Sustainable Utilization of Wildlife Resources

In Radom Biosphere Reserve

(Final Report)

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Introduction:-

Sudan is an African country located within the tropical region (partially occupying the Sahara and Equatorial zones). Owing to Harrison and Jackson (1958) Ecological classification of the vegetation of Sudan, Sudan has a great variety of climate and ecosystems including the sub-Sahara, Savannah, Wooded Savannah, Sudd swamps, lakes, river floodplains, hills and coastal regions (figure2). Each with distinct group of faunal and floral compositions creating diversed ecosystems and as a result a good representation of the African wild species, which are considered to be of great economic, scientific, recreational, biological and cultural values, which need to be protected and sustainably managed, as a consequence the government allocated 1 188 470 hectare for the conservation purposes and working within this context in collaboration with the local, regional and international nature and wildlife conservation bodies around the world to face the challenges threatening the well-being of the wild species.

Radom National Park is one of the two internationally recognized Biosphere Reserves in Sudan, it lies in the south-western corner of Darfur state adjacent to the border with the republic of central Africa on Congo watershed system between longitude 23° 20° 00″– 24′ 46′ 00″ E. and latitude 8° 45′ 00″ – 10° 00′ 00″ N. It is located within the wooded Savanna, the bulk of which is almost intercepted by Adda and Umblasha seasonal rivers confluence, covering an area of about 6000 square miles - about 155,399 hectares. annual rainfall range between 900-1700 mm while mean annual relative humidity range between 57-65%. The average annual temperature is 16-27 C° (Hakim *et al* 1974).

The drainage system of the Park is well developed and so far influenced by the underline structural feature which is predominantly basement complex comprises four main network namely are the following:

1- Adda valley drainage system which influences the central-southern and north eastern parts of the Park (50% of the Park area), to foster Adda river on its course down stream.
2- Um Blasha valley drainage system which is regarded as dentirc rectangular covering 25% of the area to enrich Um Blash river.
3- Diofo valley drainage system which is classified as rectangular system (covering 15%) and contribute to the water regime on the eastern part .
4- Khadra valley drainage system network which covers about 5% is generally rectangular and flows eastwards (Tirba 2001).

The above mentioned network contributes water to Bahr El Arab which in turn replenishes the White Nile before its confluence at Khartoum town. The area is characterized by tow main seasonal rivers, Adda and Um Blasha, in addition, streams and pools on the south and south west boundaries adjacent to the international border with the Republic of Central Africa. The parks ndary starts on higher altitude of the Congo plateau forming a watershed system from which tributaries send down to Radom town to form Bahr El Arab. These tow rivers represent the main source of the water in the Park, beside them there are few small streams (Khors) flow from the east and the southern parts of the Park, namely are Sirri, Rikki and river Eimmi. It should be noted that within Adda vicinity, a number of water resources including boreholes and Birkas (Pools) are scattered all over the area (Figure 1-4).

Generally the Park is almost completely covered by rivers, streams, permanent pools (Tirba 2001).

The importance of natural resources exploitation within Radom Biosphere Reserve has increased since 1974 following the survey mission to the area held by Mr. Field (WWF expert), and followed a second expedition organized by a panel of scientists from Wildlife Research Centre during 1976 who set a number of recommendations prior to the declaration of the national park. This effort unfortunately met only minor attention from the government authorities to conserve and manage these resources.

Based on these facts, there would be promising opportunity to enjoy benefits offered by wildlife sector if proper conservation policy being adopted (Hakim *et al* 1978).

The main objectives of this study are to:

1- Quantify flora, avifauna and faunal communities of Radom Biosphere Reserve

2- Identify the ecosystems of the Park.

3- Provide guidelines for integrating local communities to the park management.

Figure number (1):Location of Radom Biosphere Reserve

Figure number (2): Approximate Ecological Zones (Sudan).

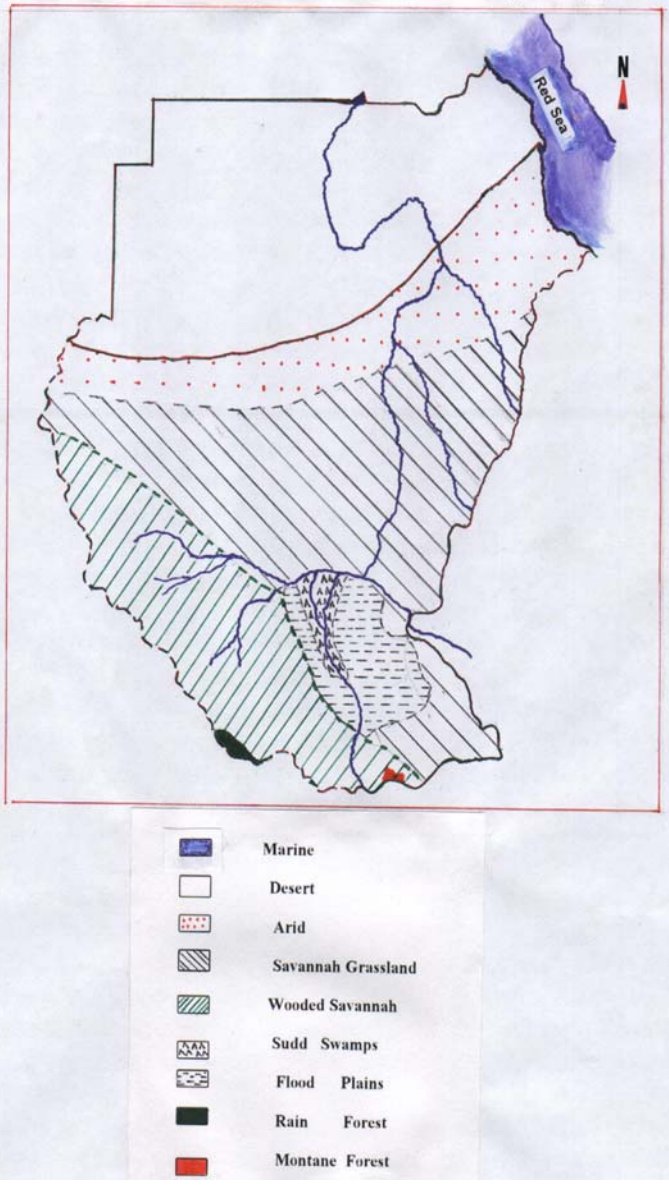


Figure number (3): Radom Biosphere Reserve (Topography)

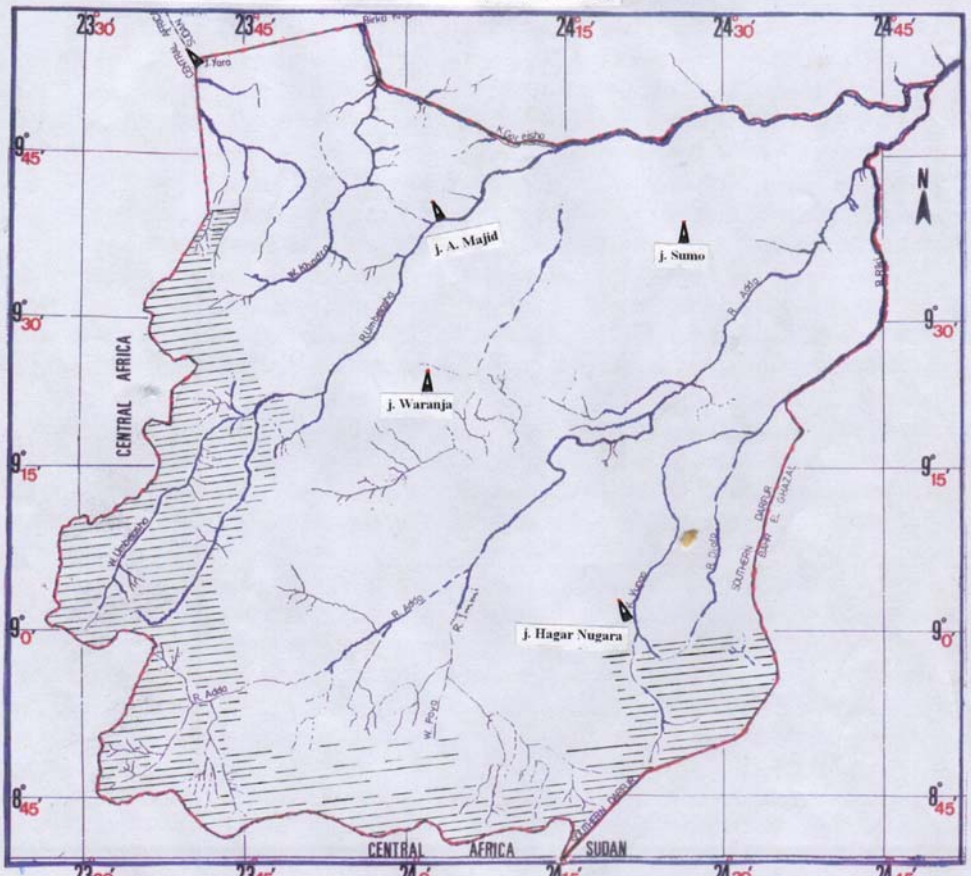
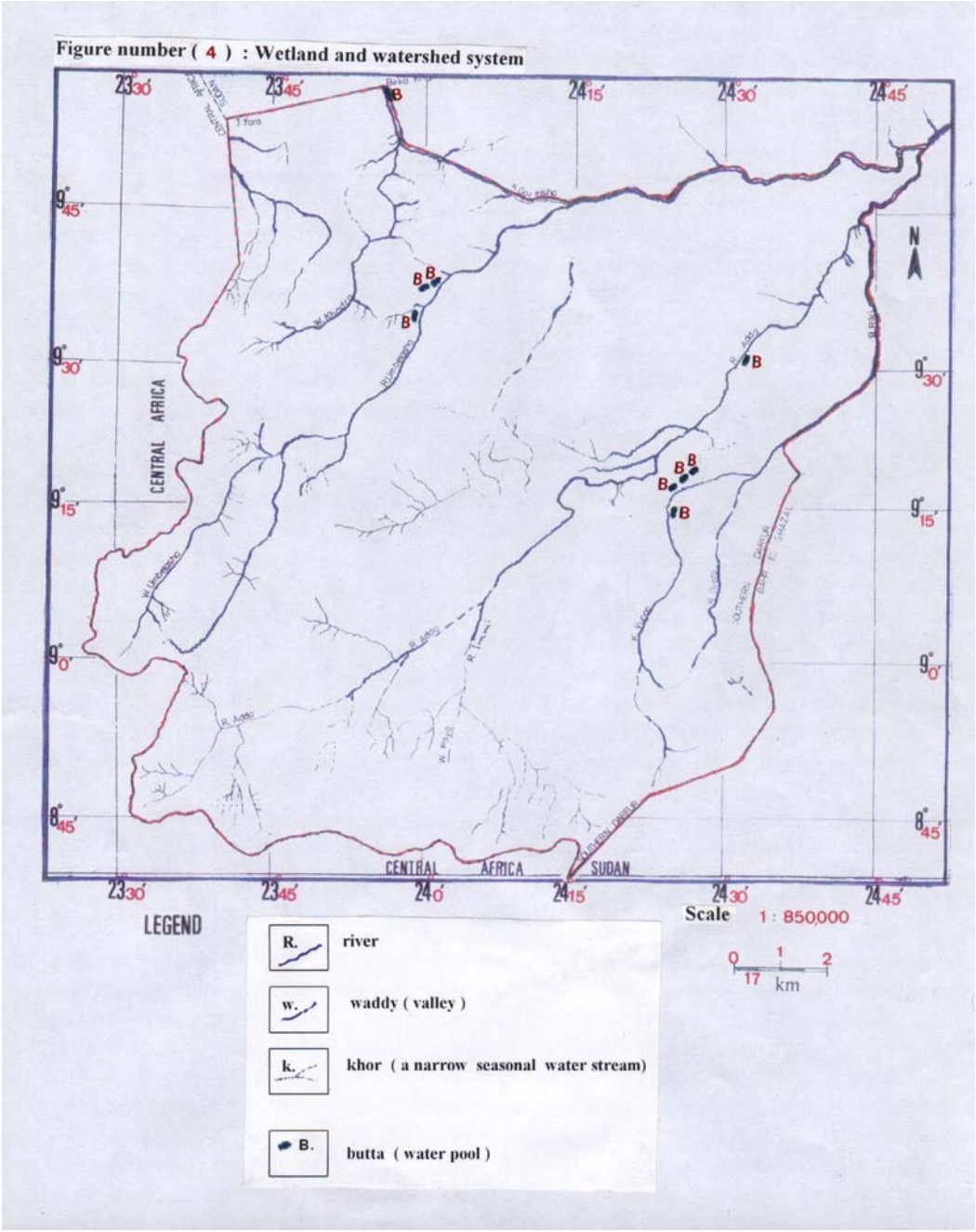


Figure number (4) : Wetland and watershed system



METHODOLOGY

The sampling techniques applied during the process of carrying out the current study involved the use of sample plots and questionnaires as two main methods for data collection. From the other hand secondary data were obtained through personal communications and reference consultations.

1- Sample plots:-

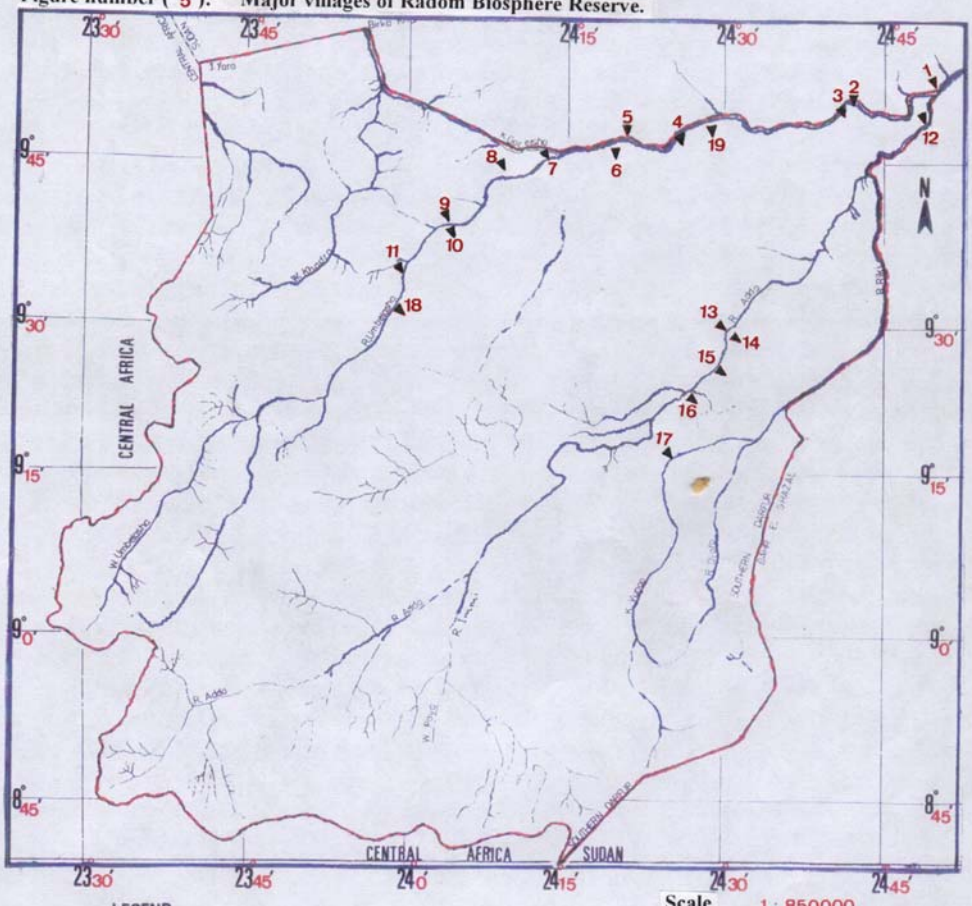
A total number of 42 transects within which circular sample plots (stations) were randomly arrayed, each transect of an area of about 10 hectare was established at different locations within the Park with intervals of 10 kilometres separating every two adjacent sub-plots, within which distribution of natural resources (fauna and flora) were quantified. A total number of 41 plots were allocated during the study adjacent to the main road which was held as a central line for each transect (reference point) to represent distribution of different resources along and within the Adda river sector. Likewise, similar arrangements were done for Umblasha river system. A total area of about 533 sq. meter has been surveyed using circular plots each of a radius of 5.6 m. situated 25 meters off-road on the right side of the sampling tracks (radom-Dafag, Radom-Kafiakingi, Kafindebi-Songo and Songo-Waranja hill) figure 5. During the survey process data on the floral composition were collected by employing GPS, compass, measuring tape and hagaltimere. DBH and height of all trees were recorded and analysed.

It is notable that along each (track) visual observations within a sight range of 50 meter were conducted (road counts) in order to determine numbers and species of wild fauna to get an inference on their distribution alongside the survey tracks.

2- Questionnaire (s):

A number of questionnaire papers were developed in intention to obtain a general idea on the socioeconomic status of the displaced people, hence to seek solutions to compromise their living conditions in a way that does not conflict with the conservation policy. Within this context three groups of key informants were recognised and separately interviewed. These included the community leaders (Omads and Sheikhs), local inhabitants and government official members.

Figure number (5): Major villages of Radom Biosphere Reserve.



LEGEND

▼ village

Scale 1 : 850000

0 1 2
17 km

1- Radom 2- Mesheitir 3- Bireikat 4- Um Gudul 5- Songo
6- Al Hufra 7- Gimeza 8- Deim Bushara 9- Chili West 10- Chili A. Majid
11- Dafag 12- Titribi 13- Kafindibei W. 14- Kafindibei E. 15- Amara
16- Um Hugar 17- Kafiakingi 18- Karmandoura 19- Shioulla

A total number of 57 questionnaire papers were processed and analysed pertaining to information regarding the socioeconomic status of the population of displaced people inhabiting nine villages.

Results and discussions

The area of Radom Biosphere Reserve is infested by tse tse fly- *Glossina* sp. It imposed great limitations on livestock presence into the area, though providing wild animals with vast areas rich of pasture due to their relative tolerance.

In the past few decades poaching took place both within and around the park during the dry season. When practices of hunting were changed from subsistence to commercial, the old traditional primitive tools such as bows, arrows and traps which villagers customarily used to hunt small game animals has no longer been replaced by modern weapons. Automatic arms and poisonous substances have modified the hunting behaviour (hunting techniques) of many people. Therefore, many poachers resorted to hunt different species in big quantities. This activity was financed and encouraged by the local merchants in order to maximize their yields of sun-fried meat which brings in handsome profit (personal communications, 2001).

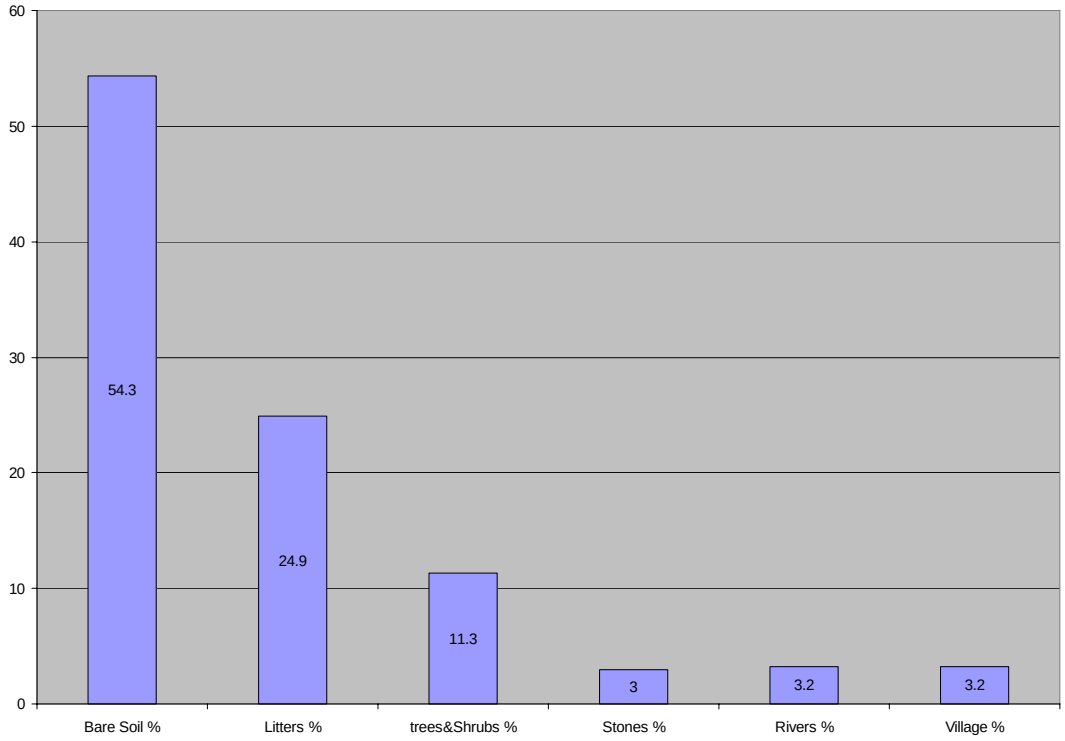
Chart 1 shows that 54.3% of the Park is bare soil while 25%, 11.3%, 3% 3.2% are litters, trees and shrub, stone, rivers and villages respectively. The observations reveal that Radom Biosphere Reserve is a rich in its species biodiversity (appendices 1-20) for instance, a sample plot, with a radius of 5.6 meter showed more than eight plant species for every single sample plot.

1- Fauna and flora

The park has a good reputation of sustaining a great variety of animal species in the early sixties, particularly when game posts were established in the park but, due to the un-incredible flow of people to the Park during 1985's famine era, much pressure has been put on the different game species and wood resources of the park, as a result, animals which were frequently seen in the park during that period such as tora harte beest (*Alcelaphus buselaphus*), has completely disappeared, others such as elephant (*Loxodonta africana*) and buffalo (*Syncerus caffer*) which were used to frequent the rangelands within the park in good numbers during the rainy season could no longer be seen.

From the other hand, animals which show existence at the present time and frequently seen include bushbuck (*Tragelaphus* scriptus), spotted hyaena (*Crocuta crocuta*), stripped hyaena (*Haeana hyaena*), baboon (*Papioanubis sp*), warthog

Chart (1): Radom Biosphere Reserve Land Cover Assessment



(*Phacochoerus aethiopicus*), patas monkey (*Erythrocebus patas*), green monkey (*Cercopithecus aethiopicus*), ratel (*Mellivora* capensis).

It is quite evident that considerable numbers of African wild birds could be seen and identified in the park including tufted guinea fowl, (*Numida meleagris*), saddle-billed stork (*Ephippiorhynchus senegalensis*), Abyssinian ground horn-bill (*bucorvus abussinian*), secretary bird (*Sagittarius serpentarius*), bustard (*Otis Kon*) Marabou stork (*Leptoptilos crumentiferus*), crowned crane (*Balaerica Pavonina*) and miscellany of small birds (John 1986).

Reptalian species frequently observed within the area include the well known African python (*Python seba*), tortoise (*Testudo sulcatus*) crocodile (*Crocodilus niloticus*), monitors (*Varanus niloticus*) and small lizards (*Agama* spp).See appendix (2).

The area is dominated by Anogessus,. Khaya and Isoberlinea species, therefore, recognized as Anogessus- Khaya-Isoberlinea type. Moreover, other plant species persist including*, Balanites aegyptiaca, Combretum sp. Ficus sycomorus, Tamarendus indica, Pilostigma reteculatum* and many other (Appendix 3), while grass species include among others *Andropogon gayanus*, *Hyperrhenia sp*. and *Oxytenanthera abyssinica*.

It is also of great importance to mention that one of the features that characterizes the area is the extensively scattered mounds of termite colonies which is regarded as an outstandng member of the class insecta that contributes vital elements to the wooded forest systems.

HUMAN-INDUCED HAZARDS

Communities of residents regularly inhabit Radom area incorporates people from several ethnic backgrounds, predominantly occupying areas more or less situated within the vicinity of the main seasonal rivers, and include among others tribes such as Kara, Kerish, Ndogo, bunda, Dinka, Dajo, Berti and Tunjur who inhabit areas around Adda river, whereas other tribal groups in addition to Kara and Kerish such as Binga, Youlu, Faur, Massaleet and Tama inhabit the banks of Umbelasha river and represent the bulk of inhabitants compared to Adda sector to the east and south eastern parts of the Park.

Since the creation of universe, man customarily used to exploit natural resource encountered within his surrounding environs either solitary or in groups of family members. These family member groups rapidly multiplied to generate communities of consumers who play a key role in manipulating the available resources, therefore, it is beyond doubt that human settlements (villages) account for most of the damages experienced within the area, and it is not a surprise that illegal existence inside and within the vicinity of the park would eventually be at the cost of the protected area. It should be brought to light that any effort to resolve the situation must take into consideration remobilization and redistribution of the existing villages in order to evacuate the area from settlers who can at the present time be categorized into main two groups:

- Residents who inhabited the area before it was recognized as a national park, with approximate population number of about 5170 distributed among 13 villages around river Umblasha with Diem Bushara being the furthest station from Radom village (figure 5).
- The second group represents displaced people who immigrated to the area following it's declaration, as a result of natural and socioeconomic changes, which consequently led to intensive human settlement at the north and northwest sides of the Park with a population number of about 10509 during 1990, a number which is known to considerably has risen by now, likewise proportional increase in the number of villages has been realized afterwards to approach 26, initiated by the influx of displaced people and refugees from Darfur, Bahr AlGazal and Chad respectively due to civil war and the attraction of the excellent crop yield reputation of the area (Tirba 2001).

Special concern should be afforded to a third minor-sized group, yet is of substantial importance who cruises the area from southern Darfur to Bahr Al Gazal state twice a year, and who are regarded as potential threat that frequently causes disturbances within the area. Fortunately it represents only a small number of nomadic people who entirely depend on subsistantly on the Park's resources in addition to the byproducts of their livestock which are frequently pulled back by tse tse fly infestation .

It is evident that the new comers are held responsible for most, if not all of the activities regarded as man induced environmental hazards, notably through agricultural activities, overgrazing, extensive poaching, fishing, mining and security related problems.

- Agricultural activities within and around the Park involve elimination of trees of economic values in big areas, either by extensive burning which affects the natural regeneration of vegetation or through logging, and both eventually trigger desertification.
- Overgrazing by domestic stock competes with the needs of wild animals, while on scarce occasions facilitates disease transmission between the wild and domestic species.
- Extensive poaching using advanced firearms always accounts for mass destruction of resources and flourishes the trade of weapons which destabilizes the security situation.
- Fishing by applying poisons to pools frequently results into mass mortality among bird population and other micro organisms of substantial importance in the completion of the biological processes.
- Mining operations at Hofrat Elnihas reflects problems with regard to land use at the decision making level, taking into consideration the devastating effects on the wildlife habitat.
- Security problems that necessitate the presence of forces other than game scouts, often hinder law enforcement and encourage violations.

3- Socio-economic Activities:

1- Education levels of settlers: -

Educational level was so important to implement any socio-economic aspects in the country.

Table (1) Educational levels of the local communities

Educational levels	Percentage (%)
Illiterate	24
Primary school	24
Intermediate	31
High secondary school	21
Total	**100**

Table (1) shows that the local community educational levels comprises 24% illiterates, 24% primary school, 30% intermediate and 21% are high secondary school education level. The results showed no graduates or postgraduates amongst them, a fact that suggests certain techniques to be supplied in order to boost their understanding and awareness of their role in environmental degradation , for which 76% of the total settlers are held responsible in the long run.

Wood cutting:-

Table (2): The source of firewood

The source of firewood	**Percentage**
From the Park	73%
From the market	3%
From forest out the Park	24%
Total	**100%**

Table (2) shows that 73% of the studied cases draw their basic needs of the firewood from the park, while 24% and 3% subsist for their living on the forest outside the park and the market respectively.

The bulk of firewood is used for cooking, lightening and ritual purposes (55%), while 21% of it is for cooking and lightening purposes only as shown in table 3 bellow.

Table (3): The basic uses of firewood

The used of firewood	**Percentage**
Cooking, lightening and ritual purposes	55%
Cooking and lightening	21%
Total	**76%**

Firewood is the main energy source used by the inhabitants for cooking, lightening and ritual purposes (55%). Previously these were collected from cultivated lands around the villages or from forest out side the Park (Direct interview 2002). In the past this did not affect the vegetation cover of the park, but now most of them(73%) are collected from the park itself. The most preferred trees exploited for production of firewood include *Acacia seyal*, *Psedocedrela kotschyii Combretum* sp. and *Anogeissus* sp. The extensive cutting practice of the above mentioned species would

eventually affect their regeneration compared to the other tree species found within the park.

Felling of trees is not practiced for firewood production alone, rather is also carried out to increase the cultivated area. From the other hand, and to a lesser degree is applied during honey harvesting from large trees. However, expansion in agricultural land is usually considered as a solution for productivity declines when the land under cultivation is exhausted coupled with the increase in population.

Agriculture Activities

Chart (2) reveal that the main crops cultivated by the local farmers around the villages include sesame, corn and *Vicia* sp (24%), sesame (15%), and fruits (9%), corn (6%) and hot pepper (3%).

Substantial growth was recorded with regard to the total number of villages which recently amount to 28 village, rather than the other smaller settlement pockets that are under way to grow to big villages due to the proportional increase in the population size through movement of small numbers of family members to the buffer areas (lands allowed for subsistent cultivation by the Sudanese laws), which extends for five kilometres within the park's border, so the inhabitants could keep their crops safe from the wild animals especially primates, but unfortunately never return back to their former villages (mother village) upon termination of the cropping season and rather tend to permanently occupy the new territories for many years to come. This devastating behaviour results into confiscation of more lands to their advantage and, eventually gives rise to new crowded villages to emerge. On contrary more complications and loss of public lands takes place.

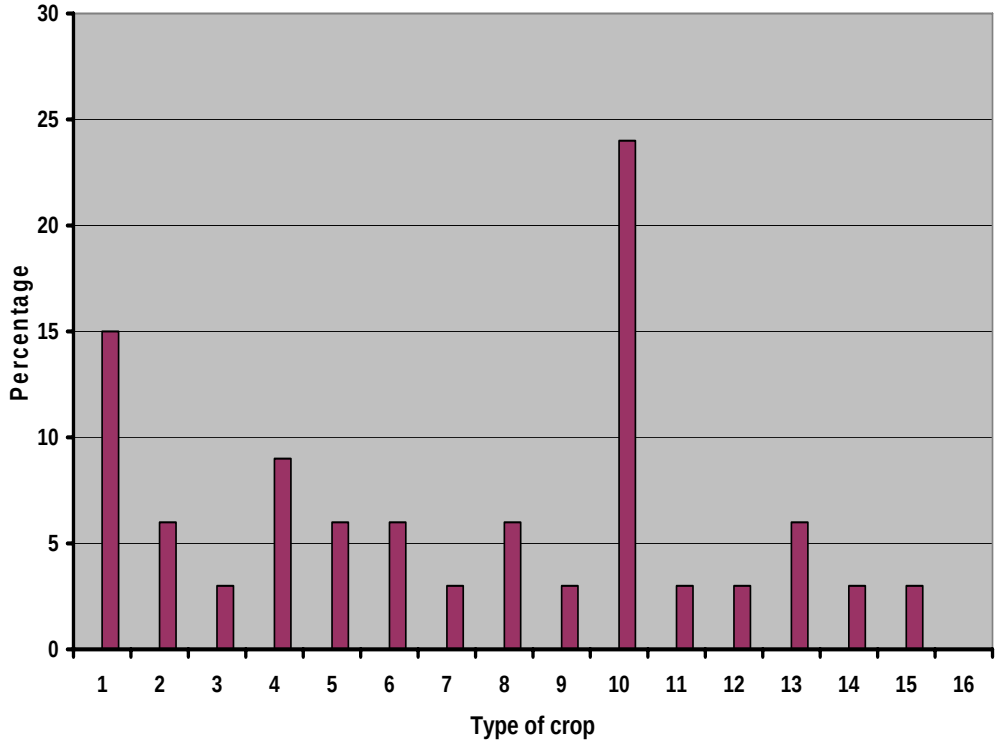
This new proliferation could take place when new comers (immigrants) of the same ethnic or relative groups are encouraged to invade a new promising land following their arrival.

Generally it could be said that higher population densities inhabit the banks of Umbelasha rive at the northern part of the park, and to lesser extent the areas surrounding Adda rive to the east. Based on the distribution of the people, quite good amount of natural resources are under intensive pressure in the former areas compared to the latter, where greater number of citizens live, and partially due to the ease of movement, a fact that encourages adventurers to invade the area and consequently become an element of uncontrolled exploitation of natural resources found within and around the park. The continuous presence of people within the park boundary, yet is considered to be a driving force leading to the depletion of the park unless best conservation and rational management policies being applied.

Animal species

Owing to the diverse climate and different types of habitats, a variety of ecosystems remained stable until the mid eighties when several adverse forces worked jointly and rendered the situation into severe devastation. It is notable that the numbers of animals showed dramatic decrease during this period, especially when considering

Chart (2): The main crops cultivated in Radom Biosphere Reserve



1= Sesame
2= Corn
3= Hot popper
4= Fruit
5= Sesame and Corn
6= Sesame and *Vicia* sp
7= Corn and *Vicia* sp
8= Hot popper and Corn
9= *Vicia* sp and Hot popper
10= Sesame, Corn and *Vicia* sp
11= Corn, *Vicia* and Fruit
12= Corn, Millet and Fruit
13= Sesame, Corn and *Vicia* sp
14= Sesame, Corn and Millet
15= Corn, *Vicia* sp and Hot popper

factors such as famine, civil war, political unrest and displacement of people, rather than the other environmental damages caused by natural factors such as drought, desertification and deterioration of the soil quality. It is quite evident that the proliferation of automatic weapons was the prime tool accounting for mass destruction of game species, which are considerably employed by poachers to shoot down animals for their meat, leather, ivory tusks and other wildlife by-products of high revenue. As a result, several mammalian game species especially the largest ones such as the African elephant, rhinoceros, lions, tigers, buffalos and many antelopes were targeted, massively cleared and being put to the verge of depletion.

Results of the current study showed that 11 mammalian species exist within the area compared to 24 species lived during the period between 1974 – 1975 (Mr. Field), and 18 species in 1976 (Nimir *et al*, and WRC scientist's panel). Also as much as 11 avian species and seven reptilian species were recorded within the same period (Table4). Moreover, several pools sustain variable numbers of freshwater species distributed all over the protected area, these pools also act at as water reservoirs for both domestic and wild animals during the dry season. It worth mention these viable ecosystems were located alongside the banks of the seasonal rivers, valley beds, narrow water streams (khor) and water pools (Dahal and Butta), which safeguard the well-being of wild animals by providing them with both water and pasture. To this end an efficient management plan of these habitats blended with optimal conservation management policies are prerequisite in any attempt to improve the area.. Reintroduction of the extinct types of animal populations known to inhabit the area previously could only be justifiable by then. Considering the remote areas void of settlements, rich vegetation cover exists providing a good grazing lands for wild species and an excellent asylum. When adverse conditions prevail, animals are usually forced to cross the borders west and southwardly to the Republic of Central Africa where both efficient protection and vast rangelands are available. Also to Bahr Al Gazal sustains a good number of them when tsetse fly infestation recesses southwardly. With special emphasis being placed upon large mammalian groups, fluctuations in the numbers of game species could obviously be seen in, where four wild animal species showed marked increase during the second survey mission, consequently disappeared once again during the present investigation. A possible reason suggests that the differences in the numbers of animals were a mere an outcome of the differences in time-scale (duration of the

Table (4): Wild animal surveys during the period between 1974 -2002

Wild animal species	**Observation**	**Years**		
English name	**Scientific name**	**1974-1975** [+]	**1976** [++]	**2002-2003** [+++]
Red-fronted gazelle	*Gazelle rufirons*	5	-	-
White-eared kob	*Kobus leucotis*	50	110	-
Serval	*Felis serval*	1	-	-
Tiang	*Damaliscus korrigum*	414	230	-
Buffalo	*Syncerus caffer*	2	24	-
Lion	*Panthera leo*	1	-	-
Red monkey	*Erythrocebus patas*	*	*	2
African hunting dog	*Lycoan pictus*	14	12	**
Salt's dikdik	*Madoqua saltiana*	36	46	7
Stripped hyaena	*Hyaena hyaena*	3	-	**
Bushbuck	*Tragelaphus scriptus*	16	2	-
Warthog	*Phacochoerus aethiopicus*	232	159	7
Common jackal	*Canis aureus*	2	**	-
Hippo	*Hippopotamus amphibious*	4	10	-
Bhor reedbuck	*Redunca redunca*	72	12	1
Oribi	*Orebia orebi*	189	26	8
Roan antelope	*Hippotragus equines*	225	117	-
Common Eland	*Taurotragus oryx*	50	-	-
African elephant	*Loxodonta Africana*	12	-	-
Waterbuck	*Kobus defasa*	85	59	-
Ostrich	*Strucio camelus*	-	-	**
Porcupine	*Hystrix cristata*	-	-	**
Colobus monkey	*Colobus abyssinicus*	-	-	6
Green monkey	*Cercopithecus aethiopicus*	-	-	6
Nile crocodile	*Crocodile niloticus*	-	-	1

(-) No observation
(*) Troops or herds
(**) Only traces

Sources:
+ Mr. Field report
++ Nimir *et al* and WRC scientist panel
+++ Current study Researchers

surveys) and total area being surveyed, with more attention given to the single season (late dry season), during which surveys took place in order to circumvent access difficulties associated with the rainy season. In the other hand, deterioration of the security situation so far worked jointly with other circumstances to limit the total area targeted by the current investigation.

It is of considerable importance to draw attention to the fact that nocturnal animals were not excluded from this current investigation due to the above mentioned security issues, which constitutes a valuable component comprising wild animal that population inhabiting the area.

Avifauna

Avian population found within the area showed variety of multiple-sized species. The number of birds inhabiting the area show marked fluctuations throughout the different seasons depending on the climatic factors and topography which both govern water distribution within the area together with their roosting and grazing grounds.

Conclusion and Recommendations

The ongoing strife in Darfur has indeed put great stress on both human beings and the environment as well. This could obviously be seen as massive displacement of citizens in Darfur region added to those formerly migrated from Bahr Elgazal states. As a result, tremendous depletion of resources took place especially those originating from wilderness notably dried meat and wild animal based byproducts. Since 2001, and owing to the continuous deteriorating security situation, it has become a custom for locals in the adjacent Bahr Elarab region to purchase automatic weapons and ammunitions from open air markets within the area for both self protection and uncontrolled poaching a reason that big number of animals were forced to cross the border in search for secured asylums into the neighboring countries. The desperate need for protein by the ever growing human populations coupled with easiness of possessing automatics triggered this grave but, tragic situation whereby several species are believed to have completely migrated and abandoned the area.

On the wake of signing Naivasha peace agreement between the government of the Sudan and the southern rebels which put an end to the southern Sudan quest, resource depletion was in part eased when southerners started to return to their home villages. Similar scenery is anticipated for Darfur when a solid peace agreement is reached, a fact that would help into alleviating the situation. It should be emphasized that both security and food are the ultimate needs of the people, therefore, only permanent peace can stop this misery and bring back conditions stable. This would of course necessitate public awareness program that addresses and reflects both the benefits of peace and the negative impacts of war that eventually affects everyone without any discrimination. Nevertheless, the situation will remain catastrophic unless efficient and sincere disarmament program is agreed upon and jointly accomplished by the warring parties provided that a positive role being played by the international community towards a lasting compromise to the political conflict. The planned program should specify certain areas as weapon free zones that will serve as asylums for wild fauna under full protection by the government of the state. This would be the first step towards enabling the entire environment to recover and restore viability.

It is quite certain that reduction in numbers of uncontrolled weapons would show a positive trend regarding faunal population growth as well as the number of species existing when habitat recovery is restored and strict law enforcement is in effect.

Therefore it could bee said that the future of the reserve rests on the positive responses exhibited by every single person but, substantially on politicians and community leaders who can mobilize people and guide the ship to safe ground that could only be accessed through the tunnel of peace. As a golden rule, every citizen should have a sense of responsibility towards the nation, regional and global environment in general.

It is beyond doubt that when man made great menaces such as war are kept within narrow limits, the dawn of success shall ever be seen.

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Appendices

Appendix 1

Plate 1 . Dryness during the summer season.

Plate 2 . Radom – Songo road. Mahogani trees.

Plate 3 . Kafiakingi. Densed grass cover.

Plate 4 . Kafidibei. A dry Butta (seasonal pool).

Plate 5 . Hagar Nuggarra. Rock outcrops.

Plate 6 . Radom . Termite colonies are distinguised features characterizing the area.

Plate 7. Hagar Nuggarra water pool.

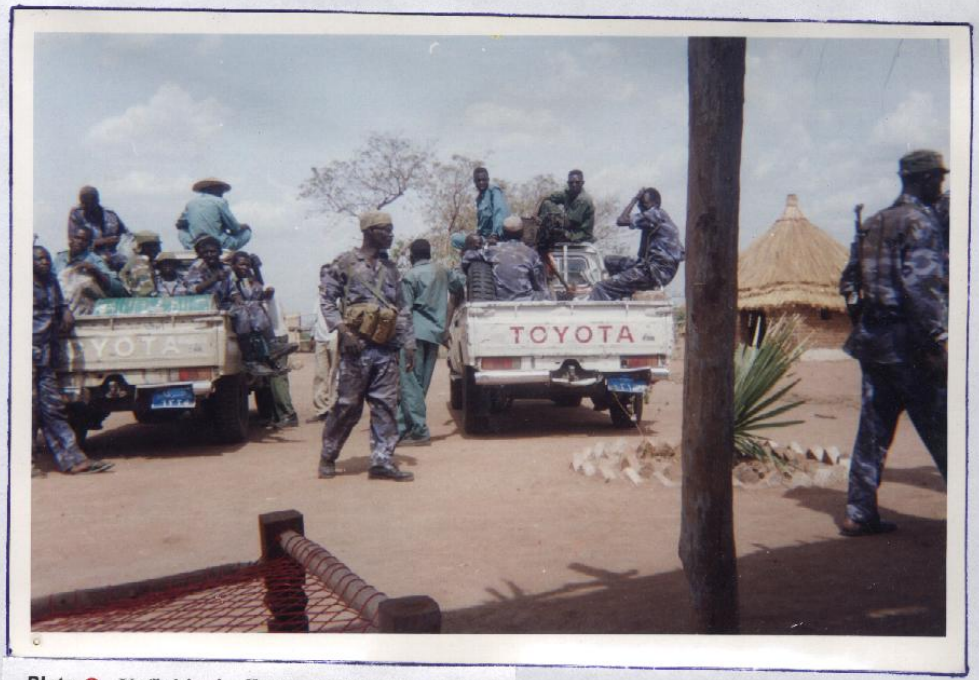

Plate 8. Kafiakingi. Game scout headquarters.

Plate 9 . Dafag. Agricultural activities around water pools (Dahal)

Plate 10 . Clearing of trees for cultivation (Land preparation).

Plate 11 . Fire-felling of trees using burning method.

Plate 12 .Timber obtained through burning is usually effortless activity.

Plate 13. Hufrat El Nihas . Deep ditches for soil sample extraction.

Plate 14 . Dafag pool (Dahal). Traditional fishing boat .

Plate 15. A wooden bridge made to access the protected area during the flood season.

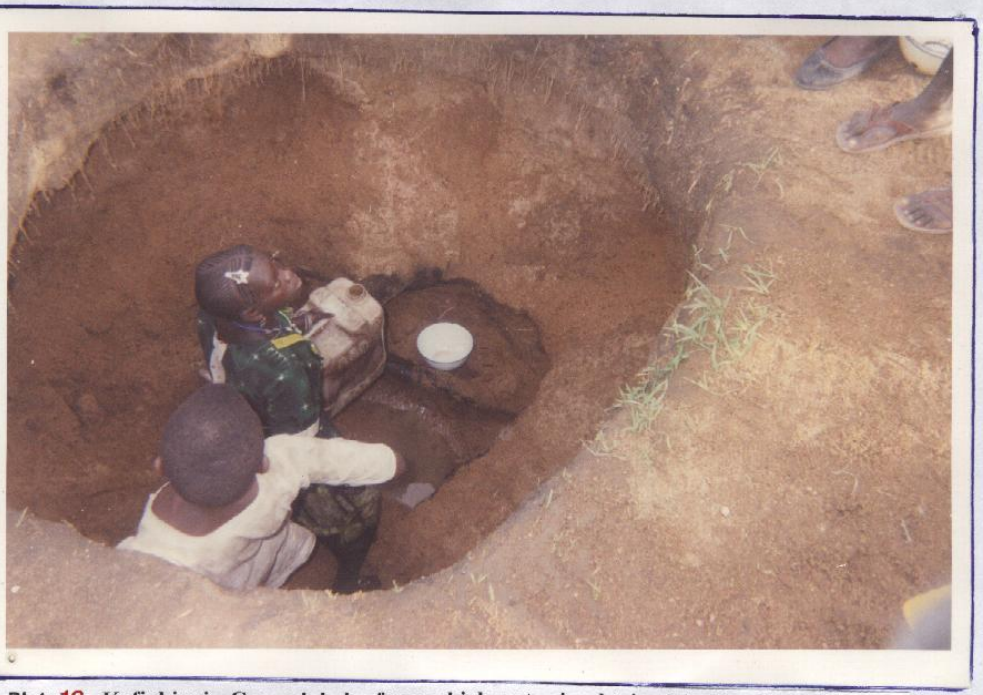

Plate 16. Kafiakingi. Ground holes from which water is obtained during the dry season.

Plate 17 . Kafiakingi. Water is always a prime concern during the summer season

Plate 18 . Dafag village . Interviewing local inhabitants.

Plate 19. Dafag pool (Dahal) . A herd of Ibis.

Plate 20. Settler's summer camp set on fire by a game warden.

Appendex No. (2): List of wild animal species in Radom Biosphere Reserve

English name	Scientific name
Red-fronted gazelle	*Gazelle rufirons*
White-eared kob	*Kobus leucotis*
Serval	*Felis serval*
Tiang	*Damaliscus korrigum*
Buffalo	*Syncerus caffer*
Lion	*Panthera leo*
Red monkey	*Erythrocebus patas*
African hunting dog	*Lycoan pictus*
Salt's dikdik	*Madoqua saltiana*
Stripped hyaena	*Hyaena hyaena*
Bushbuck	*Tragelaphus scriptus*
Warthog	*Phacochoerus aethiopicus*
Common jackal	*Canis aureus*
Hippo	*Hippopotamus amphibious*
Bhor reedbuck	*Redunca redunca*
Oribi	*Orebia orebi*
Roan antelope	*Hippotragus equines*
Common Eland	*Taurotragus oryx*
African elephant	*Loxodonta Africana*
Waterbuck	*Kobus defasa*
Ostrich	*Strucio camelus*
Porcupine	*Hystrix cristata*
Colobus monkey	*Colobus abyssinicus*
Green monkey	*Cercopithecus aethiopicus*
Nile crocodile	*Crocodile niloticus*

Stank (1976).

Appendex No (3): List of trees and shrubs recorded in Radom Biosphere Reserve

Common name	Scientific name *	Habit
Haraz	*Acacia albida* Del.	Tree
Salam	*Acacia gerradia* Benth. Var.*gerradii*	Tree
Talih	*Acacia seyal* Del. Var. *seyal* Brenan	Tree
Kuk	*Acacia sieberiana* DC. Var. *sieberana* Brenan	Tree
Arad	*Albizia amara* (Roxb.) Boiv.	Tree
Sahab	*Anogeissus leiocarpus* (DC) Guill. &Perr.	Tree
Heglig	*Balanites aegyptiaca* (Linn.) Del.	Tree
Gafal	*Boswella papyrifera* (Del.) Hochst	Tree
Habil Elgabel	*Combretum glutinosum* Perr. Ex DC	Tree
Habil	*Combretum lamprocerpum* Diels	Tree
Sudan teak	*Cordia Africana* Lam.	Tree
Dabkar	*Crateva adonsnii* DC	Tree
African black wood	*Dalbergia melanoxylon* Guill. & Perr.	Tree
Kadad	*Dichrostachys cinerea* (Linn.) Wight & Arn	Tree
Jughan	*Diospyros mespiliformis* Hochst.	Tree
African Ebony	*Diospyros mespiliformis* Hochst. Ex A. DC	Tree
Jumeiz	*Ficus platyphylla* Del.	Tree
Gemeiz	*Ficus sycomorus* Linn.	Tree
Abu Gawi	*Gardenia lutea* Fresen	Tree
African mahogany	*Khaya senegalensis* (Desr.) A. Juss.	Tree
Um shatur	*Kigelia africana* (Lam.) Benth.	Tree
Bamboo	*Oxytenanthera abyssinica* A. Rich.	Tree
Abu Khameira	*Pilostigma reteculatum* (DC) Hochst.	Tree
Karoub	*Pilostigma thonningii* (Schum.) Milne-Rdhead Po. (Gol)	Tree
Homeid	*Sclerocarya birrea* (A. Rich.) Hochst.	Tree
Tartar	*Sterculia setigera* Del.	Tree
Khash Khash abeid	*Stereospermum kunthianum* Chm.	Tree
Um bekeisa	*Strychnos innocua*	Tree
Aradeib	*Tamarendus indica* Linn	Tree
Darot	*Terminalia avicennioides* Gull. & Perr.	Tree
Gulait	*Termenalia laxiflora* Engl. & Diels	Tree
Nabak Elfeel	*Ziziphus abyssinica* Hochst.	Tree
Sider	*Ziziphus* spina-christi (Linn.) Desf.	Tree
Duruba	*Psedocedrela kotschy*	Tree

El Amin (1990) Thirakul (1984)