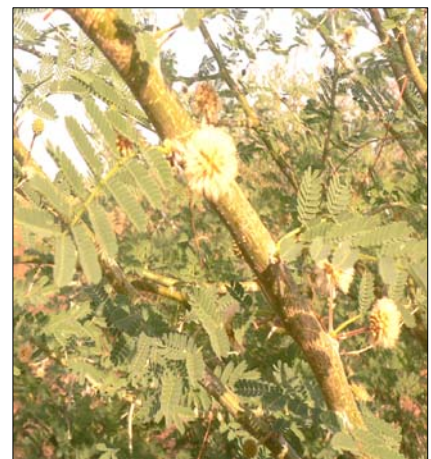


Plate 32: *Acacia nubica* Benth., (February 2007).

6. *Acacia mellifera* (Vahl.) Benth., in Hook., Lond. Journ. Bot. 1: 507 (1842); Kew Bull. 11: 191 (1956); T.S.K.: 67 (1963). **Plate (33).**

Synonym: *Mimosa mellifera* Vahl, symb. Bot. 3: 103 (1791); *Acacia*

Senegal (L.) Willd. subsp. *mellifera* (Vahl.), in Candollea 11: 153 (1948).

Vern.: Kitir (Ar.).

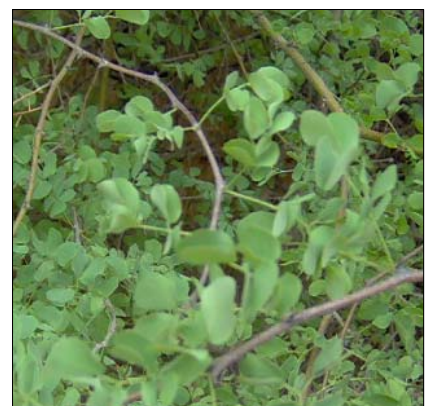
Shrub 1-9 m high much branched from base. Bark smooth grey to brown with white horizontal lenticels; stipules spinescent; prickles in pairs below each node, falcate or curved, brown to black. Leaves 2-3 cm long; pinnae 2 pairs, leaflets 1 pairs only stalked with 1 mm long stalk, obliquely obovate to obovate-elliptic. Inflorescence spicate, flowers white cream, pedicellate; sepals yellow to pinkish, glabrous; stamens free or united, glandular. Fruit membranous oblong straight dehiscent acuminate yellow straw-coloured pods; seeds 3-5 horizontal in pod, orbicular or ovate, areoles crescent-shaped, central; funicles. Flowers July-September; fruits January-March.

Habitat and Distribution

Low land plains. On dry hard clay soil plains forming pure stands, or in association with *A. leata*, *A. senegal*, *A. nubica* and *A. seyal*, in the clay plains of central Sudan.

Uses

The bark is boiled in water and the liquid used as a remedy for stomach trouble, clearing primary infection of syphilis sterility, malaria and pneumonia (Kokwaro, 1993). The species can be used as a life hedge in gardens and farms.





Rough bark with horizontal lenticels



Inflorescence with white flowers

Plate 33: *Acacia mellifera* (Vahl.) Benth., (February 2007).

2. Genus: *Albizzia* Durazz., Magazz. Tosc. 3 (4) (vol. 12): 10, 13, illust. (1772); F.T.E.A., Vol, page 1 (1959) Author: J. P. M. Brenan.

1. *Albizzia lebeck* (L.) Benth., in Hook. Lond. Journ. Bot. 3.87 (1844);

F.W.T.A., ed. 2, 1: 502 (1958). **Plate (34)**.

Syn.: *Mimosa lebbeck* L., Sp. PL.: 516 (1753); *Acaia lebbeck* (L.) Willd., Sp. P1. ed. 4, 4:1066 (1806).; DC. Prodr. 2:466 (1825).

Vern.: **Degn Al Basha Akder** (Ar.).

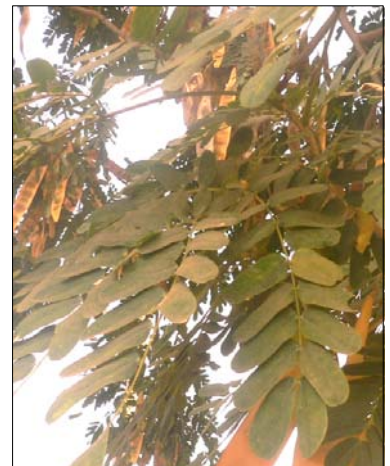
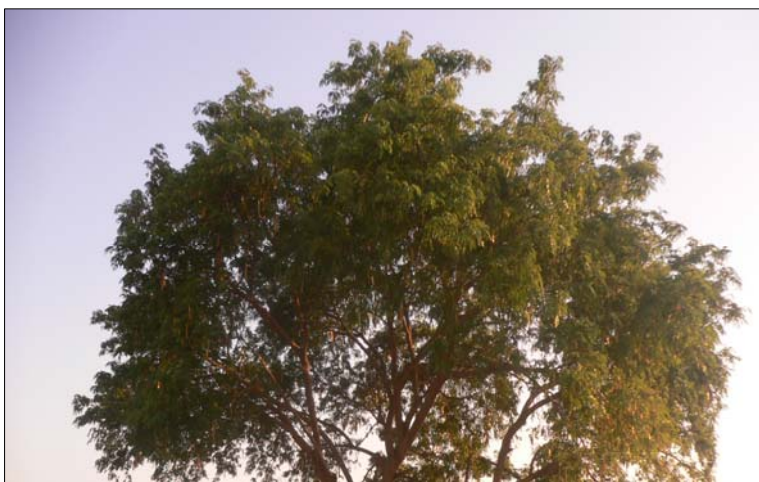
Tree 5-15 m high. Bark grey, rough, fissured, lenticellate in old age. Leaves bipinnate up 25 cm long; pinnae 2-4 pairs; leaflets 3-10 pairs, oblong or elliptic-oblong obovate, 2-4 x 2-4 cm. Flowers cream-white on round heads on peduncles 4 cm long; sepals about 3 mm long, pubescent; petals 8 mm long, glabrous; filaments pale green, 3 cm long. Fruit oblong flat pods, straw-coloured, glossy, coriaceous, glabrous; seeds brown. Flowers March-May; fruits May-August.

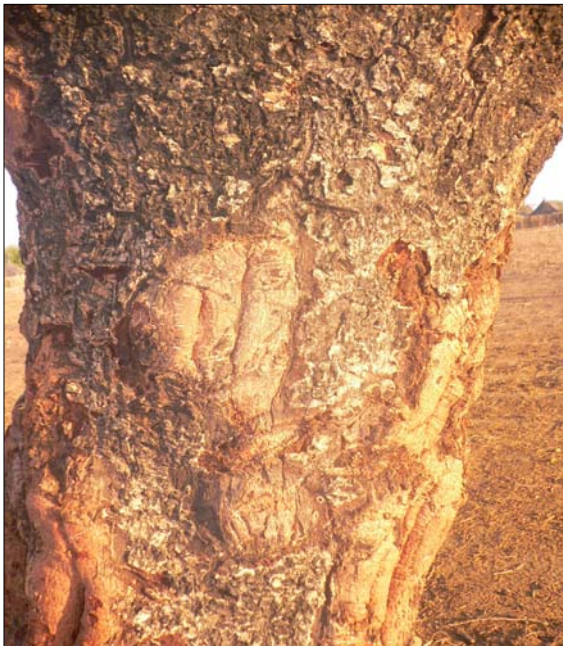
Habitat and Distribution

Low land plains. Introduced from India and growing in many parts of the Sudan, in public gardens, houses, roadside plantations and avenues.

Uses

The pods and foliage are good fodder for animals. The tree can be used as shade and avenue tree. Bark contains saponin, tannins and exudes some gums. The wood is used as firewood and in India it is used for furniture boats and for building purposes.





Shallowly fissured and lenticellate bark



Twig with light green inflorescence



Yellowish large oblong pods

Plate 34: *Albizzia lebeck* (L.) Benth., (February 2007).

3. Genus: *Dichrostachys* (DC.) Wight & Arn., Prodr. Fl. Ind. Or. 271 (1834); Fl. Trop. Afr. 2: 333 (1871).

1. *Dichrostachys cinerea* (L.) White & Arn., Prodr. Fl. Ind. Or. 271 (1834).

Plate (35).

Syn.: *Mimosa cinerea* L., Sp. Pl. : 520, No 25 (1753).; Brenan, Kew Bull. 12: 357-58 (1958); *Dichrostachys glomerata* (Forssk.) Chivo., F. W. T. A., ed. 2, 1: 494, fig. 158 (1915).

Vern.: **Kadad** (Ar.); **Bell Mimosa, Sickle Bush** (Eng.).

A small and thorny shrub or tree 3-8 m high, with irregular crown. Bark rough brown becoming longitudinal deeply fissured in old shrubs. Branchlet grey brown, lenticellate with a sharp solitary woody spine, which terminates the lateral branches. Leaves bipinnate with 5 -20 pairs of pinnae and stacked gland between each pair. Inflorescence yellow in apical hermaphrodite parts, solitary. Fruits pods indehiscent, dark brown in colour; seeds brown and glossy. Flowers April-June; Fruits August-November.

Habitat and Distribution

In tall grass savanna forming thickets in central Sudan, South Kordofan, South Darfur (J. Marra), Blue Nile (J. Gerri), South Kassala and Equatoria (Torit) (El Amin, 1990).

Uses

The wood is used for buildings and fencings, fuelwood and charcoal, building poles, too handles, the tree produces fodder and flowers as bee forage. Medicinally the bark is used for treatment of snakebites, toothache, and coughs.



Plate 35: *Dichrostachys cinerea* (L.) White & Arn., (June 2006).

4. Genus: *Entada* Adans., Fam. G. P1. 2: 318 (1763); J. P. M. Brenan, in Kew Bull, Volume 20, No 3.

1. *Entada africana* Guill. & Perr., in F1. Seneg. Cent. 233 (1832); F. W. T.

A., ed. 2, 1: 491 (1958). **Plate (36)**.

Syn.: *E. sudanica* Schweinf., Rel. Kotch, 8 (1868).; *Pusaetha africana* (Schweinf.) O. Ktze., Rev. Gen 1: 204 (1891).

Vern.: **Al Entada, Sesban bari or Layuk** (Ar.).

Shrubs or small trees 4 - 10 m high. Bark dark brown to black, very rough, fissured. Branchlets glabrous. Leaves bipinnate; pinnae 3-9 pairs, leaflets 10-24 pairs, oblong-elliptic, linear, oblong; apex rounded sometimes mucronate; base round-cuneate, asymmetrical. Flowers cream yellow in supra-axillary spikes, 1-4 together up to 15 cm long; sepals glabrous, small 5-bobed; petals 3 x 1 mm, apex reflexed; anthers glandular. Fruits pods, straight, dark brown, glabrous; seeds many brown in colour. Flowers April-May; Fruits July-November.

Habitat and Distribution

Low land plains. In high rainfall and tall grass savanna in Blue Nile (Roseires), S. Kassala, Kordofan (Talodi, Nuba Mts), Darfur (J. Marra, Nyertete, Golol, Buram-Radom) and Equatoria (Meridi-Amadi road).

Uses

Wood is suitable for building in form of poles and firewood. Leaves and young branches are eaten by animals. Bark and seeds are used to treat cold and throat complaints.



Plate 36: *Entada africana* Guill. & Perr., (June 2006).

5. Genus: *Pithecellobium* Mart., In Flora 20 (2), Beibl.: 114 (1837); F.T.E.A, Vol, page 1 (1959) Author J. P. M. Brenan.

1. *Pithecellobium dulce* (Roxb.) Benth., in Hook., Lond. Journ. Bot. 3 : 199

(1844); L.T.A.: 871 (1930); T.T.L.C.: 347 (1949). **Plate (37).**

Syn.: *Mimosa dulcis* Roxb., Pl. Corom. 1: 67, t. 99 (1795); F.T.E.A., Vol, page 1 (1959) Author: J. P. M. Brenan.

Vern.: **Tamr hindi** (Ar.).

Armed shrub or small tree 6-15 m high. Bark smooth whitish-grey. Leaves bipinnate, 3-5 cm long; petioles glandular at the junction of the pinnae pair; leaflets one paired, asymmetrically elliptic or obovate-elliptic. Flowers creamy white in heads, pubescent; sepals 1 mm long; petals 3-4 mm long; anthers eglandular. Fruit spirally twisted cylindrical beaked pods green turning reddish pink and constricted between seeds; seeds many, shiny, black covered with a white fleshy aril which at ripene turns pink, sweet and edible. Flowers March-July; Fruits August-November.

Habitat and Distribution

Low land plains, Introduced as hedge plant now naturalized. The tree is growing in many parts of the Sudan.

Uses

The wood is very hard in the old shrubs or trees. The leaves can be used as fodder for animals. The fruits edible and the fleshy part can be eaten. The bark and branches, as firewood and bulding poles in rural areas.

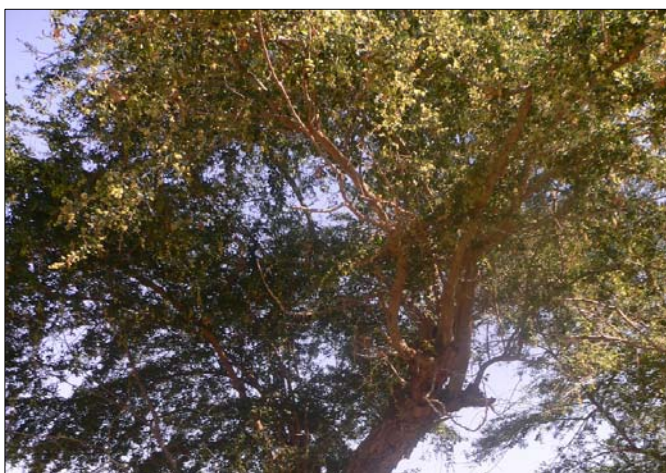


Plate 37: *Pithecellobium dulce* (Roxb.) Benth., (February 2007).

9.3. Sub-family: Papilionoideae (Papilionaceae)

Key to genera:

A. Deciduous trees or shrubs.....*Dalbergia* and *Pterocarpus*.

B. Leaves imparipinnate, leaflets oblong to elliptic or orbiculate..... *Pterocarpus*.

BB. Leaves compound imparipinnate, leaflets obovate-elliptic in spine-tipped branches..... *Dalbergia*.

AA. Leaves imparipinnate, leaflets oblong-elliptic, decreasing in size from above downwards..... *Lonchocarpus*.

1. Genus: *Dalbergia* Linn., F.T.E.A. Vol, page 1 (1971) J. B. Gillett.

1. *Dalbergia melanoxyton* Guill. & Perr., in F. Seneg. Tent.: 227, t. 53 (1832); Hepper in F.W.T.A., ed. 2, 1: 515 (1958). **Plate (38).**

Syn.: *Amerimnon melanoxyton* Guill. & Perr.

Vern.: Abnos, Babanos, Kelto (Ar.); **African ebony, African Blackwood** (Eng.).

Deciduous much-branched usually multi-stemmed shrubs or small trees up to 6 m high. Bark light grey to grey brown, thin, smooth, flaking irregularly. Branches clustering at nodes, usually spine-tipped, sparsely pubescent becoming glabrous; stipules linear. Leaves imparipinnate, with 6-10 pairs of leaflets, obovate-elliptic, glabrous above and shortly pubescent beneath. Inflorescence lax panicles. Flowers white-green; sepals slightly pubescent; petals fragrant, standard elliptic obovate narrowed to claw; stamens usually 9. Fruits flat papery seed pods, acute at both ends, elliptic-oblong, indehiscent; seeds mostly 1 and sometimes 4. Flowers February-July; fruits October-March.

Habitat and Distribution

Common on caly plains of tall grass savanna, often on rocky places or valley of impeded drainage in Darfur (J. Marra), S. Kordofan, Blue Nile State,

Upper Nile State, Bahr El Ghazal and Equatoria.

Uses:

The timber for traditional caving, ornamental turnery, chessmen, walking sticks and musical instruments (Thirakul, 1984 and El Ghazali, 2006). The root and stem bark is an antidiarrhetic and the smoke of burning roots is inhaled to treat headaches, bronchitis, abdominal pains and hernia.

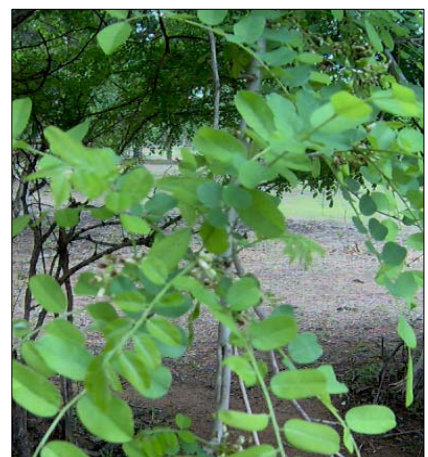


Plate 38: *Dalbergia melanoxyton* Guill. & Perr., (June 2006).

2. Genus: *Lonchocarpus* A. Rich., in Hepper F.W.T.A. 2: 241; Tent. Fl. Abyss. 1: 232 (1847).

1. *Lonchocarpus laxiflorus* Guill. & Perr., Hepper in F.W.T.A., ed. 2, 1: 523

(1958). **Plate (39)**.

Syn.: *Philenoptra schimperi* A. Rich., Tent. Fl. Abyss. 1: 232 (1847).

Vern.: **Khash khash Azrag, Al Afena** (Ar.); **Monkey's Indigo** (Eng.).

Tree up to 13 m high. Bark rough, flaky dark grey to brown. Slash producing blood red resinous exudates. Branches sparsely puberulous to glabrous. Leaves opposite imparipinnate; leaflets green grey minutely pubescent on both sides, oblong elliptic, subcoriaceous, decreasing in size from above downwards; stipules linear or subulate and caduceous. Inflorescence axillary and terminal many flowered panicles, first erect later drooping. Flowers pinkish lilac with a pale yellow splash inside; calyx purplish silvery tomentose; corolla pinkish lilac with a medium white or yellow patch on the standard inside, standard broadly ovate, basally auriculate, glabrous. Pods pale brown to straw coloured, membranous, flat thin, narrowly elliptic oblong to linear oblong, slightly sinuate or crenate between the seeds; seeds 1-4, kidney-shaped, chocolate brown. Flowering November-January; Fruiting March-May.

Habitat and Distribution

Found in high rainfall savanna on wooded grass land. It exists in Equatoria, Bahr El Ghazal, S. Kordofan, S. Darfur, Nuba Mts., S. Blue Nile State.

Uses

The wood is light yellow, hard, heavy not difficult to saw and has a smooth finish. It is used for charcoal, firewood and building poles. An infusion of the roots within water is used as a tonic (personal contact).



Plate 39: *Lonchocarpus laxiflorus* Guill. & Perr., (January 2006).

3. Genus: *Pterocarpus* Jacq., Select. Stirp. Am. Hist.: 283, t. 183/92 (1763);
F.T.E.A, Vol, page 1 (1971) Author: J. B. Gillett, R. M. Polhill.

1. *Pterocarpus lucens* Guill. & Perr., Hepper in F.W.T.A., ed. 2, 1: 517

(1958). **Plate (40)**.

Syn.: *P. abyssinicus* Hochst., Schimper. Herb. Abyss. No. 1597 (1841); F.W.T.A. 1: 376 (1928).

Vern.: **Taraya tree** (Ar.).

Large deciduous tree up to 18 m high with a straight trunk and spreading crown. Bark dark grey brown, smooth. Slash yellow brown exuding red gum. Branches first pubescent and later glabrous. Leaves imparipinnate; stipules linear, caduceous; leaflets 3-11 opposite or subopposite, oblong to elliptic or orbicular, emarginate at apex, cuneate or rounded at base, closely reticulate and shining above, glabrous apex acute, margin entire. Inflorescence axillary lax racemes. Flowers yellow fragrant; calyx with hair at mouth of the tube inside often coloured with reddish gum exudates; corolla yellow fragrant. Fruit stipitate, straw coloured, ovate to semi-orbicular, tapering, reticulate with winged margin. Flowering March-June; fruiting January-April.

Habitat and Distribution

High rainfall or tall grass savanna on rocky hills. It is found in Central and South Sudan in Equatoria and Bahe El Ghazal, Blue Nile State, Darfur and South Kassala.

Uses

The wood is white to yellow white, hard strong not easy to work, heart wood is brown, coarse textured. The wood is used for building and transmission poles and also used locally for beams and rafters in house constructions and for the manufacture of low quality furniture.



Plate 40: *Pterocarpus lucens* GuilL. & Perr., (February 2007).

10. Family: Loganiaceae

Trees or shrubs. Leaves opposite, simple and stipulate. Inflorescence usually cymose, branched, sometimes of numerous cymules racemosely

arranged; flowers regular, usually hermaphrodite, 4-5 merous; sepals campanulate; petals united, imbricate or valvate, stamens as many as and alternating with the petals; ovary superior or semi-inferior, 2-locular; style 1; stigma 1-2 or 4 ; ovules numerous; placentation axile. Fruit usually septicidal capsules, berries or drupes; seeds various, sometimes flattened or winged.

1. Genus: *Strychons* L.

1. *Strychons innocua* Del., Cent. Sp. P1. Afr.: 531 (1903). Plate (41).

Syn.: *S. xerophylla* Rak., Misc. Inf. Kew: 98 (1895); *S. penduliflora* Bak., F. T. A. 4, 1: 531 (1903).

Vern.: Umbukheisa, Hog el Fil (Ar); Duel (Ing.)

This small spineless savanna trees is readily recognized by its slender rounded twigs wit typically prominent swollen nodes bearing opposite leaves. Shrub or small tree 3-12 m height. Bark yellow or grey. Branchlets powdery, pale grey-green or stone-grey to almost straw coloured, usually without lenticels. Leaves opposite, subsessile, broadly elliptic oblong or oblong obovate, 4.5-15 x 2-8 cm. Inflorescence short, few-flowered, axillary, usually pubescent cymes; flowers pale green with a ring of hairs in the throat; sepals about 3 mm long, pubescent, ciliate; petals greenish-white or yellowish, about 5 mm long, hirsute at throat, anthers sessile on corolla throat; ovary elongate, ovoid. Fruit berries globose, woody, yellow, 7 cm or more across, glabrous; seeds 25-30, tetrahedral, 1.5-1.8 cm long, enclosed in a sweet sticky orange edible pulp. Flowers May-June; fruits August-October.

Habitat and distribution

On Low land plains, rocky or stony ground and hills slope in deciduous tall grass savanna. In Kordofan (J. El Daier, Nuba Mts), Darfur (Radom), Bahr El Ghazal (R. Jur, R. Busseri, Wau), Kassala (Gallabat, Matamma) and

Equatoria (Imatong Mts), the tree also found in small groups in different parts of the Blue Nile State (El Nour (El Azaza) natural forest).

Uses

The wood yellowish white, hard, coarse grain, fibrous, suitable as firewood, charcoal and building material. The fruit edible and it use as food. The leaves and small branches provide fodder for animals. Aqueous from leaves and bark widely used in curing stomach problems (Reported by locals, El Nour village, February, 2007).



Plate 41: *Strychons innocua* Del., (June 2006).

11. Family: Meliaceae

Trees or shrubs. Leaves alternate, usually pinnate, exstipulate; Flowers actinomorphic, usually hermaphrodite; sepals imbricate, rarely valvate; petals free or partially connate, contorted or imbricate, or adnate to the staminal tube

and valvate; stamens 8 or 10, usually monodelphous; anthers 2-locular, opening longitudinally; stigmas capitate; ovules usually 2, rarely 1 or more. Fruit berries, capsules or rarely drupes; seeds with or without endosperm, sometimes winged.

1. Genus: *Azadirachta* A. Juss., in Mem. Mus. Hist. Nat. Paris 19: 220 (1830).; F.T.W.A, Vol 1 Part 2.

1. *Azadirachta indica* A. Juss., In Mem. Mus. Par. 40:221.69 (1830).; FZ, Vol 2 Part 1, page 285 (1963) Author: F. White and B. T. Styles. **Plate (42)**.

Syn.: *Antelaea azadirachta* (L.) Adelbert., in F.T.W.A, Vol 1 Part 2.

Vern.: Neem (Ar.); **Indian lilac, margosa, neem, nim** (Eng.).

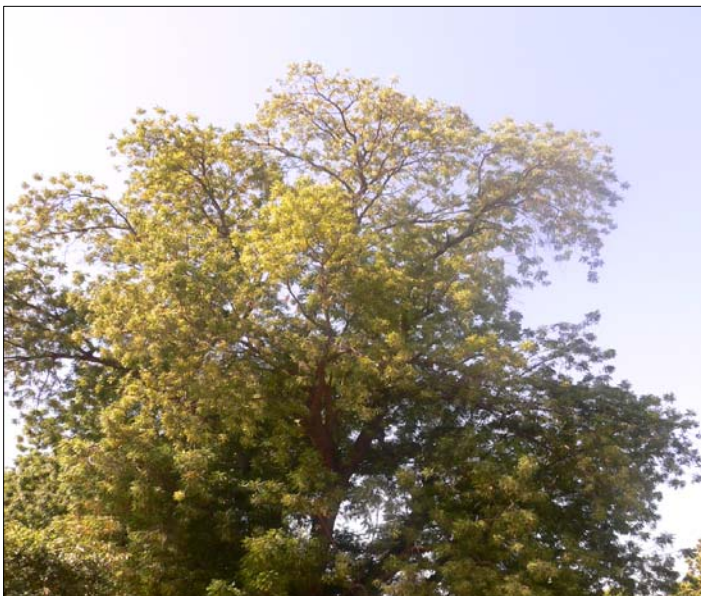
Large trees up to 30 m high. Bark rough, with wide, shallow longitudinal fissures, brown in colour, cracking off into flat ridges. Leaves imparipinnate, tufted at the ends of branches up to 30 cm long; leaflet 9-17 pairs, opposite, lanceolate, obovate-lanceolate, falcate, glossy above, glabrous, with serrate margined blade, asymmetrical base and acuminate tip; petioles with large pulvinus. In axillary many-flowered panicles, flowers white scented; sepals 5-lobed; petals 5, imbricate; staminal tube complete, anther 10, subsessile. Fruits globose drupes, surrounded by fleshy yellow orange pulp, turning brown, wrinkled when ripe. Flowers March-September; fruits April-October.

Habitat and Distribution

Commonly cultivated in semi-arid to wet tropical and subtropical regions. Can grow on dry, infertile sites but grows best when it has adequate water. Introduced from India now naturalized and commonly grown as a shade tree in different parts of the Sudan (El Amin, 1990).

Uses

Multipurpose tree, the green twigs commonly used for cleaning the teeth. The acid bitter oil from the seeds is used as an anthelmintic and antiseptic (Thirakul, 1984). Locally the stems and big branches are used for building. The leaves, bark and fruit are used in folkloric medicine for treating Malaria, skin diseases, rheumatism. It is used as shelterbelts for improving soil characteristics. Wood is red, hard, moderately heavy, durable and attractive and now widely used in furniture making.



Imparipinnate leaves with serrate

Plate 42: *Azadirachta indica* A. Juss., (February 2007).

12. Family: Moringaceae

Trees, sometimes with swollen trunks, shrubs or small woody subshrubs with tuberous rootstocks (often smelling and testing of horseradish); wood often brittle and bark sometimes resinous or gummy. Leaves petiolate, alternate, and deciduous or rachis of pinnae sometimes

present, 1-3 imparipinnate; leaflets mainly opposite, entire. Flowers regular or actinomorphic in 3 species and nearly so in two others but somewhat irregular or zygomorphic in the rest, hermaphrodite, white, red or yellow, often numerous in axillary panicles, the floral parts borne on a cup-like or in one species tubular receptacle. Sepals 5, free above the receptacle, equal or unequal, imbricate in bud, the fifth posticous; petals 5, equal or unequal, imbricate; stamens inserted on the margin of the disk or epipetalous, declinate, 5 perfect ones alternating with 3-5 staminodes; filament free or partly united. Ovary superior, stipitate, cylindrical, 1-locular of 3 carpels and with 3 parietal placentas. Capsules elongate, beaked, 3-valved, 3-6-angled, sometimes torulose; seeds unwinged or with 3 conspicuous wings, the wings hardened or membranous; embryo straight; endosperm absent.

1. Genus: *Moringa* Adans., Fam. Pl. 2: 318, 579 (1763); Verdc. In K. B. 40: 1-23 (1985).; F.T.A. 1:101.

1. *Moringa olifera* Lam., Encycl. Meth. Bot. 1: 398 (1785); F.W.T.A., ed. 2, 1: 95 (1954); Verdc. In K. B. 40:7 (1985). **Plate (43).**

Syn.: *M. pterygosperma* Gaertner., Fruct. 2:314 (1791); Oliv. In F. T. A. 1: 101 (1868).

Vern.: Al Rawag, Al Moringa (Ar.); Moringa glory, Horse Ridish, Drum stick (Eng.).

Small tree up to 7 m high. Bark grey smooth, corky, roots of young plants swollen. Leaves bi or more often tripinnate; terminal leaflets obovate, and slightly larger than lateral one, generally with 6 pairs of pinnae, with 2 pairs of opposite laterals and one terminal. Flowres along branches, paniculate, sweet scented, cream coloured; sepals 5 unequal in size; petals unequal and slightly larger than sepals, white with yellow dots at the base. Fruit 3-angled, elongate-linear tapering at both ends, 9-ribbed, up to 30 cm

long; seeds round, with 3 papery wings. Flowering November-January; fruiting January-March.

Habitat and Distribution

In short grass savanna. The tree introduced from India and Arabia, and planted in many parts of the Sudan.

Uses

The wood is soft and useless. The tree yields a gum belonging to the tragacantha group. The seeds contain up to 30% of oil (Ben oil) and saponin, the oil suitable for food. Leaves, pods and flowers are edible for human and stock. Seeds are powdered and used to clean water for drinking.



Tripinnate leaves



Plate 43: *Moringa olifera* Lam., (January 2006).

13. Family: Ochnaceae

This the first report of species belonging to this family as no mentioning was found in Harrison and Jackson, 1985 or El Amin, 1990. However the identified species below was only reported in Bahr El Ghazal by Thirakul, S. 1984.

The family consists of shrubs or trees, rarely herbs (*Sauvagesia*). Leaves simple, alternate and stipulate; margins often finely toothed; mostly with numerous and thin parallel secondary nerves (*Lophira*, *Ochna*, *Ouratea* and *Fleurydora*). Inflorescence raceme or panicle; flowers hermaphrodite, actinomorphic (except *Testulea*); sepals 4-5, free, imbricate or rarely contorted; petals 5, free, imbricate or contorted; stamens few to many, free ovary superior, 2-10 celled. Fruits drupes or septicidal; seeds 1 to many.

Genus: *Ochna* Linn., F.T.A. 1: 316.

1. *Ochna afzelii* R.Br. ex Oliver. F.W.T.A. 1: 319 (1868).; Keay, F.W.T.A., ed. 2, 1: 223 (1954). **Plate (44)**.

Syn.: *Ochna ituriensis* De Wild., in Rev. Zool. Afr. 7, Suppl. Bot.: B35 (1919). Type from the Congo (Ituri).; *Ochna rhodesica* R.E.Fr.Wiss. Ergebn. Schwed. Rhod.-Kongo-Exped. 1: 149, t. 12 figs. 1:2 (1914).

Vern.: **Lesan El Kalb** (Ar.); **Shager Mamoud** (Ar.).

Shrub or small tree up to 5 m high. Crown flabellate, or umbelliform, dense and dark green glossy foliage. Branches obliquely spreading, irregular and rather twiggy, densely lenticellate, purplish- or dark brown (more rarely whitish), usually not exfoliating. Bark pale grey-brown, rough, scaly, flaking off in thin polygonal or partially rectangular patches. Leaves simple, alternate, petiolate, closely tufted towards the end of the twigs.; petiole flattened, twisted and sparsely covered with dark lenticles.; lamina oblanceolate to oblong-oblanceolate or rarely elliptic, rounded to shortly and \pm obtusely acuminate at the apex, with margin densely curved-serrulate to crenulate, cuneate to attenuate at the base. Flowers fascicles of about 5-6 white flowers arising from the end of lateral twigs. Fruit carpels subglobose, black, receptacle red and enlarged calyx pinkish. Flowers February-April; fruits April-May.

Habitat and distribution:

Often occurring in rocky sites of savanna woodland and in dry evergreen forest. It is found in Bahr El Ghazal and Central regions (Thirakul, 1984).

Uses:

The wood is light brown, hard and heavy. The straight boles are used in local building (Reported by local, 2006).



Plate 44: *Ochna afzelii* R.Br. ex Oliv., (February 2007).

14. Family: Palmae (Aracaceae)

Climbers or trees, abundant in warmer and sandy areas of the world. Recognized by the tall cylindrical branchless trunk ending in a huge spherical crown of mostly fan-shaped leaves. Leaves simple or palmately lobed, entire at first, then pinnatisect or pinnatifid (in some genera the blade splitting into independent segments or leaflets); alternate, crowded and restricted at the end

of stem; venation parallel; leaf-base broad, amplexicaul and sheathed. Inflorescence spike or panicle, much-branched, usually a spadix with a woody spathe; flowers small, unisexual, rarely bisexual; actinomorphic, incomplete, mono- or dioecious; sepals 3; petals 3; stamens usually 6 in male flowers; ovary superior in females, 1-3 celled; fruits nuts, drupes or berries.

1. Genus: *Hyphaene* Gaertn. In De Fruct. 1: 28 (1788), Singapore 25: 283-334 (1970).

1. *Hyphaene thebaica* (Linn.) Mart., in Hist. Nat. Palm. 3: 226. t. 131-3 (1838). **Plate (45).**

Syn.: *Corypha thebaica* L. Sp. Pl. 1187 (1753).

Vern.: Dome, Saafe (Ar.); **Dom palm** (Eng.).

Tree up to 16 m high. Stem unbranched or branching dichotomously, sometimes repeatedly. Bole covered with persistent leaf bases. Bark dark grey. Leaves fan-shaped in terminal crown in each branch; lobes linear lanceolate, divided 3/4-almost to the base into numerous segments; petiole 1 m long sheathing at base with numerous upwardly curved hooks. Male and female flowers on different trees, occasionally hermaphrodite trees are found. Male spadix 120 cm long, male flowers solitary in pits of the spadix, spathe-bracts encircling the spadix, pointed emitting the branches, the latter with stalked flattened next to the axis. Branches of female spadices stouter in the fruiting stage, marked by densely tomentose cushions after the fall of the fruit. Fruits globose quadrangular, brown, smooth, shining and 1-celled; seeds single, adnate to the endocarp, truncate at base, apex obtuse. Flowers February-April; fruits November.

Habitat and Distribution

In silty soils on banks of rivers and streams and on slopes of rocky hills. The tree distributed throughout the Sudan along the Nile and it is

tributaries. There are thick pure forests of Dom Plam along Atbara River, south of Bunzuga along the Blue Nile, Upper Nile. Also in the drier parts of Equatoria in Dongotana and Didinga Mauntains and Kapoeta.

Uses

The wood is dark grey, fibrous and split, used as beams and rafters or used in the round. It is used as firewood. The leaves are made into ropes, buckets, and mates and are grazed by cattle. The fruit pulp is sweet and edible. The fruit kernels are the vegetable ivory which is made into buttons. The pulp is made into Jam.



Fan-shaped leaved



Tree with froked stem

Plate 45: *Hyphaene thebaica* (L.) Mart., (February 2007).

15. Family: Rhamnaceae

Shrubs, trees or sometimes woody climbers (*Ventilago*), of closed forest, arid or semi-arid region. Leaves simple alternate sometimes opposite to subopposite; stipulate, sometimes stipules modified into spines (*Ziziphus*); leaf margin toothed or some times with externally small glands (*Maesopsis eminii*), and often with parallel veins. Inflorescens cyme or axillary fascicle; flowers small, hermaphrodite, rarely unisexual, actinomorphic; calyx lobes 4-

5, valvate; petals 4-5, small, or absent; stamens 4-5, opposite to the petals; disk present; ovary superior or semi-inferior, 2-4 celled. Fruits often drupes, sometimes capsules or samaroids.

1. Genus: *Ziziphus* P. Mill., Abbrev. Gard. Dict. (1754).; F.T.A. 1: 379.-suessenguth in E. & P. Pflanzenfam. 20D:123 (1953).

Key to species:

A. Fruit globose, dark red to brown.....*Ziziphus abyssinica*. Plate (46).

AA. Fruits globose brownish to orange.....*Ziziphus spina-christi*. Plate (47).

1. *Ziziphus abyssinica* A. Rich., in F.W.T.A., ed. 2, 1:669 (1958). **Plate (46).**

Syn.: *Ziziphus mauritiana* var. *abyssinica* (A. Rich.) Fiori, Bosch. e piant. legn. Eritr.: 234 (1912).

Vern.: Nabag El Feel (Ar.).

Shrub or small trees 2-13 m high. Trunk usually straight and single. Bark grey, deeply fissured. Branchlets dark brown, lenticellate; spines 2, one straight, and the other curved, dark brown, pubescent zigzagging. Leaves simple, ovate to broadly ovate or ovate-elliptic; petiols tomentose. Inflorescence 10-25-flowered cymes; peduncle tomentose; sepals densely tomentose; petals 1-1.5 cm long; ovary 2-celled. Fruits drupes about 2 cm across, very dark brown, smooth, glossy; seeds 2. Flowers July-October; fruits August-December.

Habitat and Distribution

Low land plains. Common in Central and South Sudan, in Darfur (J. Marra), Kordofan (Nuba Mts), Upper Nile (Shambe), Bahr El Ghzal (Jur river), Blue Nile State (Roseires) and Equatoria. In river banks and streams, valleys and water depressions on light silty soils in the short grass savanna of Northern and Central Sudan along the Nile and tributaries.

Uses

The wood is hard and heavy, dense sapwood yellowish; heartwood red and therefore makes good fuel wood and charcoal. It is used to make furniture, tool handles and walking sticks.



**Simple, alternate leaves and
hooked spins**



Plate 46: *Ziziphus abyssinica* A. Rich., (February 2007).

2. *Ziziphus spina-christi* (L.) Hemsl. In F.T.A. 1: 380 (1868); E.P.A.: 499 (1960). Plate (47).

Syn. *Rhamnus spina-christi* L., Sp. Pl.1:195 (1753).

Vern.: Siddir, Nabak or Nabag (Ar.).

Tree 5-10 m high. Crown spreading. Bark grey, fissured. Branchlets pale white, glabrous, later becoming brown. Spines paired light brown, one of each pair straight and directed forward, the other shorter and slightly recurved. Leaves narrowly ovate to elliptic, apex rounded or shortly acute or obtuse, base rounded and nearly symmetrical, margin crenate and sometimes

thickened on the margin, glabrous above and minutely and densely pubescent beneath, especially on the nerves, tending to be glabrescent at maturity. Flowers greenish yellow in subsessile sometimes dense cymes, 10-25 flowered up to 5 cm long, basal nerves ascending; sepal minutely woody, dorsally 2 mm long; petals 1.5 mm long. Drupe globose, fleshy, edible when ripe and red brown; cells and seeds 2-rarely 3. Flowers August-December; fruits March-August.

Habitat and Distribution

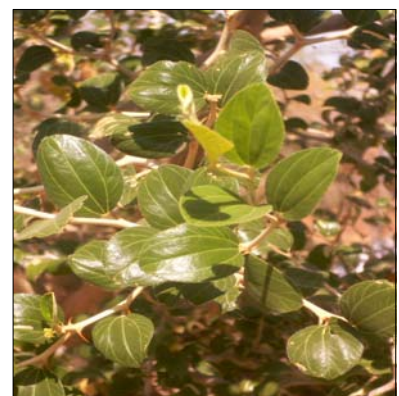
On short grass savanna on banks of rivers, streams valleys and water depressions on light silty soils. Common on Central Sudan and North Sudan along the Nile tributaries on the drier parts of Africa especially Northeast Africa.

Uses

The timber is used for tool handle, fence posts, walking sticks, furniture, bent wood chairs, doors, windows and turned items. Poles are used for building thatches houses. The fruit is edible and a cake is made from it for food or treatment of dysentery. The leaves are grazed by animals. The branches are lopped and used to make thorn hedges and as fuel and charcoal.



Small tree with many stems, and drooping branches



Simple, alternate leaves and hooked spines

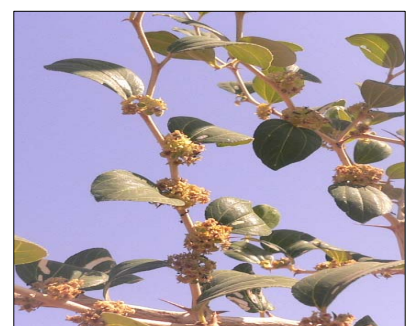


Plate 47: *Ziziphus spina-christi* (L.), (January 2006).

16. Family: Rubiaceae

Trees, shrubs, herbs or rarely climbers. Leaves simple, entire, opposite sometimes verticillate or whorled and usually with stipules. Inflorescence solitary, cymose or often capitate; flowers usually hermaphrodite, actinomorphic; sepals adnate to the ovary; petals tubular, epigynous, contorted, imbricate or valvate and rarely campanulate, lobes 4-12; stamens 4-10, epipetalous, many as and alternating with the petals; anthers 2-locular, opening longitudinally; ovary inferior, 2- or more locular; placentation axile, apicular basal or often 1-locular with parietal placentation; ovules 1-many.

Fruits capsules, drupes or berries, dry and indehiscent.

Key to genera:

A. The flowers are solitary terminal or in small clusters, with a tubular-based corolla *Gardenia*.

AA. The flowers solitary or paired at the ends of lateral branchlets, with imbricate corolla..... *Xeromphis*.

1. Genus: *Gardenia* L., in F.T.W.A, Vol 2.

1. *Gardenia lutea* Fres., in Mus. Senc Kenb. 2:167 (1937); Stapf & Hutch.I. c. 425. Plate (48).

Syn.: *Gardenia thunbergia* L., in F. T. W. A. 3: 100, partly.

Vern.: Abu Gawi (Ar.).

Shrubs or small trees growing to 3-4 m high. Crown usually dense, rounded or umbelliform and much-branched. Branches spreading, zigzag and crooked. Bole straight and short. Bark yellowish, smooth peeling off in large irregular and rather thin plates. Twigs rounded, stout, smooth and covered with greyish powder. The leaves are simple opposite or in whorls of three or four; blade narrowly elliptic to obovate, dark green, glossy and with a leathery texture; apex acuminate or obtuse; base attenuate. The flowers are solitary terminal or in small clusters, white, or pale yellow, with a tubular-based corolla with 5-12 lobes (petals). Fruits multi-seeded berries elliptic, ovoid or globose with persistent calyx at the apex. The seeds embedded in fleshy pulp. Flowering November-March; fruiting December-April.

Habitat and Distribution

Common in savanna woodlands of the Central Sudan. Widespread in south and southeast of the Blue Nile State, Kordofan and Darfur States.

Uses

The wood is pale yellow and hard and is use locally as firewood and

the branches for tool handles. Leaves and roots are used by the herbalists for curing stomach diseases.



Twig with 4-whorled opposite leaves



Yellowish smooth bark



Pale yellow solitary terminal flowers

Plate 48: *Gardenia lutea* Fres., (February 2007).

2. Genus: *Xeromphis* Raf., F.T.W.A. Sylva Tellur. 21 (1838).

1. *Xeromphis nilotica* (Stapf.) Keay., in Bull. Jard. Bot. Brux. 28: 39 (1958).

Plate (48).

Syn.: *Randia nilotica* Stapf., F.W.T.A, ed. 1, 2: 78; Aubrev. Fl. For. Soud.-Guin. 462, t. 100, 5-6.

Vern.: Shidr El Merfein, Simein (Ar.).

Mluti-stemmed shrub up to 4 m high. Crown widely umbelliform, extremely much-branched, dense and light foliage. Branches spreading, twiggy, irregular, drooping down at the ends. Bole very short and fluted. Bark

grey more or less smooth, scaly, flaking off in small irregular patches leaving large and smooth whitish underbark; twigs rounded, usually zigzag or straight, stout, puberulous, with straight stiff sharp and woody thorns. Leaves simple, sessile, clustered in 3 or more at the end of the twigs; blade obovate or nearly spatulate; apex rounded or obtuse, base cuneate-attenuate or decurrent; margin entire, glossy, dark green and glabrescent above, pale green and pubescent beneath. Flowers solitary or paired at the ends of lateral branchlets, small white flowers rapidly fading to yellow, fragrant. Fruits berries ellipsoid to subglobose, yellowish and glabrous. Flowers November-December; fruits November-December.

Habitat and Distribution

Common in savanna woodlands of the Central Sudan. Widespread in Blue Nile State, Kordofan and Darfur States.

Uses

The wood yellow and hard and is use locally as firewood and the branches as building material. Leaves and roots are used by the herbalists for curing some diseases.



Typical shrub with dense crown



**Twig showing leaves and
prikles**



Plate 49: *Xeromphis nilotica* (Stapf.) Keay., (February 2007).

17. Family: Sterculiaceae

Trees, shrubs, climbers or rarely herbaceous plants. It recognized easily by the leaves or the presence of satellite hairs on the blade surface; petiole, twig or even inflorescence. The fibrous bark, characteristic of the family, peel off easily in long strips. Leaves mostly simple margin entire or deeply lobed, sometimes compound digitate, alternate rarely subopposite and usually stipulate; petiole long, thick and swollen at the apex and base. Inflorescence very variable, usually axillary; flowers hermaphrodite or unisexual, actinomorphic; sepals 3-5, slightly connate at the base (fused), valvate; petals

5, or absent, hypogynous, contored or imprecate; stamens free or connate into a column (monadelphous), sometimes staminodes present; ovary superior, 2-12 united carpels; style simple or lobed; ovules 2 or more in each loculus or rarely 1; placentation axile. Fruits various, usually dry, winged, follicular, or capsular, dehiscent or not; seeds often winged.

1. Genus: *Sterculia* L., in F.T.W.A. A. 1: 215.; (Genus number: 11565, last updated: 05-Jun-2003)

Key to the species:

A. leaf-blade dul green, 3-5 angled or shallowly lobed; bark slighty fissured, brownish..... *Sterculia africana*. Plate (49).

AA. leaf-blade pale grey or greenish-yellow, 3-5 lobed; bark rough, flaking off, grayish to white *Sterculia setigera*. Plate (50).

1. *Sterculia africana* (Lour.) Fiori., Agr. Colon. Ital. 1911. Suppl. 376 (1912).; in Roy. Bot. G. K, Schweinfurth, G, No 758 (1881) **Plate (49)**.

Syn.: *Triphaca africana* Lour.; *Sterculia guineensis* Hort. Ex Steud.

Vern.: Tartar Ahmer (Ar.), African star chestnut, Mopopaja Tree (Eng.).

Much-branched shrubs or trees up to 5 m high. Branches stout, grey wide spreading. Bark smooth or slightly fissured, mottled, green or whitish, flakin off. Leaves simple 3-5 angled or shallowly lobed, nearly glabrous on both surfaces. Inflorescence in clustered axillary panicles up to 9 cm long; peduncles 5-7.5 cm; sepals 5, about 1.2 cm long, yellow- green inside, downy with conspicuous red or pink lines inside. Fruiting carpels 3-5, ovoid, rostrate, up to 8 cm long, hispid tomentose outside, closely and longitudinally straight ridged; seeds black with red aril. Flowers March-September; fruits December-March.

Habitat and Distribution

Low land plains, and rocky or hilly areas. Confined to the hilly ground

of the Red Sea hills (Erkowit, J. Elba), the species were found to form scattered thickets in El Nour (El Azaza) natural forest reserve, Blue Nile State.

Uses

Seeds are edible, full of oil and can be consumed raw or roasted with maize. Pods with seeds and also leaves are good fodder for animals. Barks are used for tying purposes in house and local beehive or huts construction.

The tree is suitable for soil stabilization due to huge and spreading root stock.



Deciduous tree with ascendant branches



Dull green, alternate leaves



Plate 50: *Sterculia africana* Fiori., (February 2007).

2. *Sterculia setigera* Del., Cent. Pl. Afr. 61 (1826).; Aubrev. Fl. Soud.-Guin. 159, t. 28.; in Burkill, H. M. (U. P. W. T. A), Vol 5 (1985). **Plate (50).**

Syn.: *Streculia tomentosa* Guill. & Perr., Cent. Fl. Seneg. 1: 81, t. 16 (1831); *S. cinerea* A. Rich., F.T.A 1: 218 (1868).

Vern.: Tartar, Gaidr, Talih (Ar.).

Deciduous tree up to 15 m high. Bole with small buttress at the base. Bark smooth, grey-purple, flaking in oblong scales. The leaves simple, closely alternate, pale grey or greenish-yellow patches on falling, suborbicular or ovate, 3-5-lobed, tomentose on both sides but densely beneath, sometimes velvety; petioles 6-13 cm long, grey tomentose. Slash red with paler streaks,

exuding white gum and water sap. Young branches velvety, older branches rough rugose with leaf scars. Inflorescence 4-9 erect, tomentose cymes produced on leafy or leafless twigs; sepals green outside petals absent. Fruits grey-green or brown, usually 4 together, sessile, oblong, beaked, velvety outside with numerous pungent red brown bristles on the outside; seeds numerous, purplish-black with small yellow-brown fleshy aril at base. Flowers December-March; Fruits April-May.

Habitat and Distribution

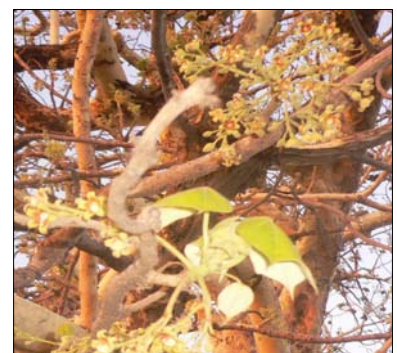
Low land plains, and rocky areas. On hilly ground in tall grass or high rainfall savanna on the Central Sudan, Blue Nile State, Kassala, Kordofan, Darfur (J. Marra.), Red Sea Hills and common in the Southern regions.

Uses

The wood white in colour and very soft and suitable for plywood cases, concealed items in carpentry, insulation purposes (Vogt, 1995).



Dark green, alternate leaves





Scaly white-grey bark



4 – 5-lobed, dehiscent fruit

Plate 51: *Sterculia setigera* Del., (January 2006).

18. Family: Tiliaceae

Climbers, shrubs, trees or sometimes herbs. Leaves simple, alternate, usually stipulate; blade entire or lobed; margin of blade mostly toothed; presence of stellate hairs on the leaves, twigs and inflorescences. The bark is also characteristic, easily peeling off in long strips. Inflorescence often cyme; flowers hermaphrodite, actinomorphic; sepals 5, valvate; petals free or absent; stamens numerous, free or rarely connate into 5-10 bundles; ovary superior, syncarpous or occasionally apocarpous, 2-10 celled. Fruits berries, drupes or capsules, dehiscent or not.

Genus: *Grewia* L., F. T. E. A. Vol, page 1 (2001).

Key to species:

- A.** Branches not angled.....*Grewia tennat* and *G. mollis*.
 B. Leaves lobed broadly ovate or cordate or orbicular; fruit smooth, orange*Grewia tennax*. Plate (53).
 BB. Leaves oblong-lanceolate or lanceolate; fruits black at maturity,*G. mollis*. Plate (52).
AA. Branches angled..... *G. flavescens*. Plate (51).

1. *Grewia flavescens* Juss., Ann. Mus. Nation. Hist. Par. 4:91 (1804). **Plate (51).**

Syn.:

Vern.: **Guddeim Khlisan, Abou Dlouae** (Ar.).

Shrubs 1.2-4 m high, sometimes ascendent and reaching a high of 11 m or more. Bark dark brown, fluted, 3-4-angled. Leaves ovate-oblong, oblong-elliptic, lanceolate, sometimes asymmetrical 0.9-6 cm long, sub-coriaceous, scabrid above, fairly densely bristly pubescent beneath; petioles pubescent, 0.2-1 cm long. Inflorescence 2-3-flowered axillary cymes; flowering bud densely bristly-tomentose; sepals linear, 1-3 cm long yellow, shortly tomentose outside; petals up to 1.5 cm long, sharp-shaped, slightly notched at apex. Fruit spherical, of 1-4 lobes pilose, shiny-brown, edible. Flowers July-October; fruits October-March.

Habitat and Distribution

Low land plains. Common in the Savanna zone sometimes forming thickets on iron-stone soils. In the Red Sea Hills, Kassala, Blue Nile State, Kordofan, Darfur, Upper Nile.

Uses

Fruits are edible. Leaves used for smoking by Beni Amer women in the Red Sea and Kassala provinces.



Small shrub with angled branches and simple leaves



Ovate-oblong, alternate leaves



Plate 52: *Grewia flavescens* Juss., (February 2007).

2. *Grewia mollis* Juss., F.T.A 1:248 (1868). Plate (52).

Syn.: *G. venusta* Fresen., Mus. Senckenb. 2: 159, t. 10 (1837).

Vern.: Guddeim basham (Ar.).

Shrub or small tree up to 7 m high, with many spreading hairy branches, often drying purplish. Bark black, rough, deeply fissured. Leaves oblong-lanceolate or lanceolate 5-18 x 2-8 cm, dull bluish green above, silky white beneath; petiole about 5 mm long, villous. Inflorescence 2-3 axillary cymes on peduncles in the leaf axils, each with 2-3 flowers; flowers yellow; sepals 5, 6-9 mm long, villous; petals 5. Fruits globose, apiculate, black when ripe, villous. Flowers May-August; fruits August-October.

Habitat and Distribution

Low land plains, near rivers in the dry savanna zones. In Central and S. Sudan. Red Sea Hills, Blue Nile State, Kordofan (Nuba Mts), Darfur (J. Marra), Bahr El Ghazal (Wau) and Equatoria (Kagalo and Torit).

Uses

Wood is red or pink and very elastic. It is used for bows and arrows. The wood ashes are used as a substitute for salt. The fruit is edible. The baste yields a fiber bark and leaves are used to cure fever.



Leafless Gudaim sbrub



Ripe fruits



Typical bark

Plate 53: *Grewia mollis* Juss., (February 2007).

3. *Grewia tenax* Ascher & Schweinf., Dask. Bot. Ark. 4, 3:21 (1922). Plate (53).

Syn.: *G. betuleafolia* Juss., Ann. Mus. Nation. Hist. Nat. Par. 4:92. t. 1 (1804).

Vern.: Guddeim (Ar.).

Shrub sometimes scrambling, up to 3 m high. Bark dark brown to grey, smooth. Branches dark brown with white lenticles. Leaves broadly ovate or cordate or orbicular, 2-5 x 3.5 cm, sparingly stellate-pubescent beneath; petioles slender, up to 1.25 cm long. Inflorescence solitary, axillary, or in pairs. Flowers white or yellow, scented; sepals 5; base nectaris 1.5-1.8 cm long enlarged above to a broad hairy scale exceeding the width of the petal

claw. Fruit fleshy, sweet-scented, orange-red, about 1.25 cm across, 1-4 lobed, shiny, glabrous. Flowers November-July; fruits December-July.

Habitat and Distribution

Low land plains. Very common in North and Central Sudan, Blue Nile State, Darfur, Kassala, Kordofan, Khartoum, white Nile, Upper Nile, Bahr El Ghazal and Equatoria.

Uses

The fruits are edible. Leaves and young branches as fodder for animals. The species has local uses in curing some diseases particularly stomach complains.



154

Small shrub with many branches



Alternate, simple leaves



Plate 54: *Grewia tenax* Ascher & Schweinf., (February 2007).

4.1.1 Check list of the identified families, genera and species.

The studied families, genera and species were alphabetically arranged and listed as shown in the table below.

Table 2: List of the plant species in the flora of the study area:

No	Family	Species	Vern.names	Page
1	Anacardiaceae	<i>Lannea fruticosa</i> (Hochst. ex A. Rich.) Engl	Leyun-Ghallub	26
2	Anacardiaceae	<i>Lannea schimperi</i> (A. Rich.) Engl.	Leyun-Amzag-Suda	28
3	Anacardiaceae	<i>Sclerocarya birrea</i> (A. Rich.) Hochst.	Humeid	31
4	Asclepiadaceae	<i>Calotropis procera</i> (Aiton.) Aiton	Usher	34
5	Balanitaceae	<i>Balanites aegyptiaca</i> (L.), Del.	Hegleeg (Laloub)	37
6	Bombacaceae	<i>Adansonia digitata</i> Linn.	Tabaldi (Gongulis)	40
7	Bignoniaceae	<i>Stereospermum kunthianum</i> Cham.	Khashkash Abiad	43
8	Burseraceae	<i>Boswellia papyrifera</i> (Del.) Hochst.	Trag Trag	46
9	Capparaceae	<i>Boscia angustifolia</i> A. Rich.	Irg Al Sraih	49
10	Capparaceae	<i>Boscia senegalensis</i> (Pers.) Lam. ex Poir.	Mokheit	51
11	Capparaceae	<i>Cadaba rotundifolia</i> Forssk.	Kurmut	53
12	Capparaceae	<i>Capparis decidua</i> (Forssk.) Edgew.	Tundub	56
13	Capparaceae	<i>Capparis tomentosa</i> Lam.	Irg Al Gulum	58
14	Capparaceae	<i>Crateva adansonii</i> DC.	Dabker	60
15	Capparaceae	<i>Maerua angolensis</i> DC.	Shagar ElZaraf	62
16	Combretaceae	<i>Anogeissus leiocarpus</i> (DC.) Guill. & Perr.	Sahab – seilk	65
17	Combretaceae	<i>Combretum aculeatum</i> Vent., Choix.	Habeel Shehait	68
18	Combretaceae	<i>Combretum ghasalense</i> Engl. & Diels.	Habeel Um Ismaeel	70
19	Combretaceae	<i>Combretum glutinosum</i> Perr. ex DC.	Habeel Khrisha	72
20	Combretaceae	<i>Combretum hartmannianum</i> Schweinf.	Habeel Al Gabal	74
21	Combretaceae	<i>Combretum lamprocarpum</i> Diels.	Habeel El Grouz	76
22	Combretaceae	<i>Combretum molle</i> R. Br. Ex G. Don.	Habeel Khrisha Kabeira	78
23	Combretaceae	<i>Terminalia brownii</i> Fresen.	Subagh – Shaf	81
24	Combretaceae	<i>Terminalia laxiflora</i> Engl. & Diels.	Subagh – Darut	83
25	Caesalpinioideae	<i>Cassia arereh</i> Del.	Al Gaga	86
26	Caesalpinioideae	<i>Piliostigma reticulatum</i> (DC.) Hochst.	Kharub – Abu khmeira	88
27	Caesalpinioideae	<i>Tamarindus indica</i> L.	Aradaib	90

28	Mimosoideae	<i>Acacia polycantha</i> Willd.	Kakamoot	93
29	Mimosoideae	<i>Acacia senegal</i> (L.) Willd.	Hashab	95
30	Mimosoideae	<i>Acacia seyal</i> var <i>fistulal</i> .Schwinf.Oliv.	Sufar Abiad	97
31	Mimosoideae	<i>Acacia seyal</i> var <i>seyal</i> Del.	Talih Ahmar - Talih	99
32	Mimosoideae	<i>Acacia nubica</i> Benth.	Laut	101
33	Mimosoideae	<i>Acacia mellifera</i> (Vahl.) Benth.	Kitir	103
34	Mimosoideae	<i>Albizzia lebeck</i> (L.) Benth.	Degn El basha Akhdar	105
35	Mimosoideae	<i>Dichrostachys cinerea</i> (L.) White & Arn.	Kadad	107
36	Mimosoideae	<i>Entada africana</i> Guill. & Perr..	Al Entada - Layuok	109
37	Mimosoideae	<i>Pithecellobium dulce</i> (Roxb.) Benth.	Tamer hindi	111
38	Papilionoideae	<i>Dalbergia melanoxylon</i> Guill. & Perr.	Abnos - Babanos	114
39	Papilionoideae	<i>Lonchocarpus laxiflorus</i> Guill. & Perr.	Khashkash Azrag	116
40	Papilionoideae	<i>Pterocarpus lucens</i> Guill. & Perr.	Taraya	118
41	Loganiaceae	<i>Strychnos innocua</i> Del.	Um Bukheisa	121
42	Meliaceae	<i>Azadirachta indica</i> A. Juss.	Neem Baldi	124
43	Moringaceae	<i>Moringa olifera</i> Lam.	Moringa	127
44	Ochnaceae	<i>Ochna afzelii</i> R.Br. ex Oliv.	Lessan al klib	130
45	Palmae (Arecaceae)	<i>Hyphaene thebaica</i> (L.) Mart.	Dom - Saaf	133
46	Rhamniaceae	<i>Ziziphus abyssinica</i> Hochst., A. Rich.	Siddir Al Feel	136
47	Rhamniaceae	<i>Ziziphus spina-christi</i> (L.) Desf.	Siddir - Nabag	138
48	Rubiaceae	<i>Gardenia lutea</i>	Abu Gawi - AlGardenia	141
49	Rubiaceae	<i>Xeromphis nilotica</i> Stapf.	Shidr el Marfein	143
50	Sterculiaceae	<i>Sterculia africana</i> Fiori.	Tartar	146
51	Sterculiaceae	<i>Sterculia setigera</i> Del.	Tartar	148
52	Tiliaceae	<i>Grewia flavescens</i> Juss.	Abou Dlouae	151
53	Tiliaceae	<i>Grewia mollis</i> Juss.	Guddeim Basham	153
54	Tiliaceae	<i>Grewia tenax</i> Ascher & Schweinf	Guddeim	155

Table 3: Genera and Species frequency by identified families.

No	Family	Number of Genera	Number of Species	Genus Frequency (%)	Species frequency (%)
1	Anacardiaceae	2	4	5.56	7.41
2	Asclepiadaceae	1	1	2.78	1.85
3	Caesalpinioideae	3	3	8.33	5.56
4	Capparaceae	5	7	13.89	12.96
5	Combretaceae	3	9	8.33	16.67
6	Balanitaceae	1	1	2.78	1.85
7	Bombacaceae	1	1	2.78	1.85
8	Bignoniaceae	1	1	2.78	1.85
9	Burseraceae	1	1	2.78	1.85
10	Loganiaceae	1	1	2.78	1.85
11	Meliaceae	1	1	2.78	1.85
12	Mimosoideae	5	10	13.89	18.52
13	Moringaceae	1	1	2.78	1.85
14	Ochnaceae	1	1	2.78	1.85
15	Palmae (Arecaceae)	1	1	2.78	1.85
16	Papilionoideae	3	3	8.33	5.56
17	Rhamnaceae	1	2	2.78	3.70
18	Rubiaceae	2	2	5.56	3.70
19	Sterculiaceae	1	2	2.78	3.70
20	Tiliaceae	1	3	2.78	5.56
		36	54		

4.2 The tree and shrub vegetation cover in the forest area

The phenology of the forest cover depends on the rainfall and the soil moisture. The seeds of the annuals and perennials species germinate in the beginning of the rainy seasons in early June. In addition all the deciduous trees, shrubs and woody scrambling sprout producing new leaves, shoots and in some species flowers and/or inflorescence.

The average number of trees and shrubs per hectare was 452 and 461 in site A and site B, respectively as shown in Figure (13). The observed densities in the two sites is considered low as the average spacing between trees is

around 4.70 and 4.66 meters in site A and site B, respectively. The species composition and dominance differs within and between sites as shown in Figures 14 and 15. The above mentioned differences may be due to variation in topography and soil type. Additional factors such as natural and man made fires, illegal cutting and weak natural regeneration of some species, may have contributed to the variation.

Harrison and Jackson (1958) attributed variation in species composition and density in the Blue Nile State to the amount and distribution of rains, soil type and the topography.

The results showed that the Acacias were predominant in the clayey and drier area in northern and northern east part of the forest. Whereas the broad leaved deciduous trees such as *Sterculia setigera*, *Terminalia brownii*, *Terminalia laxiflora*, *Lonchocarpus laxiflorous* were predominant in the areas dominated by the sandy-loam soils and slightly wetter parts in the central and south and southeast part of the forest area as shown in Figure 14.

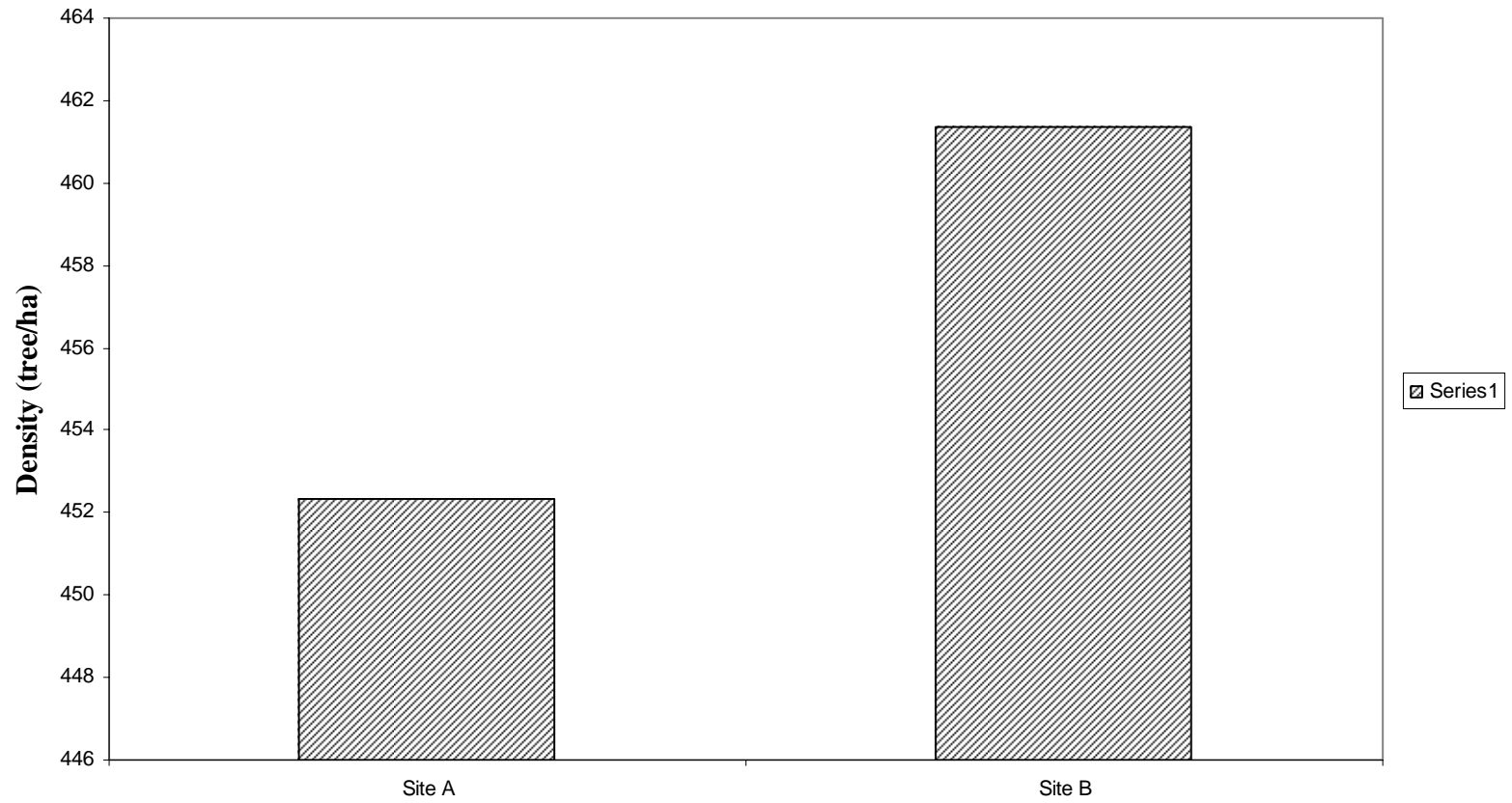


Figure 11: Histogram showing the average density (tree/ha) in site A and B of the forest.

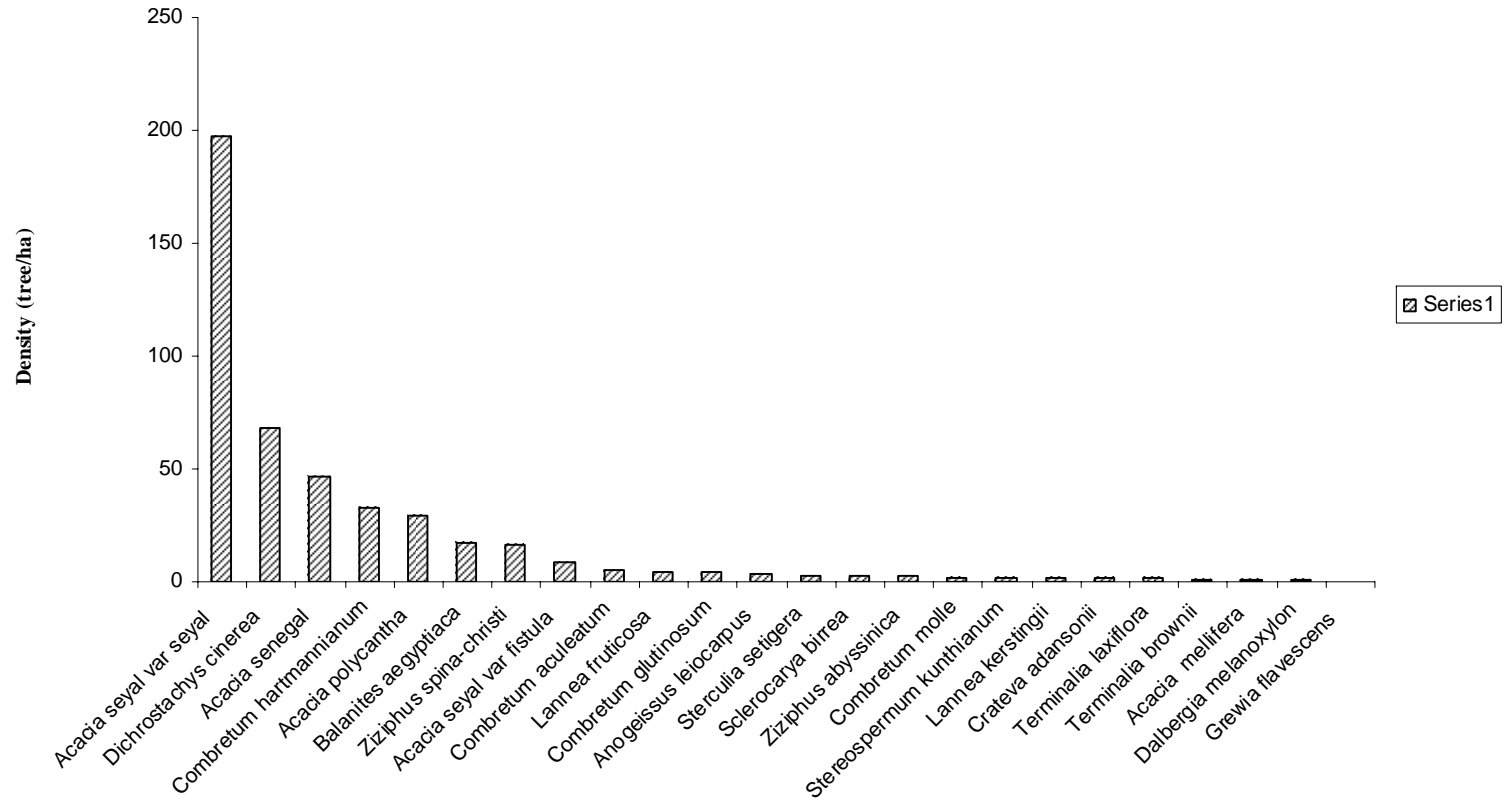


Figure 12: Histogram showing the average density (tree/ha) of the dominant species in site A.

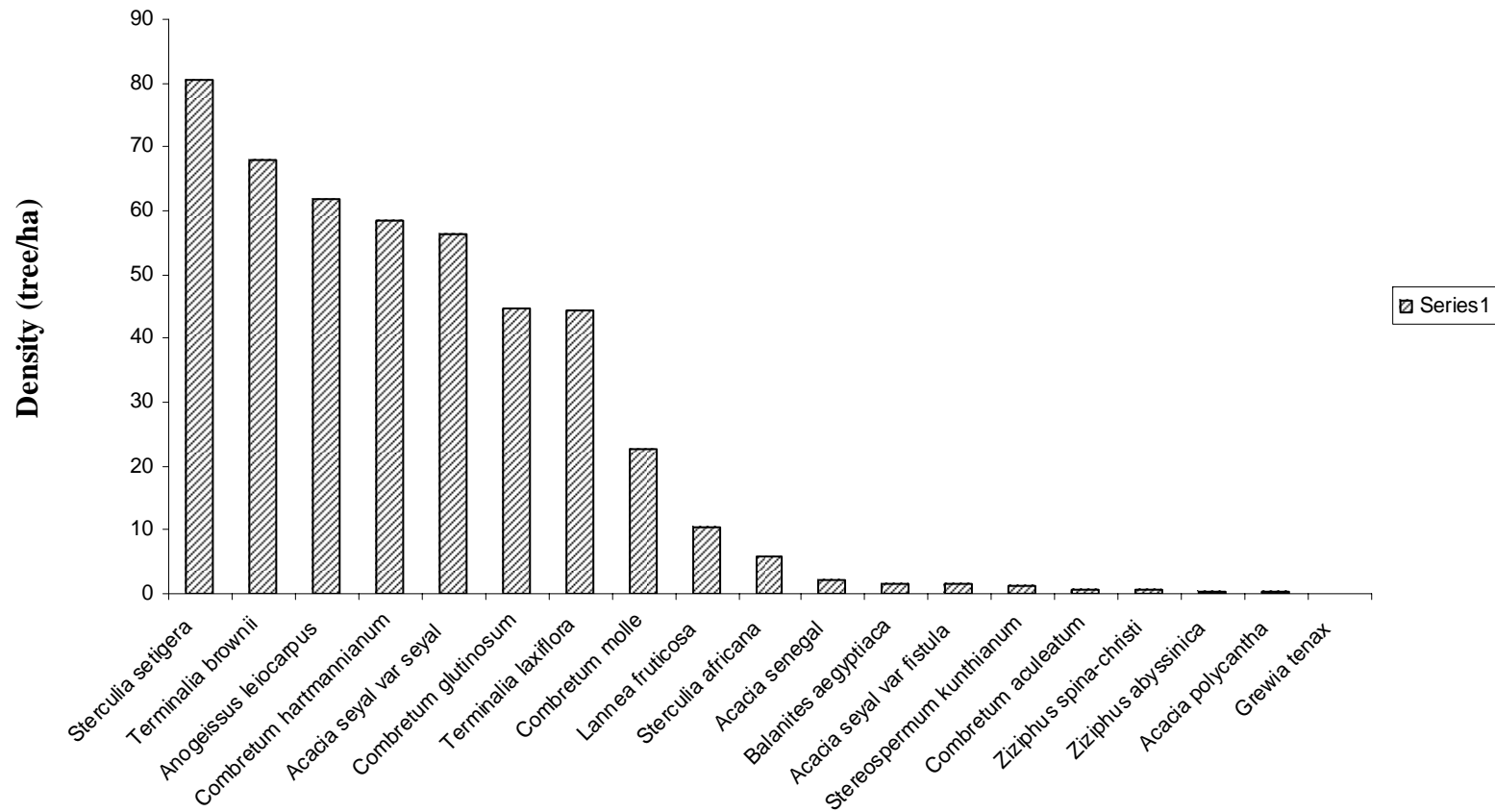


Figure 13: Histogram showing the average density (tree/ha) of the dominant species in site B.

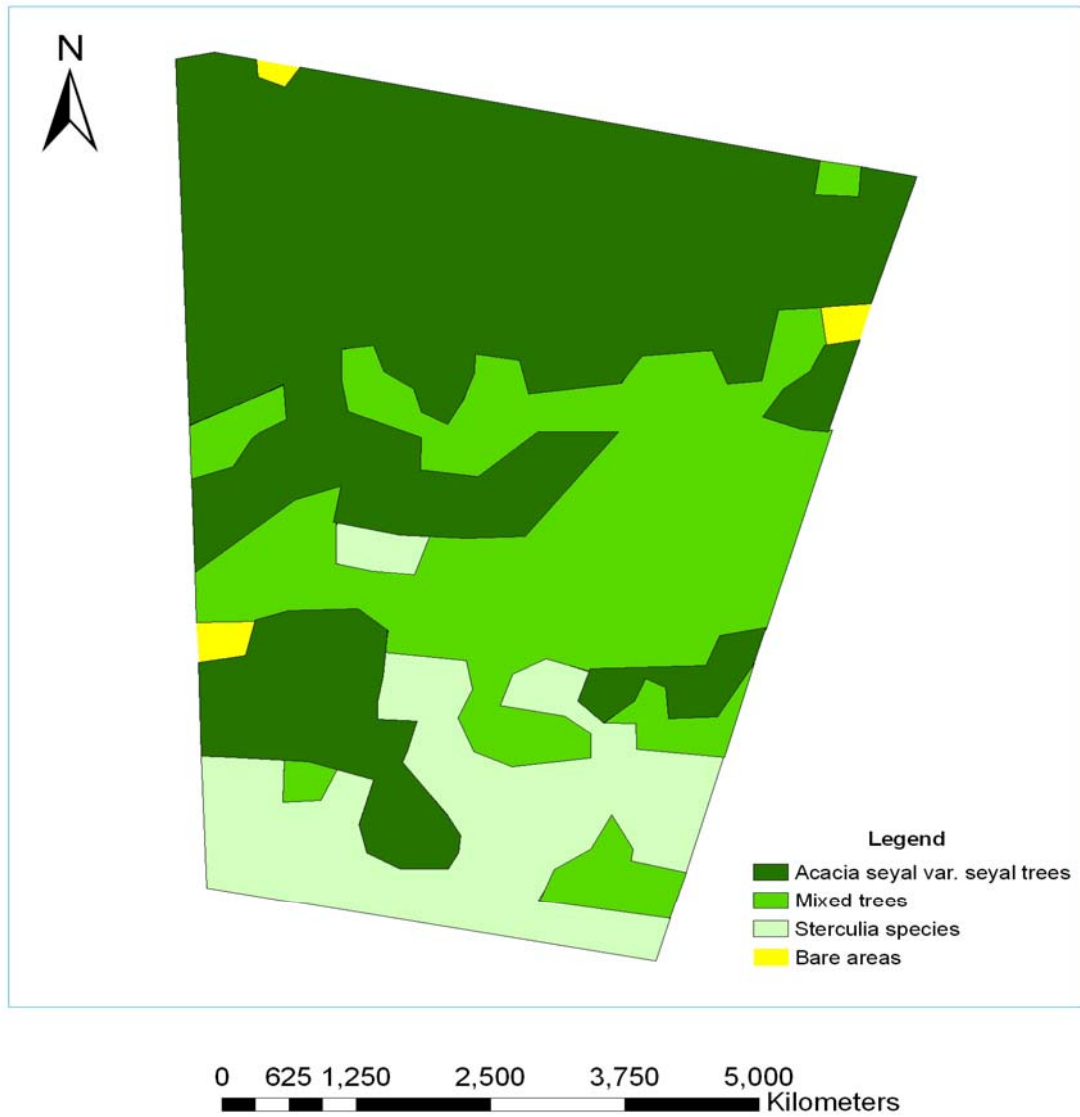


Figure 14: Showing the species composition of El Nour natural forest area.

CHAPTER FIVE

Conclusion

The study identified 54 plant species that belong to 20 families (19 dicotyledonae and 1 monocotyledonae) of which 3 are sub-families and 36 genera. The collected species were revised for botanical names, synonyms and vernacular names and were updated to the recent available literature nomenclature. The identified species were grouped according to height into 22 species large trees, 12 small trees, 18 shrubs and 2 woody climbers. The identified species were described to highlight the diagnostic features, and were arranged alphabetically. High quality digital images were used in the illustration of the prevailing flora in support and completion of the taxonomic description. Family characteristics were extracted from intensive revision of the scientific literature. The diagnostic features of the studied species were used in keys construction. The main findings include the following:

- The study reported for the first time the presence of the family Ochnaceae which is represented by one species in the forest area which is *Ochna afzelii* R.Br. ex Oliver.
- The species *Diospyros mespiliformis* (Gugan) and *Cordia siensis* (Andrab) were not found in the study, although their presence was indicated by local people and El Amin, 1990 reported their presence in the Blue Nile State.
- The updated names for the families Capparidaceae to Capparaceae and leguminaceae to Fabaceae were used in this study. Also, the updated subfamilies Mimosoideae, Casealpinioideae and Papilionoideae were used instead of Mimosaceae, Caesalpinaceae and Papilionaceae, respectively.
- Within and between the study sites of El Nour natural forest reserve, the

vegetation composition is varying with climatic, soil and edaphic factors, in addition the forest is under great pressure from the local communities and their livestock. The clearance of several areas around the settlements for cultivation of various crops, over cutting and lopping of trees and shrubs for housing and fencing, and intensive grazing were identified to be the main factors of the vegetation changes and loss of biodiversity in the forest area especially high value trees (the number of tree species identified by El Amin in 1990 in the Blue Nile was 106, while this study identified 53 species). This is clear in the disappearance of *Acacia sieberiana* (Kuk), *Diospyros mespiliformis* (Gogan) and *Cordia siensis* (Andrab).

- A number of species are considered as endangered in the study area due to their very low relative density that resulted from the intensive illegal exploitation, and personal communications with the local inhabitants insured their past presence in and around the forest. These species are listed below:

No	Species	Family	Vern. names	Habit
1	<i>Adansonia digitata</i> Linn.	Bombacaceae	Tabaldi	Tree
2	<i>Ochna afzelii</i> R.Br. ex Oliv.	Ochnaceae	Lessan al klib	Small tree
3	<i>Grewia flavescens</i> Juss.	Tiliaceae	Abou Dlouae	Shrub
4	<i>Grewia mollis</i> Juss.	Tiliaceae	Guddeim Basham	Shrub
5	<i>Grewia tenax</i> Ascher & Schweinf.	Tiliaceae	Guddeim	Shrub
6	<i>Balanites aegyptiaca</i> (L.), Del.	Balanitaceae	Hegleeg	Tree
7	<i>Cadaba rotundifolia</i> Forsk.	Capparaceae	Kurmut	Shrub
8	<i>Xeromphis nilotica</i> Stapf.	Rubiaceae	Shidr el Marfein	Small tree
9	<i>Gardenia lutea</i> Fres.	Rubiaceae	Abu Gawi	Small tree
10	<i>Ochna afzelii</i> R.Br. ex Oliv.	Ochnaceae	Lessan al klib	Small tree
11	<i>Dalbergia melanoxylon</i> Guill. & Perr.	Papilionoideae	Abnos - Babanos	Small tree
12	<i>Lonchocarpus laxiflorus</i> Guill. & Perr.	Papilionoideae	Khashkash Azrag	Small tree
13	<i>Piliostigma reticulatum</i> (DC.) Hochst	Caesalpinioideae	Kharub	Shrub
14	<i>Boswellia papyrifera</i> (Del.) Hochst.	Burseraceae	Trag Trag	Small tree

It is recommended that:

- Further studies must be conducted at different times of the year especially during the early rainy seasons to capture for the perennials and short-lived annual species.
- Since the vegetation of El Nour Natural Forest Reserve is endangered by malpractices of man, it is advised that a working plan have to be designed for controlling the man's impacts on the environment and equally the provision of proper information on forest management by so doing, the El Nour Natural Forest Reserve with its rich flora would be preserved.
- Sustainable management of the El Nour Natural Forest Reserve needs a set of information to be available regarding the vegetation composition of the forest, environment, community around and the interaction between them.
- There is need for dividing the forest area into compartments in order to regulate the miss-use of the land and planning for sustainable resource utilization and conservation.
- Attention should be paid to the local communities around the forest to participate strongly, with the forest authorities toward conservation and rehabilitation of El Nour Natural Forest Reserve.
- There is need for reseedling or replanting the endangered woody species for enhancing plant diversity in the study area.
- There is current need for national, regional and global financial and technical aid to rehabilitate the forest area.

REFERENCES

- Abdalla, W. E. (1997).** The Flora of The Nile Banks in Khartoum State, with special reference to Medicinal and Folkloric uses. M.Sc. Thesis, Botany, University of Khartoum, Khartoum.
- Adam, A. W. (1998).** Ecological Aspects and Dynamics of selected Woody Plant Formations in Jebel Marra Mountains, Western Sudan. M.Sc. Thesis, Forestry, University of Edenbhra, Germany.
- Andrews, F.W. (1947).** The flora of Erkawit, trees and shrubs. Department of Agriculture and Forestry. Bull. No. 1, Khartoum.
- Andrews, F.W. (1948).** Vegetation of the Sudan, In Agriculture in the Sudan (ed. J.D. Tothill), Oxford University Press, Oxford.
- Andrews, F.W. (1949).** Vernacular names of plants as described in Flowering plants of Anglo-Egyptian Sudan (Vol. 1) Mc. Coroudale and Co. (Sudan) ltd.
- Andrews, F.W. (1950).** The flowering plants of the Anglo-Egyptian Sudan (Vol. 1). T. Buncl E. and Co. Ltd., Arboath.
- Andrews, F.W. (1952).** The flowering plants of Anglo-Egyptian Sudan (Vol. 2). T. Buncl E. and Co. Ltd., Arbroath.
- Andrews, F.W. (1953).** Vernacular names of Anglo-Egyptian Sudan (Vol. 2). Mc. Coroudale and Co. (Sudan) Ltd.
- Andrews F.W. (1956).** The flowering plants of the Anglo-Egyptian Sudan (Vol. 3). T. Buncl E. and Co. Ltd., Arbroath.
- Badi, K. H. and Ahmed, A. E. (1989).** The Forests of the Sudan. Khartoum.
- Bebawi, F.F. and L. Neugebohrn (1991).** A review of plants of Northern Sudan, with special reference to their uses. Eschborn. Germany.
- Blue Nile province, (1984).** Landsat report Vol-1- Metrology- July.

- Boulos, L. (1983).** Medicinal plants of Northern Africa. Inc. Algonac Michigon.
- Braun, A. F. and Massey, R. E. (1929).** Flora of the Sudan. Thomas Marby and Co. London.
- Brenan, J. B. M. (1983).** Manual on Taxonomy of Acacia species. F.A.O. of the United Nation Rome.
- Burkill, H. M. (1985).** The Useful Plant of West Tropical Africa, Vol 5.
- Crowfoot, G. M. (1928).** Flowering plants of the Northern and Central Sudan. Orphan's Printing Press, London.
- Daoud, H.S. (1985).** Flora of Kuwait (Vol. 1) Dicotyledoneae. K. P. L. Ltd.
- El Amin, H. M. (1972).** Taxonomic studies on Sudan *Acacia*. M.Sc. Thesis, University of Edinburgh.
- El Amin, H. M. (1973).** Sudan Acacias. Bull. No. 1 Forest Research Institute, Khartoum.
- El Amin, H. M. (1990).** Trees and Shrubs of the Sudan. Ithaca Press, Exeter.
- El Awad, A. A. (1995).** Ecotaxonomical Studies of Red Sea State, Sudan. Ph.D. Thesis, University of Khartoum, Khartoum.
- El Din, A. S. and Obeid, M. (1970).** Ecological Studies of the Vegetation of the Sudan, IV, The Effect of Simulate Grazing on the Growth of *Acacia Senegal* (L.) Willd. Seedlings, Journal of applied Ecology, 8(1):211-216.
- Elffers, J. R. A. Graham and G. P. Dewolf (1964).** Capparidaceae in: Flora of tropical Africa (eds. C.E. Huddard. & E. Milneredhead) Crown Agent for overseas government's administration. London.
- El Ghazali, G.E.B. (1983).** A study on the Compositae of Khartoum Province. B.Sc. dissertation, Botany Department, Faculty of Science, University of Khartoum, Khartoum.

- El Ghazali, G.E.B. (1985).** The flora of the Eastern Nuba Mountains with special reference to medicinal plants, M.Sc. thesis, University of Khartoum, Khartoum.
- El Ghazali, G.E.B. (1986).** Medicinal plants of the Sudan, part 1: Medicinal plants of Erkawit, National Council for Research, Khartoum.
- El Ghazali, G. E. B., E. A. Bari, A. K. Bashir and A. K. M. Salih (1987).** Medicinal plants of the Sudan. Part II: Medicinal plants of the Eastern Nuba Mountains, National Council for Research, Khartoum.
- El Ghazali, G. E. B., M. S. El Tohami and A. A. B. El Egami (1994).** Medicinal plants of the Sudan, part III: Medicinal plants of the White Nile Provinces, National Council for Research, Khartoum.
- El Ghazali, G. E. B. (1997).** The promising medicinal plants of the Sudan. National Council for Research, Khartoum.
- El Ghazali, G. E. B. (1997).** Medicinal plants of the Sudan. National Council for Research, Khartoum.
- El Ghazali, G. E. B.), H. E. Khalid, M. S. El Tohami, W. E. Elsadig, and S. M. A. Yagi (1998).** Medicinal plants of the Sudan. Medicinal plants in Khartoum State, National Council for Research, Kartoum
- Elobeid, M. M. (2000).** Comparative Studies on the Effect of Progressive Soil Drying Treatment on Some Physiological and Growth Parameters of *Eucalyptus citriodora* and *Eucalyptus camaldulensis* Seedling, M.Sc thesis, University of Khartoum, Khartoum.
- Elsafori, A. K. (2000).** A study on the flora of Al Faw Hills, (Eastern Sudan), M.Sc thesis, University of Khartoum, Khartoum.
- Elsafori, A. K. (2006).** Eco-taxonomic Study on the vegetation of Um Rimmitta Area, White Nile State (Central Sudan), Ph.D, thesis, University of Khartoum, Khartoum.

- Forest National Corporation (FNC) annual report, (2002).** Blue Nile State-Sudan.
- Gumaa, N. A. (1988).** The flora of the Ingessana Hills, S. E. Sudan, with special reference to the Kors areas during January to August, Ph.D, thesis, University of Khartoum.
- Halwagy, (1961).** The Vegetation of Semi-desert North East of Khartoum.
- Halwagy, (1963).** The Succession of Vegetation on Some Islands and Sand banks in the Nile near Khartoum , Sudan.
- Harrison, M. N. & J. K. Jakson, (1958).** Ecological Classification of the Vegetation of the Sudan. Sudan Forestry Department Bulletin, No.2:1-45.
- Hassan, M. H. (1974).** An Illustrated Guide to Plants of Erkwait, Eastern Sudan. Khartoum University Press, Khartoum.
- Hutchinson, J. M. and Dalziel (1927).** Flora of West Tropical Africa. Vol. 2 (2nd edition). Crown Agents of Overseas Governments and Administration, London.
- Hutchinson, J. M. (1964).** The genera of flowering plants, Dicotyledons. Vol. 1 printer, Oxford University.
- Ibrahim, M. M. (1996).** The flora of the Gash Delta, Eastern Sudan. M.Sc. Thesis, University of Khartoum, Khartoum.
- Ikram, M. A. (1997).** Ecotaxonomy of El Rwakeeb Area, West Omdurman, Khartoum State, (A case study of degradation of an arid area in Sudan). M.Sc, Thesis, Uninversity of Khartoum, Khartoum.
- Kokwaro, J. O. (1993).** Medicinal Plant of East Africa (2nd edition). General printer Ltd., Nairobi.
- Maydell, H. J. V. (1986).** Trees and Shrubs of the Sahel, their characteristics and uses. (GTZ)., Egchborn.
- Milne-Redhead and Polhill, (1967).** Flora of Tropical East Africa.

- Obeid and Mahmoud (1968).** The Vegetation of Khartoum Province, Sudan Notes and Records 50: 135-159.
- Sahni, K. C. (1968).** Important trees of Northern Sudan. Khartoum University Press, Khartoum.
- Sudan Annual Needs Assessment, (2001).**
- Smith, J. (1949).** Distribution of tree species in the Sudan in relation to rainfall and soil texture. Ministry of Agriculture. Sudan Government. Bull. Vol. 4.
- Sommerlatte, M. (1990).** A field Guide to the Trees and Shrubs of the Imatong Mountains, Southern Sudan. English Press Ltd., Nairobi.
- Sudan Annual Needs Assessment, (2001).**
- Thirakul, S. (1984).** Manual of Dendrology, Bahr El Ghazal and Central Regions: Groupe Poulin, Theriault Ltee Consultants, Quebec.
- Turril, N. B. Milne-Redhead (editors) (1952-1991).** Flora of Tropical East African. Royal Botanical Garden, Kew.
- Tutu, S. O. (2002).** Trees and Shrubs of Shambat Area: Taxonomy, Growth, Natural regeneration and Uses, M.Sc thesis, University of Khartoum, Khartoum.
- Voget, K. (1995).** A Field worker's guide to the Identification, Propagation and uses of common trees and shrubs.
- Walsh, (1991).** Climatic zones of Sudan.
- Whiteman, (1971).** The geology of the Sudan Republic, Clarendon Press, Oxford.
- Wickens, G. E. (1976).** The flora of Jebel Marra and its geographical affinities. Her Majesty's Stationary Office, London.
- Wickens, G. E. (1991).** Natural vegetation in the Agriculture of the Sudan (ed. G. M. Craig). Oxford University Press, Oxford. of Dry land Sudan.