Information Sheet on Ramsar Wetlands (RIS)

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2. Date this sheet was completed/updated:

22nd March 2006

3. Country:

Republic of the Sudan

4. Name of the Ramsar site:

Sudd

5. Map of site included:

a) hard copy :Yes

b) digital (electronic) format :Yes

6. Geographical coordinates:

06° 00' - 09° 08' N
30° 10' - 31° 08' E

7. General location:

The Sudd wetland, situated in the lower reaches of Bahr el Jebel in Southern Sudan, is perhaps the largest tropical wetland in the world. It is located in the administrative region of Southern Sudan Government. The nearest large towns are : Bor (Jonglei State), 890 km from Khartoum; Malakal (Upper Nile State), 654 km from Khartoum; and Rumbek (Lakes State), 1044 km from Khartoum. The population size of Bor is around 93,000; Rumbek 100,000 and Malakal 280,000 (the figures are estimates

based on information provided by NGOs. The last census, in 1993 did not include Southern Sudan because of the war).

The Ramsar Site lies within the floodplains of the Sudd Region. The land is flat with heavy clay soil. Longitudinally, the Sudd wetland falls within three distinct belts. A narrow southern belt extending 146 km long and 10 km wide has a featureless floodplain with a self regulating mechanism that fills and empties to the west (Alliab valley) and east (Mongalla-Jumeiza) depressions. The Flat (gradient of 1.0-1.5 cm/km) central portion of the floodplain extending from Bor to Lake No has a width of 40 km and is the largest. It has a depth of < 10m and water velocity at 1 m/sec. The small northern portion extending from Lake No to the confluence of Bahr Elzeraf with the White Nile is the narrowest and smallest (2 km wide).

8. Elevation:

At 380-450 m a.s.l.

9. Area: (in hectares)

The exact area of the Sudd is not known because it has always been subject to the fluctuations of river discharge and rainfall. Its greatest extend occurs in September but shrinks during the dry season. In periods of high flood and rainfall such as in 1917-1918, 1932-1933 and 1961-1964, the floodplain remained flooded well into the dry season. During periods of low flood and rainfall such as in 1921-1923, the floodplain shrinks to the extent that even the permanent swamps dry up.

The area of the Sudd Wetland Designated Ramsar contains the permanent swamps that extends from Bor to Lake No and is approximately $57x10^5$ ha (5,700,000 ha) in size.

10. Overview:

The word Sudd is derived from an Arabic word, meaning a blockage of river channels, which obstructs navigation. The Sudd wetland is inundated by freshwater inflows from the spill of Bahr el Jebel as well as sheet flow from the runoff of the adjacent flat terrain.

The lateral extent of the Wetland is greatly influenced by the flooding regime and precipitation. Ecologically the Sudd wetland is composed of various ecosystems, grading from open water and submerged vegetation, floating fringe vegetation, seasonally inundated woodland, rain-fed and river-fed grasslands and finally floodplain scrubland.

Hydrologically the Sudd wetland is regarded as a giant filter that controls and normalizes water quality and a giant sponge that stabilizes water flow. It is the major source of water for domestic, livestock, and wildlife use. The Sudd wetland is a wintering ground for birds of international and regional conservation importance and is home to some endemic fish, birds, mammalian and plant species. Migratory mammals depend on the wetland for their dry season grazing.

The occupants living within and adjacent to the Sudd region are almost exclusively Dinka, Nuer and Shilluk. The socio-economic and cultural activities of these Nilotes are entirely dependent on the Sudd wetland. Pasturalism, fishing, game hunting and agriculture are the major economic activities. They depend on the annual floods and rains to regenerate floodplain grasses to feed their cattle. They move from their

permanent settlements on the highlands to dry season grazing in the intermediate lands *(toich)* at the beginning of the dry season and return to the highlands in May-June when the rainy season starts.

11. Ramsar Criteria:

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

12. Justification for the application of each Criterion listed in 11. above:

Criterion (1) *A wetland should be considered internationally important if it contains a representative, rare or unique example of a natural or near-natural wetland type found the appropriate biogeographical region.*

The Sudd wetland is probably the best known natural wetland in Africa because of its size and of its location on the longest river in the world (the Nile). The wetland is an important source of water for domestic use and wildlife as well as livestock production especially for the Nilotic cattle that play a significant role in the cultural history of the Nilotes in its catchment.

Criterion (2) *A wetland should be considered internationally important if it supports vulnerable endangered or critically endangered species or threatened ecological communities.*

The swamps and floodplains of the Sudd support a rich biota and are an important habitat for endangered and or vulnerable wildlife species. Among the mega-herbivores found in the wetland, the elephant (*Loxodonta africana*) is vulnerable (VU). Some antelope species that use the wetland are listed by the IUCN as vulnerable, notable among which are Mongalla gazelle (*Gazella rufifrons albonotata*). Other species include the tiang (*Damaliscus lunatus tiang*, CITES App. III) and Nile sitatunga (*Tragelaphus spekii*, CITES App. III). The vulnerable shoebill stork (*Balaeniceps rex*) can be found at the site too.

Criterion (3) *A wetland should be considered internationally important if it supports population of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.*

The Area supports plant species which are important for the biodiversity of the Sudd region. The Sudd is the home of *Suddia*, a plant genus which is only known to exist in the Sudd region. The Nile lechwe (*Kobus megaceros*) is threatened and is endemic to the Sudd. This antelope species is of potential socio-cultural value to the Shilluk tribe and is utilized on a very limited scale as a source of animal protein and skins for the royal household. Over 350 plant species have been identified in the Sudd Area. It is also home to over 100 fish species, 100 mammalian species and 470 bird species and an unknown number of reptilian and amphibian species. Over 120 insect species of economic importance have been identified in the Sudd area of which 63 are mosquitoes.

Criterion (4) *A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.*

The floodplains provide an important breeding habitat and support the largest population of resident species of shoebill stork (*Balaeniceps rex*) in Africa. It also acts as stopover and wintering ground for many migrant water birds such as white pelican (*Pelecanus onocrotalus*), black crowned crane (*Balearica pavonina*), white stork (*Ciconia ciconia*) and white-winged black tern (*Chlidonias nigra*) among others. Migratory mammals depend on the wetland for their dry season grazing. Among these are white eared kob (*Kobus kob leucotis*), tiang (*Damaliscus lunatus tiang*), elephant (*Loxodonta africana*), Mongalla gazelle (*Gazella rufifrons albonotata*) and zebra (*Equus bruchelli*).

The Sudd is also a habitat for many species of freshwater mammals, reptiles and amphibians such as hippopotamus (*Hippopotamus amphibius*) and crocodile (*Crocodylus niloticus*) which depend entirely on the wetland for their livelihood. The diverse invertebrate communities support the large fish populations of the wetland and freshwater crabs of the genus *Potamonautes* occur in the wetland. Also, rare freshwater shrimps such as *Caridina nilotica*, *Palaemon nilotica* and *Cyclestheria hislopi* are found in the wetland.

Criterion (5) *A wetland should be considered internationally important if it regularly supports 20,000 or more water birds.*

The Sudd swamp is an important site/stopover area for water birds including significant numbers of migratory species. It is of great ornithological importance as it has over 20,000 water birds throughout the year. Estimates of the Range Ecology Survey Team (RES, 1983 cited in Howel *et al*, 1985) show that at any one time, the Sudd wetland supports among others about 300,000 open bill stork (*Anastomus lamelligerus*); 100,000 cattle egret (*Bubulcus ibis*); 100,000 spur-wing goose (*Plectropterus gambensis*) and more than 20,000 black crowned crane (*Balearica pavonina*). About 1.7 million glossy ibis (*Plegadis falcinellus*) spend the dry season in the Sudd wetland (Howell et al, 1985; Postel, 1992).

Criterion (6) *A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of water bird.*

According to Wetlands International's Waterbird Population Estimates (third edition, 2002), the world population of shoebill stork is between 5,000 and 8,000 birds. The Range Ecology Survey Team estimated the number of shoebill stork (*Balaeniceps rex*) in the Sudd to be over 5,000 which is within the global estimate. The increase in shoebill stork in the wetland is said to be positively correlated with the increase in the wetland area that was caused by the high floods of the early 1960s.

Criterion (7) *A wetland should be considered internationally important if it supports a significant proportion of indigenous fish subspecies , species or families, life-history stages, species interactions and/or populations*

that are representative of wetland benefits and/or values and thereby contributes to global biological diversity.

Fish diversity in the Sudd is impressive and appears to be a response to the favourable environmental conditions for recruitment and survival offered by the mosaic of habitat types. The fish communities in the wetland are comprised of 31 Siluroids, 16 Characoids, 14 Cyprinoids, 11 Momyrids, 8 Cichlids, and 7 Cyprinodonotids. Fish species whose life-cycles start and end in the wetland belong to the following genera: *Polypterus, Heterotis, Hyrocymus, Alestes, Distichordus, Citharinus, Labeo, Sarotherodon, Synodontis, Auchenoglaris, Oreochromis, Ctenopoma, Clarias* and *Protopterus*. Eight dwarf fish species of the Nile are endemic to the Sudd wetland and are *Cromeria nilotica*, *Nannaethiops unitaeniatus*, *Barbus stigmatopygus*, *Chelaethiops bibie*, *Andersonia leptura*, *Aplocheilichthys loati*, *Epiplatys marnoi* and *Electris nanus*. Nilotes of the Sudd who have no cattle or lost them during the floods of the 1960s depend on fishing for their livelihood. Although fishing in the wetland is mostly of subsistence nature, commercial fishing picked up in the 1970s with arrival of fishermen from West Africa and northern Sudan.

Criterion (8) *A wetland should be considered internationally important if it is an important source of food for fishes, spawning grounds, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.*

The permanent and seasonal aquatic systems of the Sudd wetland play important roles in the life-cycles of many fish species identified in the wetland. The different habitat types ranging from open water, riverine, lacustrine to palustrine offer ideal spawning, rearing, growing, feeding and survival grounds for over hundred species of fish identified in the Sudd area. *Clarias, Polypterus* and *Protopterus Spp*, for example, are amphibious because they aestivate in the mud during the dry season. Also found in the drier reaches of the Sudd is the annual fish *Nothobranchus* that spends the dry season in the egg stage**.** The different species found in the Sudd have a rich supply of food that appeared to have evolved with them. The diverse populations of microphytes, benthos, invertebrates, mollusks and detritus feeders probably created the diversity in the herbivore, omnivore and carnivore fish consumers. Recruitment, growth and survival of most fish species take place within the various habitat types of the wetland though lateral and longitudinal migration may take place.

13. Biogeography

(a) biogeographic region:

The Ramsar Site is found in the Sudd Region which lies within the "Open Grass Plains" of the floodplains.

(b) biogeographic regionalisation scheme (include reference citation):

The "Open Grass Plains" lie within the "*Acacia* Tall Grass Savannah" with rainfall belt lying between 500 and 1000 mm isohyets described by Harrison and Jackson (1958) in their excellent report *"Ecological Classification of the Vegetation of the Sudan"*

14. Physical features of the site:

The topographical features of the site that makes up the Ramsar site designation cannot be described in isolation due in part to its being an integral part of the Sudd Region. The site falls within the mud flats of the Sahelian Region of Africa at the lower reaches of the Bahr el Jebel River (this is the name given to the White Nile as it flows north) sloping gently to the north at an inclination of 1-1.5 cm/km. The Sudd is an alluvial floodplain of recent geological formation and consists of vertic soils which are interspersed by alfisols. The characteristics of the Sudd soil vary along the lateral extent of the floodplain. Soils of the highland areas are made up of heterogeneous loam soils which are generally alkaline, of low organic matter content, high salinity and a clay content ranging from 15 to 40%. The more fertile seasonal flooded alluvial soils occupy the middle portion of the wetland. These soils have a top layer pH that varies with depth from 7.0 to 8.5, and organic content $\leq$ 5% and low salinity. Soils of the permanent swamps are considered to be of ectomorphic origin through hydrarch plant succession and mineral alluvium deposition by river water. These soils are generally acidic and have an organic matter content that varies from 5 to 45% with variable sand-clay proportions.

The climate of the Sudd wetland varies annually with annual precipitation ranging from 600 mm in the north to 1000 mm in the extreme south of the wetland. Annual maximum temperature is 33°C and a minimum of 18°C. Flooding of the wetland occurs in June-October during an average year and the water rises and falls at 3 m/day with a 7 mm/day net loss through evaporation.

The Hydrology of the Sudd wetland has been described in detail by Howell *et al* (1985). The Bahr el Jebel River originating from East African Lakes is the main drainage system of the wetland. Other rivers that drain into the wetland have their origin from the Nile-Congo divide. About 50% of the 2.9×10^9 m^3 of water that flows into the Sudd wetland is lost within it through evaporation. The southern limit of the permanent swamp is Bor.

The downstream catchment to the Sudd wetland has a well defined channel with a depth of 10 m lying in a broad valley whose banks are flat on the west and higher to the east. River gradient downstream of the Sudd wetland falls to 1.4 cm/km and water velocity drops to 0.5 m/s. The channel is dotted by small alluvial islands vegetated by dense stands of aquatic macrophytes such as *Vossia cuspidata* and *Phragmites domingensis*.

15. Physical features of the catchment area:

The topographical features of the Sudd catchment have been described in detail by Howell *et al* (1985). Briefly, the area falls within an even plain sloping gently to the north at a gradient of 1-1.5 cm /km. The depression in which the Bahr el Jebel river runs is bound by scrub vegetation that decrease in height from south to north and virtually disappear north of Bor. Soils of the Sudd wetland area are generally seasonal with very considerable annual variation. Mean annual rainfall stands at 800$\pm$ 200 mm per annum with the southern portion of the wetland being wetter than the northern portion. The mean annual temperature in the Sudd area is also seasonal and stands at 33°C during the hot season and 18°C during the cold season. Relative humidity of the area also tracks seasonal changes and stands as 23% during the dry season and 88% during the wet season. Annual insolence at Bor averages 64% per annum.

16. Hydrological values:

The rivers that drain into the Sudd wetland bring annually large volumes of water laden with inorganic particles, nutrients and salt ions but leave the wetland without them. As such the Sudd serves as a giant filter that controls and normalizes the water quality. It also regulates flooding by acting as a giant sponge that absorbs excess water during periods of high water yield. The Sudd area loses about 51% of the water that enters it from Bahr el Jebel and almost all the water of Bahr el Ghazal through evapotranspiration.

The socio-economic benefits of the Sudd wetland to the transhumance communities living in its catchment are immense. The wetland is a source of water for domestic, livestock and wildlife use. It provides dry season grazing to the livestock industry, which is the backbone of the Nilotes economy. The concentration of a large mammalian biomass (10,000 kg/km^2) in the seasonal floodplain provides excellent opportunities for traditional hunting and tourism if developed.

17. Wetland Types

(a) presence:

Marine/coastal:

A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**Zk(a)**

Inland:

L	**(M)**	**(N)**	**(O)**	**(P)**	**Q**	**R**	**Sp**	**Ss**	**(Tp)**	**(Ts)**	**(U)**	**Va**	**Vt**	**W**	**Xf**	**Xp**	**Y**	**Zg**	**Zk(b)**

Human-made:

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Zk(c)**

(b) dominance:

N, M, P, O, Tp, Ts, U

18. General ecological features:

Moving laterally from the centre of the swamps, different successive vegetation zones are recognized grading from:**-**

(i) Open water vegetation: This ecotype is dominated by free-floating-leaved plants like *Eichhornia crassipes*, *Lemna gibba*, *Azolla nilotica* and *Nymphaea lotus* as well as submerged vegetation e.g. *Potamogeton*, *Trapa* and *Ceratophyllum* spp in both flowing waters and lakes. Microphytes are prevalent in lakes but less so in the flowing turbid waters of the main channel. The diatom *Aulacosiera granulata* dominates the phytoplankton during the dry season but is replaced by the cyanobacterium *Lyngbya limnetica* during the wet season when the river velocity and turbidity are high.

(ii) Permanent swamps: These occur on land that is flooded throughout the year. The most prevalent types of plants are the floating and fringe vegetation, dominated along the banks of the river by massive stands of *Cyperus papyrus*, *Vossia cuspidata, Phragmites karka* and *Typha domingensis*. Associates of the Cyperus swamp are climbers and ferns

(iii) River flooded grassland or Toich: These grasslands are seasonally flooded to varying extent and depth by the river. During the rainy season the plains of this belt are often swampy and completely covered with luxuriant growth of tall grasses. Species composition and biomass is closely linked to soil type and degree of inundation. The tall grasses are dominated by Phragmites, *Sorghum, Hyparrhenia* and *Setaria spp* as well as *Oryza* and *Echinochloa*. Two grassland types are recognized. These are wild rice grassland dominated by *Oryza longistaminata* and Echinochloa grassland dominated by *Echinochloa pyramidalis*. Sedges, herbs and other grasses such as *Sporobolus pyramidalis* associate with the *Oryza* grassland. It is the most productive grassland type in terms of year-round grazing for livestock and wildlife because of the high protein content of dead materials of wild rice grass. The *Echinochloa* grassland associates with *Oryza* and legumes like *Desmodium hirtum.*

Within the toich there are many small seasonally flooded pools that support a variety of plants at different times of the year. They are dominated by grasses and herbs during the dry season, semi-woody herbs (*Sesbania rostrata)* in the early wet season, and floating and submerged aquatic plants during the remaining part of the rainy season. When the rivers flood, the pools are colonized by green algae (desmids and filamentous) and Cyanobacteria which themselves are replaced by euglenophytes and dinoflagellates following evaporative concentration and nutrient enrichment from cattle and bird feeding. These pools are sources of water for domestic, livestock and wildlife use as well as fish and pasture during the dry season

(iv) Rain-flooded grasslands: These are seasonally inundated grassland or rain-fed wetlands (Toich). They occur on seasonally waterlogged clay soil which in part is heavily used by livestock. It is made up of a comparatively well drained portion dominated by *Echinochloa haploclada*, heavily grazed grassland dominated by *Sporobolus pyramidalis*, *Phragmites*, *Sorghum* and a high biomass but nutrient poor *Hyparrhenia ruffa* grassland in areas that are inundated by rain water and sheet flow. These grasslands act as a source of string and grass for thatching.

(v) Floodplain scrubland (Woodland): It is quite distinct from the grass plains being higher in level. It is the well drained areas around the floodplains. This rain fed belt is an open mixed *Acacia* forest supporting several species of trees and shrubs and a luxuriant growth of grasses. The tree vegetation is dominated by *Acacia seyal*, Acacia *sieberiana* and *Balanites aegyptiaca.* The tree vegetation is an important source of firewood and building poles. Balanites has additional food and medicinal values. It is the most utilized ecotype for settlement, crop production and wet season grazing

19. Noteworthy flora:

Plants play important roles in ecosystems as integrators of environmental conditions and as food for herbivores. In the Sudd, the plant communities are comparable to

those of other floodplains in Africa (eg Kafue Flats) especially in zonation of grasslands around the floodplain. Usually the deep open water is surrounded by a permanent swamp zone consisting of *Cyperus papyrus*, *Vossia cuspidata* and *Typha* spp. which are important habitats for Shoebill stork. This in turn is surrounded by seasonally flooded grasslands consisting of *Echinochloa stagnina, E. pyramidalis*, and *Oryza longistaminata* as well as *Hyparrhenia ruffa* at the edge of the wetland.

Unlike other wetlands, the Sudd wetland has not been shown to be a hotspot of plant species endemism. So far out of the 350 plant species identified in the Sudd region only one species is endemic. Denny's (1984) record was the first description of a previously unknown swamp species named *Suddia sagitifolia*. *Suddia*, a rare genus belonging to the Poaceae, is only known to exist in the Sudd Region. The *Cyperus papyrus* which is threatened elsewhere by pollution and flood control, flourishes in the pristine Sudd wetlands.

20. Noteworthy fauna:

Animal life in the Sudd wetlands ranges from microscopic to the largest land mammal (elephant – *Loxodonta africana*). It has poor benthic fauna composed mainly of insect larvae, oligocheates, leaches and mollusks, probably due to high current velocity, large quantities of detritus and low oxygen content. It has however a rich zooplankton community of which there are 17 species of Rhizopoda, 39 Rotifera, 27 Cladocera, 7 Copepoda, 2 Decapoda, 1 Chaoborus and 1 Conchostraca. Insect diversity in the Sudd region is very high with mosquitoes, Chironomids and Tabanids forming the aquatic and semi-aquatic communities while Orthoptera, Hemiptera, Lepidoptera and Coleoptera making up the terrestrial communities. A total of 120 insect species of economic importance have been identified in the Sudd Area of which 63 are mosquito species. In addition, it is a habitat for many species of freshwater mammals and reptiles such as hippopotamus (*Hippopotamus amphibius*) and crocodile (*Crocodylus niloticus*) and a wide range of mammals, and invertebrate communities. It is home to endemic wildlife such as sitatunga, *Tragelaphus spekei* and Nile lechwe, *Kobus megaceros* which migrate between the swamps and toich, ie follow changing water levels and vegetation. The tallest land mammal, the giraffe (*Giraffa camelopardalis*) also uses the wetland during the dry season, together with waterbuck (*Kobus ellipsiprymnus defassa*) and reedbuck (*Redunca redunca*).

Birdlife in the Sudd region is diverse. Notable birds of the wetland are white pelican (*Pelecanus onocrotalus*), black crowned crane (*Balearica pavonina*), white stork (*Ciconia ciconia*), white-winged black tern (*Chlidonias nigra*), saddle-billed stork (*Ephippiorhynchus senegalensis*), white-backed duck (*Thalassornis leuconotus*), African skimmer (*Rynchops flavirostris*) and African darter (*Anhinga rufa*) among others.

Fish diversity in the Sudd is impressive and appears to be a response to the favourable environmental conditions for recruitment and survival offered by the mosaic of habitat types. Some species of *Clarias, Polypterus* and *Protopterus* are amphibious because of their ability to aestivate during the dry season. Another unique feature of the Sudd ichtyofauna is the occurrence of the annual-fish *Nothobranchus* in the rain-filled pools at the edge of the wetland.

Although little is known about the reptilian and amphibian diversity and abundance of the Sudd Region, it is safe to say that it has the largest wild crocodile population in the world because of its large size and remoteness.

21. Social and cultural values:

The vegetation of the Sudd Area is a mixture of luxuriant growth of shrubs and trees, tall perennial grasses and herbs and short annual grasses as well as ephemeral herbaceous plants. Trees, shrubs and perennial and annual grasses are encountered as essential elements of the landscape almost everywhere in the region. Trees and shrubs in the region are still among the few renewable natural resources, which contribute to employment and income generation. They play a very important role in the functioning of the ecosystem and indeed in the daily life and subsistence of nomadic herdsmen and sedentary small farmers as well as urban dwellers. Trees and shrubs provide timber for building and firewood, food, medicine and a vast array of useful products. Grasses provide fodder and are used for thatching. The main grazing domestic animals are cattle which feed on perennial and annual grasses where they predominate.

The site has very high socio and cultural values for Dinka, Nuer and Shilluk communities. These communities have a very high sense of ownership and positive attitude towards natural resources of the area. They use the area as a source of food through fishing and water for domestic use. Fish production is an important activity mainly by local fishermen (Nuer and Shilluk). Dinka and Nuer tribes depend on the annual floods and rain to regenerate floodplain grasses that feed their herds of cattle. These communities also acquire firewood, mud and other construction material from the scrubland and wetland**.**

22. Land tenure/ownership:

According to the recently rectified constitution of Southern Sudan, the Government of Southern Sudan (GOSS) is the custodian of the land on behalf of the people of Southern Sudan. Within the site, there are protected areas solely owned by the Government which are surrounded by communal lands based on customary land ownership. The wetland comprises about 20% protected areas and 80% communal land.

The land use practices in the region follow the customary pattern of ownership in that different communities regulate the use of the land in those areas that fall under their jurisdiction. However, there are no strict boundaries for communal use and often rights to use land belonging to other communities can be obtained on request.

23. Current land (including water) use:

(a) within the Ramsar site

The Sudd wetland serves a number of functions, the most notable ones being**:**

1. **Communal grazing**: This is the major land use practice that the wetland supports. In the 1980s, the number of livestock using the floodplains of the wetland during the dry season was estimated to be 700,000 (Howell *et al*, 1985).
2. **Fishing**: Is the second most important practice of the Nilotes of the Sudd region. Traditionally it is an important occupation of the Shiluk and Nuer. The Dinka also fish during the dry season. Commercial fishing has also become progressively an important economic activity of the wetland.
3. **Hunting**:. Subsistence hunting is practiced by the inhabitants of the Sudd wetland. Of late however, poaching using automatic rifles has led to a

decrease in the number of wildlife in the area. In the 1980s, the biomass of wild herbivores using the wetland during the dry season was estimated to be 1000kg/m^2 (Howell *et al*., 1985).

4. **Agriculture**: During the rainy season, crop cultivation on a small scale is practiced by the Nilotes of the Sudd wetland on the higher grounds surrounding the floodplain. Major crops grown include sorghum (*Sorghum spp*), maize (*Zea mays*), cowpeas (*Vigna unguiculata*), groundnuts (*Arachis hypogaea*), sesame (*Sesamum indicum*), pumpkin (*Cucurbita maxima*), okra (*Hibiscus esculentus*) and tobacco (*Nicotiana tabacum*). Although crop production does not depend on the wetland, hundreds of thousands of seed eating birds especially *Quelea quelea* that breed in the wetland are a major threat to agricultural development and their control a major threat to non-targeted species.
5. **Preservation of biodiversity**: There are three protected areas (comprising about one fifth of the wetland's area) within the Sudd wetland, namely, Shambe National Park, Zeraf Game Reserve and Fanyikang Game Reserve.
6. **Navigation**: Although the Sudd wetland is an obstacle to navigation between Malakal and Juba, many traditional and commercial boats and steamers as well as canoes use the channels within the wetland for fishing and transport.

(b) in the surroundings/catchment:

The areas surrounding the Sudd wetland are heavily utilized for wet season grazing and crop production. They also form the major settlement areas and contain trading centers like Bor town. Most of the tribes living within the Sudd catchment are nomadic and move with their large herds of cattle in response to the annual discharge of Bahr el Jebel and rainfall. Fishing is the second most important occupation of the inhabitants of the wetlands especially the Shilluk and Nuer. Subsistence hunting is another activity by the Nilotes of the Sudd catchment. Crop production is not an important occupation of the Nilotes though some subsistence agriculture is carried out in the highland area during the wet season. Agricultural potential of the area is limited by the vagaries of the climate, soil fertility, pests, weeds and diseases.

24. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land (including water) use and development projects:

(a) within the Ramsar site

The Sudd Area is still pristine and untouched in terms of industrial or agricultural development or in terms of research activities. However floodplain degradation leading to habitat alteration and disappearance of wetland may result from flow and flood control, pollution and cultivation.

Block B, the largest of all oil Blocks in the Sudan occupies most of the Sudd area and will be developed by Total of France soon. No visible impacts so far have been detected. Oil development, particularly on-shore exploration, is hazardous and may cause severe damage to environmental systems. It carries potential risks for plants, domestic animals, wildlife and humans living within the wetland. Elsewhere the impacts of untreated produced water discharges from world oil/ gas operations on shallow water wetlands have become an issue of significant concern. Produced water is very hazardous to wetlands in that many aromatic hydrocarbons, nitroaromatic compounds, polycyclic aromatic hydrocarbons and other compounds

remaining in produced water are highly toxic, mutagenic and/or carcinogenic to natural flora, animals and humans living in the wetland.

(b) in the surrounding area:

The Jonglei Canal Project:

The need to conserve the water lost in the Sudd Region has led hydrologists, environmentalists, economists and sociologists to try and understand the effects such ventures would have on the functioning of the Sudd ecosystem. The most important of the undertakings was the Jonglei Canal Project (see Equatorial Nile Project, 1954). The aim of the project was to alter the flooding regime of Bahr el Jebel by diverting 20-25 million m^3 per day of its water directly northwards through a side canal from Bor to near Malakal in order to by–pass the Sudd. However the canal was not completed but only two- thirds of the 360 km length of the canal was excavated. The digging of the canal stopped since the start of the civil war in 1983. No one knows when a political decision shall be taken to resume excavation. The project, if completed, is expected to reduce the water level of the swamp by 10% during flood season and by 20% during the dry season, greatly reducing the area of the *toich*. The possible impacts of the project on the fauna and flora of the Sudd are not well documented.
The expected environmental, social and economic consequences of the canal are well reviewed by Howell *et al.* (1985). The effects of the canal on the economic activities of the inhabitants of the Sudd region though variable can be viewed under the following headings according to their importance.

(1) Pasturalism: Although the construction of the canal is supposed to increase the area of rangeland, the canal interferes with the seasonal migration pattern of the nomads and their cattle.

(2) Fisheries: Enlargement of the Sudd floodplains during the last four decades brought many positive changes to the fisheries of the Sudd region. The mosaic of open water, riverine, palustrine and lacustrine environments created by the high floods improved recruitment and survival chances for most fish species in the area. Some biologists speculate that this healthy state will be reversed if the effect of the canal is combined with a return of the flooding regime to its pre 1961 period. Low river discharges into the swamp will create blockages of channels thereby impairing river transport and lateral fish migration, reduction in permanent and seasonal swamp areas causing decline of fisheries resources and their possibility of expansion.

(3) Wildlife: Change in habitat due to reduced river discharge, blockage of mammalian migratory routes for species like tiang, reedbuck, giraffe and zebra among others, and increased poaching, due to improvement in communication, are the major effects of the canal on wildlife. Habitat loss will affect recruitment and survival of the Shoebill stork as well as toich dependent and resident mammalian species. It will also create competition between wildlife and livestock for the shrinking toic grassland. The canal will also expose animals to other forms of mortality at the canal edge.

(4) Agriculture: Large scale crop production has never been an important occupation of the nomadic tribes of the Sudd region due probably to the

effects of climate, soil fertility, pests, weeds and diseases. The assumed benefits of the canal to the agriculture sector have been found to be minimal. The use of avicides for the control of pest birds like *Quelea quelea* will disrupt the ecosystem function if non-target species are affected.

25. Conservation measures taken:

Three protected areas fall within the Sudd wetland of which Zeraf Game Reserve is the largest. The protected areas cover 1,080,000 ha and are:

(i) Zeraf Game Reserve:	970,000 ha , established in 1939
(ii) Shambe National Park:	62,000 ha, established in 1985
(iii) Fanyikang Game Reserve	48,000 ha, established in 1939

The present status of the protected areas in the wetland is not known but judging from the trend of the heavily protected Dinder National Park which has been experiencing a downward trend in numbers and diversity of wildlife, it is logical to say that all the protected areas within the wetland are likewise declining.

Under the Wildlife Act of 1987 and even the newly developed New Sudan Wildlife Provisions of 2003, all protected areas in the country are by law not to be accessed or used unless permitted. To enforce the Act, a Wildlife Force is deployed in each protected area. Except the construction of access roads and housing for wildlife personnel, no kind of development is allowed in any protected area in the Sudan.

Since the inception of the notion of preservation and consequently conservation in the Southern Sudan, management of protected areas has been through trial and error. For instance no protected area had adopted or applied a management plan. All protected areas including the three within the wetland have not had a monitoring programme designed specifically for biodiversity. The only surveys conducted were either side surveys such as the Range Ecology Surveys (Howell *et al*, 1985) or through individual initiatives. Throughout the 21 years of war, no surveys have been made within the wetland or its protected areas.

Many factors have made the enforcement of wildlife regulations difficult but the most conspicuous one is the effects of the 21-year civil war in Southern Sudan. The war not only increased the level of poaching, but also halted all management activities in all protected areas in Southern Sudan.

A move towards integrated management of the wetland's catchment areas has not been tried nor thought of. Neither have the local communities been involved previously nor at present in managing the wetland save for traditional management practices such as those practiced by the Shiluk. For the Shiluk, animals like the Nile lechwe, the crowned crane and the shoebill stork are sacred and any one who kills these animals is fined ten cattle per kill.

26. Conservation measures proposed but not yet implemented:

The Sudd wetland despite its ecological importance has never been proposed for protection previously. It never had a management plan nor is there any under preparation. Even the protected areas within it have never had management plans formulated.

Regarding potential threats to the site, before oil exploration can commence, an independent environmental impact assessment (EIA) must be undertaken. During exploration, measures must be implemented by oil companies in order to protect the wetland. We hope that oil companies working in the Sudd wetland or elsewhere in the Sudan, through the adoption of high operational standards together with adequate mitigating measures, continuous environmental monitoring programmes and prompt remediation of contaminated sites, shall not cause any damage to the environment.

Produced water must be treated and decontaminated before being discharged onto the wetland. It should not be stored in evaporation ponds or released onto the wetland without treatment. The 'indefinite' storage of produced formation water in 'unlined' *evaporation* ponds without proper treatment is very hazardous to the wetland and should not be allowed. Therefore an effective produced water management strategy that handles large amounts of produced water and meets environmental regulations is needed to protect the wetland. Also spills and leakages of crude oil from pipelines or oil processing facilities to the wetland must be promptly contained and decontaminated.

27. Current scientific research and facilities:

There are no ongoing scientific researches being conducted or planned for the Sudd wetland nor have facilities been set up for the purpose. Before the war, there was an Ecological Research Station at Nyany which was the site for Penko Pilot Project. Another project, known as the FAO Kongor Project was based in the Kongor District. Most taxa indigenous to the area are poorly known or poorly understood. No taxonomic undertaking has been conducted during the past two decades. Therefore no plant species in the region, to our knowledge, has been declared rare or endangered under any local and/or international act.

28. Current conservation education:

The Sudd wetland has an immense potential as a site for education in the disciplines of ecology, hydrology, economics, sociology, medicine, wildlife, agriculture, forestry and animal husbandry. Despite the huge potential however, no education programme has been designed for the area nor any communication programmes and facilities set up. There are no plans for awareness campaigns or even training.

29. Current recreation and tourism:

With its high biodiversity and biomass of wildlife as well as the unique social fabric, the Sudd wetland could have acted as a magnet for ecotourists had it been developed. If developed however the industry will be mostly seasonal due to the seasonality of life patterns in the area. The area nonetheless has high natural and cultural attractions that contribute immensely toward eco-tourism development in the region especially in Shambe National Park and Zeraf areas.

30. Jurisdiction:

The Sudd wetland is geographically located in Southern Sudan and therefore falls under the authority of the Government of Southern Sudan (GOSS). Within GOSS, the Ministry of Environment, Wildlife Conservation and Tourism will be responsible for policy issues concerning the wetland but management will fall under the Directorate of Wildlife Conservation and Tourism. All matters relating to the management of the

wetland will be addressed by the Director General, Major General Alfred Akwoch Omoli whose details are:

Major General Alfred Akwoch Omoli
Director General
Wildlife Conservation and Tourism
Ministry of Environment, Wildlife Conservation and Tourism
Government of Southern Sudan, Juba
Telephone:249 811 8 80221
E-mail: akwochomoli@yahoo.com

31. Management authority:

As no single authority can be delegated to manage the wetland at this time of structuring government institutions in Southern Sudan, the management of the wetland will continue to be the sole responsibility of the Director General whose details are given above.

32. Bibliographical references:

Denny, P. 1984. Permanent swamp vegetation of the Upper Nile. *Hydrobiologia* 110: 79-90.

Equatorial Nile Project 1954 The Equatorial Nile Project. Being the report of the Jonglei Investigation Team. Sudan Government. London.

Harrison, M.N. and J. K. Jackson 1958. Ecological classification of the vegetation of the Sudan. *Bull. Min. Agric., Sudan (New Serie*s) No.2.

Howell, P., Lock, M. and Cobb, S. 1985 The Jonglei Canal. Impact and Opportunities. Combridge University Press. Cambridge.

Moghraby, A.I.El and Sammani, M.O.El. 1985 On the Environment and Socio-Economic Impact of the Jonglei Canal Project, Southern Sudan. *Environmental Conservation* 12: 41-47.

Moghraby, A.I.El. 1982 The Jonglei Canal – Needed Development or Ecodisaster? *Environmental Conservation* 9: 141-148.

Postel, S. (1992) The Last Oasis. The World Watch Environment Alert Series. Norton Company, New York, London.

Wetlands International. (2002). Waterbird Population Estimates – Third Edition. Wetlands International Global Series No. 12, Wageningen, The Netherlands.